UNCONTROLLED

FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
RECORD OF TECHNICAL CHANGE (ROTC)

Corrective Action Unit (CAU) Number: 504
CAU Description: 16a-Tunnel Muckpile
CAU Owner: Defense Threat Reduction Agency (DTRA)

ROTC No. DOE/NV--1369 07-DTRA-012-ROTC 1 **Page** 1 of 13

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 01/07/2020

The following technical changes (including justification) are requested by:

Tiffany Gamero
Requestor Name

Long-Term Monitoring Activity Lead
Requestor Title

Description of Change:

1. This ROTC replaces the Use Restriction (UR) information listed in the documentation for CAU 504.

   UR forms have been updated to list all UR requirements, including but not limited to: post-closure site controls (signs, fencing, etc.), inspection and maintenance requirements, and Geographic Information Systems (GIS) coordinate information. The UR requirements and form(s) included in this ROTC represent the current corrective action requirements for each Corrective Action Site (CAS) in this CAU and supersede information concerning corrective action and post-closure requirements in existing documentation.

2. The FFACO UR for CASs 16-06-01, 16-23-01, 16-23-02, and 16-99-01 was separated into URs for each CAS.

Justification:

1. Some changes in the UR requirements from those found in closure documents have been subsequently modified in letters, memos, and inspection reports. This has resulted in difficulty in determining current post-closure requirements. A review of the post-closure requirements for this CAU has been conducted to ensure that all requirements have been identified and documented on the new UR form. The new UR form was developed to be inclusive of all requirements for long-term monitoring and standardize information contained in the URs consistent with current protocols.

2. Current protocol is to have separate URs for each CAS. The FFACO UR boundary for CAS 16-06-01 was defined as the left (west) portion of the original UR boundary and the Administrative UR boundary for CAS 16-23-02 defined as the CAS boundary shown in Figure A.2-2 for CAS 16-23-02 in the CADD/CR.

FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
RECORD OF TECHNICAL CHANGE (ROTC)

Corrective Action Unit (CAU) Number: 504
CAU Description: 16a-Tunnel Muckpile
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ROTC No. DOE/NV--1369 07-DTRA-012-ROTC 1 **Page** 2 of 13

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 01/07/2020

Description of Change:	Justification:
3. The UR for CAS 16-23-01 was eliminated.	3. The results from the CADD/CR stated that this CAS was totally encompassed by the muckpile (CAS 16-06-01) and was not distinguishable from the muckpile. Therefore, this CAS does not exist as a separate release.
4. The UR for CAS 16-99-01 was eliminated.	4. Results from the CADD/CR for this CAS did not exceed final action levels (FALs) or industrial action levels and, therefore does not require a use restriction.
5. The UR for CAS 16-23-02 was changed to an Administrative UR.	5. The results from the CADD/CR for this CAS did not exceed FALs but did exceed industrial action levels.
6. Changed monitoring frequency for CAS 16-06-01 to annual.	6. Although post-closure monitoring was not required in the previous UR, a requirement to monitor the controls annually was added to be consistent with current requirements for similar sites.
7. Added the following as a note in the UR: "This CAS is owned by DTRA. Any modification to the UR must be approved by DTRA."	7. This statement was added to clarify that the CAS is owned by DTRA even though the use restriction form title states, "U.S. Department of Energy, Environmental Management Nevada Program Use Restriction Information."

Schedule Impacts:
No impacts to schedule.

ROTC applies to the following document(s):

- Defense Threat Reduction Agency. 2007 (Republished 2010). Corrective Action Decision Document/Closure Report for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site, Nevada, Rev. 0, DOE/NV--1369 07-DTRA-012. Mercury, NV.

FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
RECORD OF TECHNICAL CHANGE (ROTC)

Corrective Action Unit (CAU) Number: 504
CAU Description: 16a-Tunnel Muckpile
CAU Owner: Defense Threat Reduction Agency (DTRA)

ROTC No. DOE/NV--1369 07-DTRA-012-ROTC 1 **Page** 3 of 13

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 01/07/2020

- Errata Sheet for CAU 504 CADD/CR (DOE/NV--1369 07-DTRA-012), dated 08/10/2016

Approvals:

/s/ Tiffany Gamero

Date 1/28/2020

Tiffany Gamero
Activity Lead
Environmental Management (LM) Nevada Program

FRAHERJEFFREY.T.1020435395 Digitally signed by FRAHERJEFFREY.T.1020435395 Date: 2020.01.27 10:03:00 -07'00'

Date

Jeffrey Fraher
Environmental Engineer
Defense Threat Reduction Agency (DTRA)

/s/ Mark McLane

Date 01/28/2020

Christine Andres
Chief, Bureau of Federal Facilities
Nevada Division of Environmental Protection (NDEP)

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

General Information

Use Restriction (UR) Type(s): FFACO Only

Corrective Action Unit (CAU) Number & Description: 504 - 16a-Tunnel Muckpile

Corrective Action Site (CAS) Number & Description: 16-06-01 - Muckpile

CAU/CAS Owner: DTRA

Note: CAS previously shared UR Form with CASs 16-23-01, 16-23-02, and 16-99-01. This CAS is owned by DTRA. Any modification to the UR must be approved by DTRA.

Section I. *Federal Facility Agreement and Consent Order* (FFACO) UR

Basis for FFACO UR

Summary Statement: This FFACO UR is established to protect workers from inadvertent exposure to radiological and chemical contaminants that were released at this site. Radiological contaminants are present that exceed final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

FFACO UR Physical Description

Surveyed Area (UTM, Zone 11, NAD 83, meters):

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	571,533	4,096,447
	2	571,502	4,096,721
	3	571,716	4,096,722
	4	571,716	4,096,631
	5	571,830	4,096,651
	6	571,831	4,096,493
	7	571,533	4,096,447

[1]UR Points are listed clockwise beginning at the southernmost point. If multiple points share the southernmost Northing coordinate, the easternmost point is listed as Point 1.

[2]UR Coordinate values presented herein were captured in North American Datum of 1983, and rounded to the nearest meter when necessary; due to that rounding, coordinates may not reflect the original precision of values contained within the source GIS data set.

Boundary Applies to: Both Surface and Subsurface

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

Depth is unknown.

Survey Source: GIS

FFACO UR Requirements

Site Controls:

This FFACO UR is recorded as described in **Section IV. Recordation Requirements** to restrict activities within the area by the coordinates listed above and depicted in the attached figure without prior notification of NDEP unless the activities are conducted under the provisions of 10 CFR, Part 835, Occupational Radiation Protection and 10 CFR, Part 851, Worker Safety and Health Program.

Control	Criteria
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: N/A

Section II. Administrative UR

An Administrative UR is not identified for this site.

Section III. Supporting Documentation

UR Source Document(s)

ROTC 1 for CAU 504 CADD/CR (DOE/NV--1369 07-DTRA-012), dated 01/07/2020.

Errata Sheet for CAU 504 CADD/CR (DOE/NV--1369 07-DTRA-012), dated 08/10/2010.

Defense Threat Reduction Agency. 2007 (Republished 2010). Corrective Action Decision Document/Closure Report for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site, Nevada, Rev. 0, DOE/NV--1369 07-DTRA-012. Mercury, NV.

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

Attachments

- FFACO UR Boundary Map (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

- FFACO Database
- NNSA M&O Contractor GIS
- EM Nevada Program CAU/CAS Files

Section V. DTRA Approval

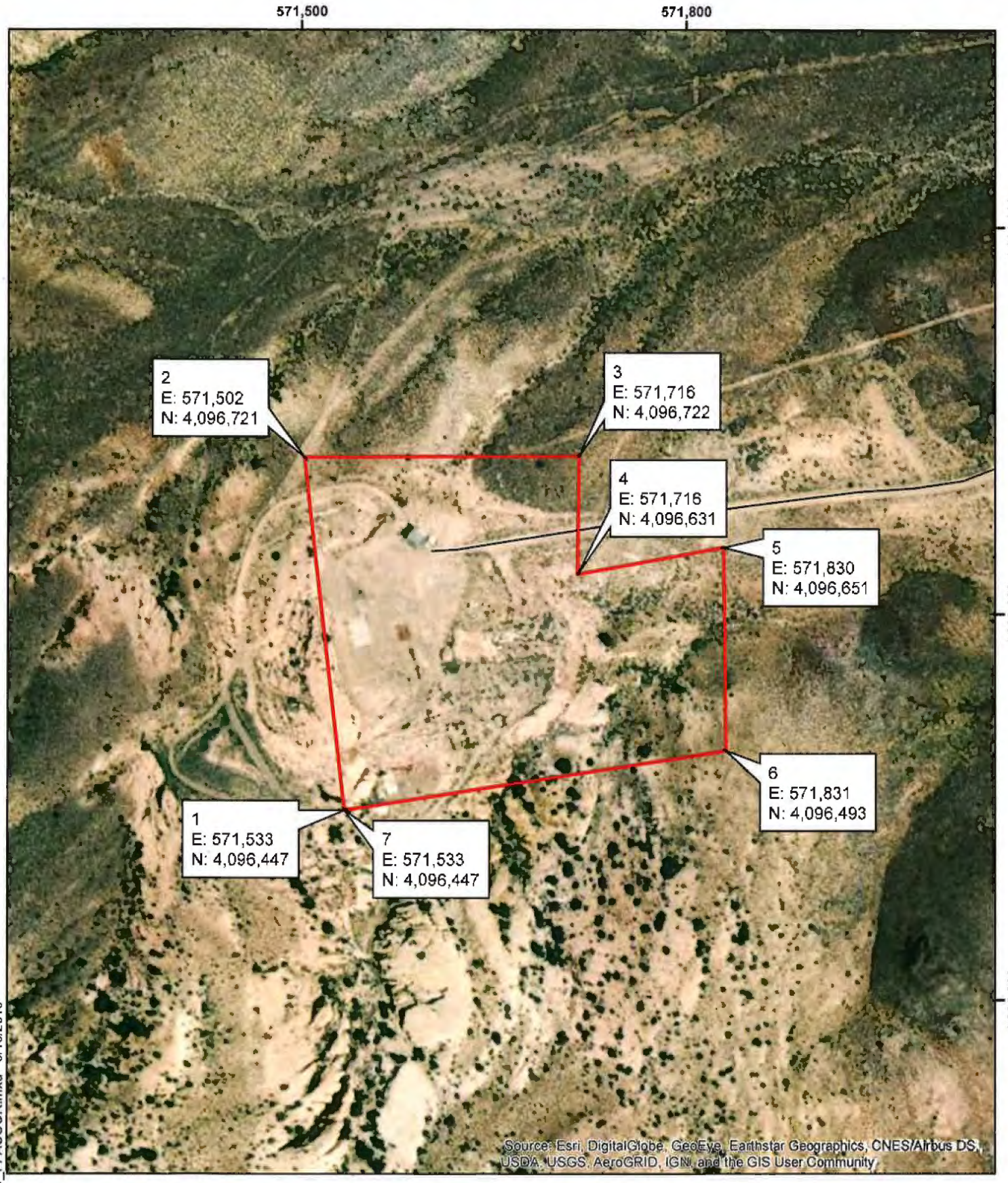
FRAHER.JEFFREY.T.1020435395 Digitally signed by FRAHER.JEFFREY.T.1020435395 Date: 2020.01.27 10:04:19 -07'00'

Date: _____

Jeffrey Fraher

Environmental Engineer

DTRA



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CAU 504, CAS 16-06-01
Muckpile
FFACO UR Boundary

Explanation

- FFACO UR
- Local Road

0 50 100 200 Meters

0 150 300 600 Feet

N

NOTE: Size and location of features are approximated

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2019

Supplemental Information Figure

Additional supplemental information on site features was not present in previous iterations of this Use Restriction (UR), therefore a supplemental information figure is not attached. If additional information on site features is required for this site, please contact the *Federal Facility Agreement and Consent Order* (FFACO) Database Administrator.

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

General Information

Use Restriction (UR) Type(s):	Administrative Only
Corrective Action Unit (CAU) Number & Description:	504 - 16a-Tunnel Muckpile
Corrective Action Site (CAS) Number & Description:	16-23-02 - Contaminated Area
CAU/CAS Owner:	DTRA
Note:	CAS previously shared UR Form with CASs 16-06-01, 16-23-01, and 16-99-01. This CAS is owned by DTRA. Any modification to the UR must be approved by DTRA.

Section I. *Federal Facility Agreement and Consent Order* (FFACO) UR

An FFACO UR is not identified for this site.

Section II. Administrative UR

Basis for Administrative UR

Summary Statement: This Administrative UR is established to protect workers should future land use result in increased exposure to site contaminants. Radiological contaminants are present that exceed action levels under the Industrial Area (2,000 hours per year) exposure scenario.

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

Administrative UR Physical Description

Surveyed Area (UTM, Zone 11, NAD 83, meters):

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
Admin Boundary	1	571,831	4,096,554
	2	571,830	4,096,650
	3	572,342	4,096,643
	4	572,613	4,096,908
	5	572,692	4,096,891
	6	572,401	4,096,582
	7	572,250	4,096,558
	8	571,831	4,096,554

[1]UR Points are listed clockwise beginning at the southernmost point. If multiple points share the southernmost Northing coordinate, the easternmost point is listed as Point 1.

[2]UR Coordinate values presented herein were captured in North American Datum of 1983, and rounded to the nearest meter when necessary; due to that rounding, coordinates may not reflect the original precision of values contained within the source GIS data set.

Boundary Applies to: Surface

Depth is unknown.

Survey Source: GIS

Administrative UR Requirements

Administrative URs do not require onsite postings or other physical barriers, and they do not require periodic inspections or maintenance.

Site Controls:

This Administrative UR is recorded as described in **Section IV. Recordation Requirements** to restrict activities within the area defined by the coordinates listed above and depicted in the attached figure without prior notification of NDEP unless the activities are conducted under the provisions of 10 CFR, Part 835, Occupational Radiation Protection and 10 CFR, Part 851, Worker Safety and Health Program.

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

Section III. Supporting Documentation

UR Source Document(s)

ROTC 1 for CAU 504 CADD/CR (DOE/NV--1369 07-DTRA-012), dated 01/07/2020.

Errata Sheet for CAU 504 CADD/CR (DOE/NV--1369 07-DTRA-012), dated 08/10/2010.

Defense Threat Reduction Agency. 2007 (Republished 2010). Corrective Action Decision Document/Closure Report for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site, Nevada, Rev. 0, DOE/NV--1369 07-DTRA-012. Mercury, NV.

Attachments

- Administrative UR Boundary Map (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

- FFACO Database
- NNSA M&O Contractor GIS
- EM Nevada Program CAU/CAS Files

Section V. EM Nevada Program Approval

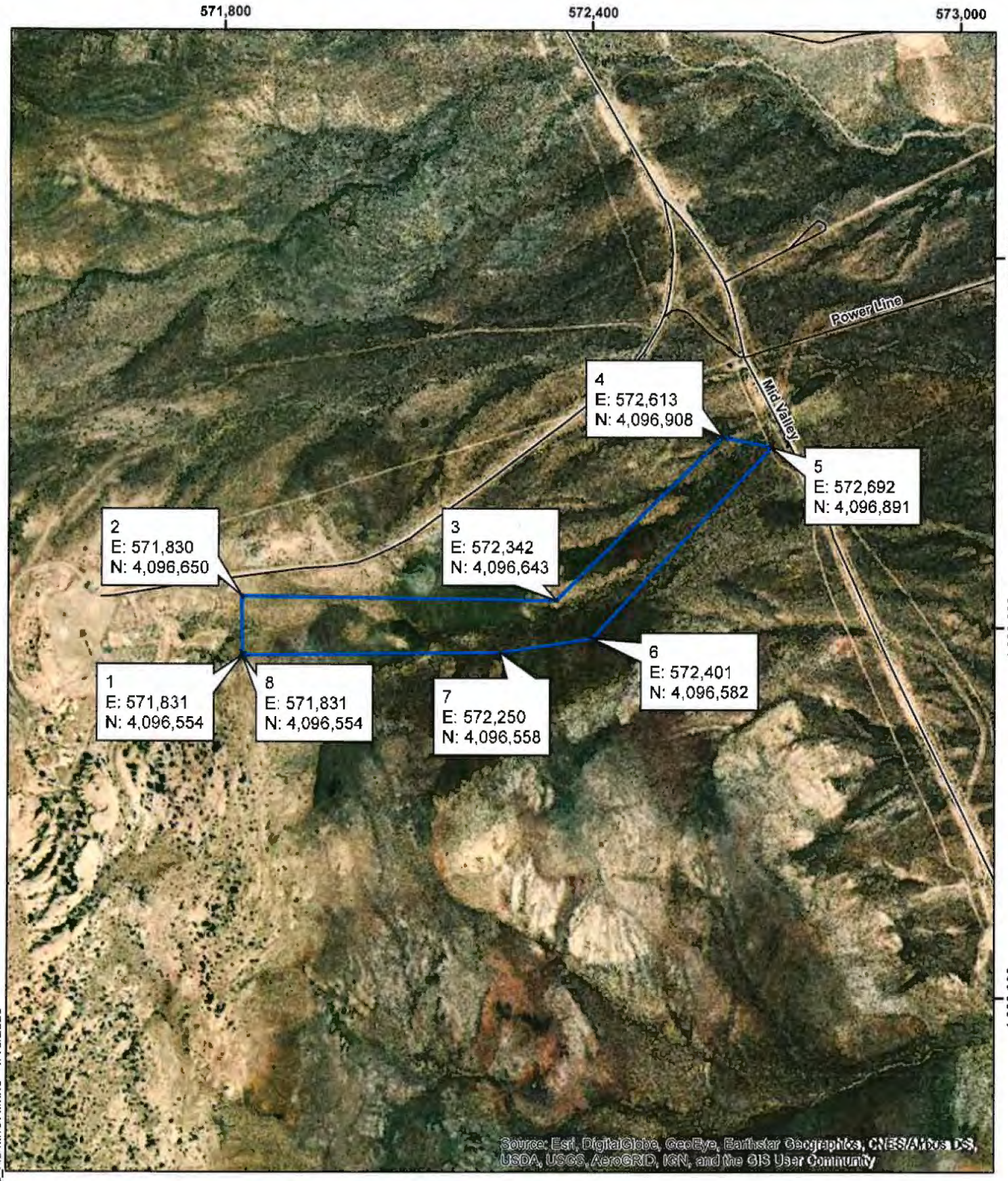
FRAHER.JEFFREY.T.1020435395 Digitally signed by FRAHER.JEFFREY.T.1020435395 Date: 2020.01.27 10:05:17 -07'00'

Date: _____

Jeffrey Fraher

Environmental Engineer

DTRA



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CAU 504, CAS 16-23-02
Contaminated Area
Administrative UR Boundary

Source: Navarro GIS, 2020

Explanation

- Administrative UR
- Local Road

0 50 100 200 Meters

0 200 400 800 Feet

N

NOTE: Size and location of features are approximated
Coordinate System: NAD 1983 UTM Zone 11N, Meter

Supplemental Information Figure

Additional supplemental information on site features was not present in previous iterations of this Use Restriction (UR), therefore a supplemental information figure is not attached. If additional information on site features is required for this site, please contact the *Federal Facility Agreement and Consent Order* (FFACO) Database Administrator.

UNCONTROLLED

ERRATA SHEET

The Following Corrections and Clarifications Apply to: Corrective Action Decision Document/Closure Report (CADD/CR) for Corrective Action Unit (CAU) 504: 16a-Tunnel Muckpile

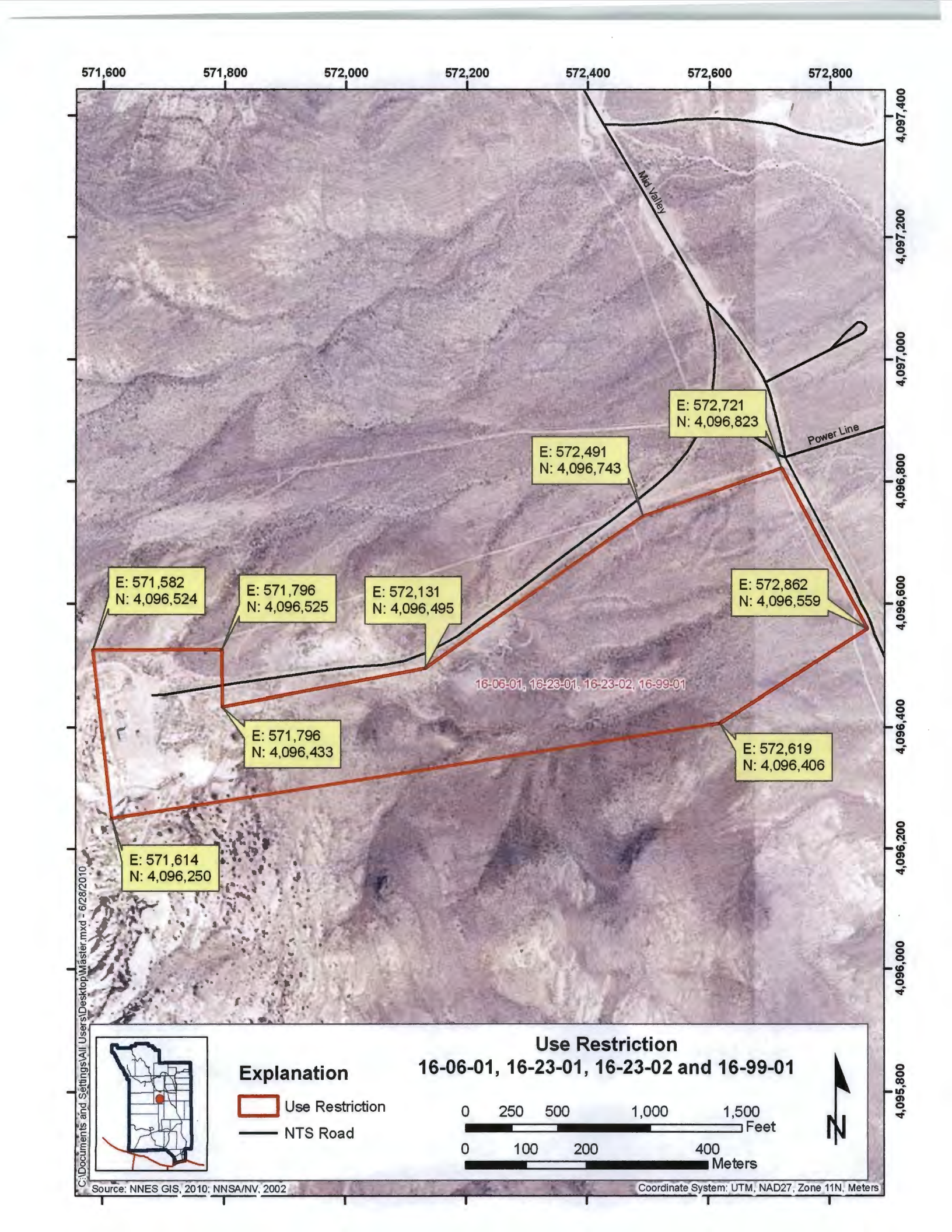
DOE Document Number: DOE/NV--1369; 07-DTRA-012

Revision: 0

Original Document Issuance Date: July 2007 (Republished March 2010)

This errata sheet was issued under cover letter from DOE on: August 10, 2010

In Appendix E, Closure Summary, the use restriction coordinates on the aerial photo are incorrect and do not match the approved Use Restriction (UR) Form. The coordinates have been verified and this Errata Sheet replaces the aerial photo of the use restricted area with an updated photo and coordinates that match the approved UR Form.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4,096,400
4,096,200
4,096,000
4,095,800
Mid Valley
Power Line
E: 572,721
N: 4,096,823
E: 572,491
N: 4,096,743
E: 571,582
N: 4,096,524
E: 571,796
N: 4,096,525
E: 572,131
N: 4,096,495
E: 572,862
N: 4,096,559
16-06-01, 16-23-01, 16-23-02, 16-99-01
E: 571,796
N: 4,096,433
E: 572,619
N: 4,096,406
E: 571,614
N: 4,096,250
Use Restriction
16-06-01, 16-23-01, 16-23-02 and 16-99-01
Explanation
Use Restriction
NTS Road
0 250 500 1,000 1,500
Feet
0 100 200 400
Meters
N
C:\Documents and Settings\All Users\Desktop\Master.mxd - 6/28/2010
Source: NNES GIS, 2010; NNSA/NV, 2002
Coordinate System: UTM, NAD27, Zone 11N, Meters

DOE/NV--1369
07-DTRA-012

CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 504: 16a-TUNNEL MUCKPILE, NEVADA TEST SITE

Controlled Copy No: **UNCONTROLLED**

Revision No.: 0

July 2007
(Republished March 2010)

DISCLAIMER

CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 504: 16a-TUNNEL MUCKPILE, NEVADA TEST SITE

Prepared by
Defense Threat Reduction Agency
Mercury, Nevada

Controlled Copy No. UNCONTROLLED

Revision No.: 0

July 2007
(Republished March 2010)

CORRECTIVE ACTION DECISION
DOCUMENT/CLOSURE REPORT
FOR CORRECTIVE ACTION UNIT 504:
16a-TUNNEL MUCKPILE,
NEVADA TEST SITE, NEVADA

Approved by: /s/Tiffany A. Lantow Date: 07/25/2007

Tiffany A. Lantow
Environmental Program Manager
Nevada Operations Office
Defense Threat Reduction Agency

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List of Acronyms and Abbreviations

ALARA	As low as reasonably achievable
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BZA	Breathing zone apparatus
CADD	Corrective Action Decision Document
CAI	Corrective Action Investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
cps	Counts per second
CR	Closure Report
Cs	Cesium
CSM	Conceptual site model
CZ	Contaminated Zone
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DLAPS	Dual large-area plastic scintillation
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
DTRA	Defense Threat Reduction Agency
EPA	U.S. Environmental Protection Agency

List of Acronyms and Abbreviations (continued)

FAL	Final action level
FFACO	*Federal Facility Agreement and Consent Order*
FGR	Federal Guidance Report
ft	Foot
g/cm^3	Grams per cubic centimeter
g/m^3	Grams per cubic meter
g/yr	Grams per year
GPS	Global Positioning System
H&S	Health and safety
HPGe	High-purity germanium
hr/yr	Hours per year
HWAA	Hazardous waste accumulation area
IDW	Investigation-derived waste
IT	IT Corporation
kg/day	Kilograms per day
kg/yr	Kilograms per year
L/day	Liters per day
L/yr	Liters per year
m	Meter
m/sec	Meters per second
m/yr	Meters per year
m^2	Square meter
m^3/h	Cubic meters per hour
m^3/yr	Cubic meters per year
M&O	Management and operating

List of Acronyms and Abbreviations (continued)

mg/day	Milligrams per day
mg/kg	Milligrams per kilogram
mph	Miles per hour
mrem	Millirem
mrem/yr	Millirem per year
N/A	Not applicable
NAC	*Nevada Administrative Code*
NCRP	National Council on Radiation Protection and Measurements
ND	Nondetect
NDEP	Nevada Division of Environmental Protection
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
PAI	Paragon Analytics, Inc.
PAL	Preliminary action level
pCi/g	Picocuries per gram
POC	Performance Objective for the Certification of Nonradioactive Hazardous Waste
PPE	Personal protective equipment
PRG	Preliminary remediation goal
Pu	Plutonium
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
Ra	Radium
RAGS	*Risk Assessment Guidance for Superfund*
RAIS	Risk Assessment Information System

List of Acronyms and Abbreviations (continued)

RCRA	*Resource Conservation and Recovery Act*
RCT	Radiological control technician
REOP	Real Estate/Operations Permit
RESRAD	Residual Radioactive
RPD	Relative percent difference
RT	Regulatory threshold
RWP	Radiological Work Permit
SAPS	Small-area plastic scintillation
Sr	Strontium
SS	Site Supervisor
SSHASP	Site-Specific Health and Safety Plan
SSO	Site Safety Officer
SSTL	Site-specific target level
SVOC	Semivolatile organic compound
TEDE	Total effective dose equivalent
Th	Thorium
TID	Tamper-indicating device
TPH	Total petroleum hydrocarbons
TSB	Tailgate safety briefing
UCL	Upper confidence limit
VOC	Volatile organic compound
yr	Year
/yr	Per year
yd^3	Cubic yard
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter

Executive Summary

This Corrective Action Decision Document (CADD)/Closure Report (CR) was prepared by the Defense Threat Reduction Agency (DTRA) for Corrective Action Unit (CAU) 504, 16a-Tunnel Muckpile. This CADD/CR is consistent with the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management. Corrective Action Unit 504 is comprised of four Corrective Action Sites (CASs):

- 16-06-01, Muckpile
- 16-23-01, Contaminated Burial Pit
- 16-23-02, Contaminated Area
- 16-99-01, Concrete Construction Waste

Corrective Action Site 16-23-01 is not a burial pit; it is part of CAS 16-06-01. Therefore, there is not a separate data analysis and assessment for CAS 16-23-01; it is included as part of the assessment for CAS 16-06-01.

In addition to these CASs, the channel between CAS 16-23-02 (Contaminated Area) and Mid Valley Road was investigated with walk-over radiological surveys and soil sampling using hand tools.

The purpose of this CADD/CR is to provide justification and documentation supporting the recommendation for closure in place with use restrictions for CAU 504. A CADD was originally submitted for CAU 504 and approved by the Nevada Division of Environmental Protection (NDEP). However, following an agreement between NDEP, DTRA, and the DOE, National Nuclear Security Administration Nevada Site Office to change to a risk-based approach for assessing the corrective action investigation (CAI) data, NDEP agreed that the CAU could be re-evaluated using the risk-based approach and a CADD/CR prepared to close the site. To support this recommendation, a CAI was performed in May, June, and July 2001. The purpose of the CAI was to fulfill the following data needs as defined during the Data Quality Objective (DQO) process:

- Determine whether identified contaminants of concern are present within or beneath the Muckpile, the Contaminated Burial Pit, or the Area of Concrete Construction Waste, or at the surface of the Contaminated Area.

- Provide sufficient information and data to develop appropriate corrective action strategies for the Muckpile and associated CASs to be evaluated in the CADD/CR.

The CAU 504 dataset from the CAI was evaluated based on the data quality indicator parameters. This evaluation demonstrated the quality and acceptability of the dataset for use in fulfilling the DQO data needs (Appendix C of this document).

Analytes detected during the CAI were evaluated against final action levels (FALs) established in this document. Tier 2 FALs were determined for arsenic and for the radionuclides cesium (Cs)-137, cobalt (Co)-60, plutonium (Pu)-238, and Pu-239. Tier 2 FALs were calculated using site-specific information. The arsenic FAL was calculated using the Risk Assessment Information System website as discussed in Appendix D. The radionuclide FALs were calculated using the Residual Radioactive (RESRAD) code (version 6.3) for the occasional reuse scenario. The RESRAD calculation determined the activities of all radionuclides that together would sum to an exposure dose of 25 millirem per year to a site receptor based on the relative abundance of individual radionuclides at the site. Based on the field investigation, Co-60, Cs-137, Pu-238, and Pu-239 exceeded their FALs in the Muckpile, and Pu-239 exceeded the FAL in one random sample in the channel below the Contaminated Area. The analytical results for arsenic, Cs-137, Pu-238, and Pu-239 were entered into the SW-846 formula to determine whether the site had been characterized to the 90 percent confidence level. Enough samples were collected to adequately characterize the site with respect to these analytes (Appendix C).

Based on the data and risk evaluations, the DQO data needs presented in the CAIP were met, and the data accurately represent the radiological and chemical risk present at CAU 504. Based on the results of the CAI data evaluation, it was determined that closure in place with use restrictions is the appropriate corrective action for CAU 504 and that use restrictions will effectively control exposure to future land users. This is based on the fact that even though the site is contaminated with Co-60, Cs-137, Pu-238, and Pu-239 as described above, this remote, controlled access site poses only limited risk overall to public health and the environment. Therefore, DTRA provides the following recommendations:

- Close the radionuclides in place at CAU 504 with use restriction.
- No further action for CAU 504.
- A Notice of Completion be issued to DTRA by NDEP for closure of CAU 504.
- Move CAU 504 from Appendix III to Appendix IV of the FFACO.

1.0 Introduction

This Corrective Action Decision Document (CADD)/Closure Report (CR) has been prepared for Corrective Action Unit (CAU) 504, 16a-Tunnel Muckpile. The corrective action proposed in this document complies with the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense (DoD); and DOE, Legacy Management (FFACO, 1996; as amended August 2006).

The 16a-Tunnel Muckpile is identified under FFACO classification as CAU 504, 16a-Tunnel Muckpile. The CAU consists of four corrective action sites (CASs): 16-06-01, Muckpile; 16-23-01, Contaminated Burial Pit; 16-23-02, Contaminated Area; and 16-99-01, Concrete Construction Waste. The 16a-Tunnel Muckpile is located approximately 37 miles north of Mercury in Area 16 of the Nevada Test Site (NTS) (Figure 1-1).

A CADD was originally submitted for CAU 504 and approved by the Nevada Division of Environmental Protection (NDEP). However, following an agreement between NDEP, the Defense Threat Reduction Agency (DTRA), and the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) to change to a risk-based approach for assessing the corrective action investigation (CAI) data, NDEP agreed that the CAU could be re-evaluated using the risk-based approach and a CADD/CR prepared to close the site.

This CADD/CR describes the corrective action that is selected as a result of the investigation activities and the rationale for its selection. The rationale consists of a justification for closure in place with use restrictions in accordance with Sections IV.8 and IV.11 of the FFACO (1996, as amended August 2006).

1.1 Purpose

The purpose of this CADD/CR is to provide justification for the closure of CAU 504 with use restrictions based on the results of the CAI. The CAI was conducted in accordance with the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site* (DTRA, 2001), which provides additional information on the history, planning, and scope of the investigation.

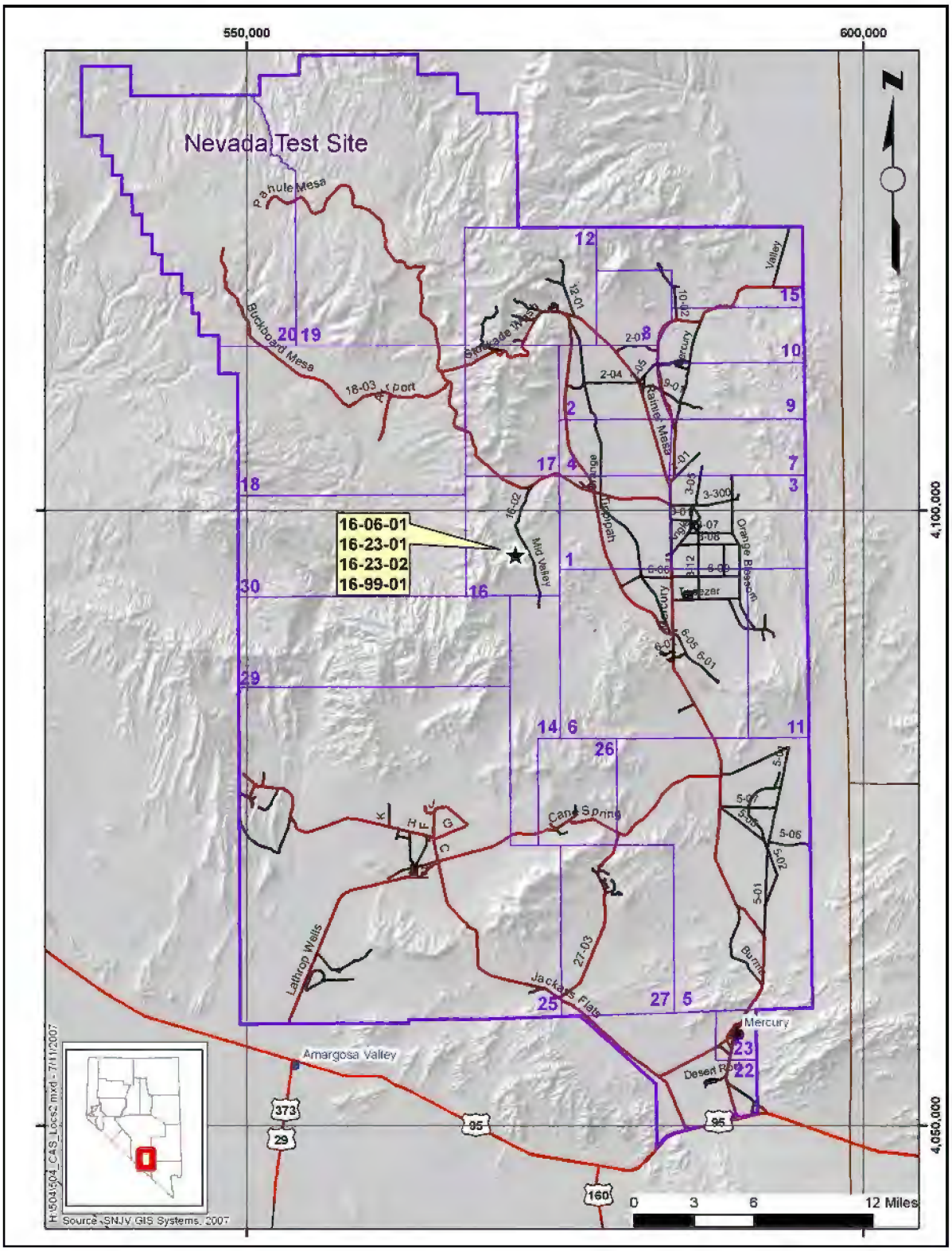

Figure 1-1
CAU 504 Location Map

The 16a-Tunnel was used for four nuclear weapons effects and two Vela Uniform tests between 1962 and 1971, and 10 high explosives tests between 1995 and 1999. Vela Uniform was a DoD program designed to improve the capability to detect, identify, and locate underground nuclear explosions. The Muckpile consists of approximately 175,000 cubic yards (yd^3) of material mined from the 16a-Tunnel during initial construction and re-entry operations following tests.

1.2 Scope

The scope of this CADD/CR is to justify and recommend that closure in place with use restrictions is the appropriate action at CAU 504, 16a-Tunnel Muckpile. To achieve this scope, the following actions were implemented:

- Evaluation of current site conditions, including the nature and extent of contaminants of concern (COCs).
- Closure in place with use restrictions to prevent exposure of industrial and construction workers to unacceptable risks.

The 16a-Tunnel Muckpile was one of the early investigations, so the data quality objectives (DQOs) did not follow the later format and no decision statements were prepared. However, the decision statement from a later investigation is applicable to CAU 504. The decision statement is:

- Are there concentrations of COCs present in the Muckpile that exceed the preliminary action levels (PALs) and, if so do they pose an unacceptable risk to human health and/or the environment?

The data quality indicators (DQIs) as defined in the Industrial Sites Quality Assurance Project Plan (QAPP) (DOE/NV, 1996a) were achieved, and the DQOs established in the CAIP were met.

Subsequent to approval of the CAIP and completion of the CAI, NDEP approved a risk-based approach for developing final action levels (FALs) to evaluate contaminant concentrations. That approach was used to evaluate the potential hazards at CAU 504.

1.3 CADD/CR Contents

This CADD/CR is divided into the following sections:

- Section 1.0 – Introduction: Summarizes the purpose, scope, and contents of this CADD/CR.
- Section 2.0 – CAI Summary: Summarizes the investigation field activities, the results of the investigation, and the DQO assessment.
- Section 3.0 – Recommendations: States why no further action is required.
- Section 4.0 – References: Lists all documents referenced in the CADD/CR.
- Appendix A: Corrective Action Investigation Report for CAU 504, 16a-Tunnel Muckpile
- Appendix B: Data Quality Objective Process for CAU 504, 16a-Tunnel Muckpile
- Appendix C: Data Assessment
- Appendix D: Risk Assessment for CAU 504
- Appendix E: Closure Summary

All work was performed in accordance with the following documents:

- *Corrective Action Investigation Plan for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site,* Rev. 0 (DTRA, 2001).
- Industrial Sites QAPP, Rev. 0 (DOE/NV, 1996a)
- *Federal Facility Agreement and Consent Order* (FFACO, 1996; as amended August 2006)
- *ITLV Site-Specific Health and Safety Plan for DTRA 16a-Tunnel Muckpile Characterization* (IT, 2001).

2.0 Corrective Action Investigation Summary

The following sections describe and summarize the results of the CAI activities conducted at CAU 504. For detailed CAI results, refer to Appendix A.

2.1 Investigation Activities

From May 22 through July 16, 2001, CAI activities were performed at the 16a-Tunnel Muckpile as set forth in the CAIP (DTRA, 2001). The purpose of the CAI was to determine whether or not the 16a-Tunnel Muckpile, the underlying native soils, and/or the channel below the Muckpile have been impacted by inorganic, organic, or radiological constituents at concentrations that exceed regulatory limits and pose an unacceptable risk to human health or the environment, and to provide sufficient information and data to develop appropriate corrective action strategies for the Muckpile and channel. In accordance with the CAIP (DTRA, 2001), the following tasks were performed:

- **Walk-over and drive-over radiological surveys** – Before beginning drilling and sampling, walk-over and drive-over radiological surveys were conducted to identify surface and near-surface areas with elevated radiological readings. The drive-over survey was conducted on the Muckpile, and the walk-over surveys were conducted over the Concrete Construction Waste, the Contamination Area, and the channel between the Contamination Area and Mid Valley Road.

- **Muckpile and underlying native material sampling –** Twenty-one locations were drilled in the Muckpile to characterize the muck and the native material beneath the muck. A total of 428 feet (ft) were drilled in 20 boreholes ranging in depth from 4.5 to 63.0 ft. Up to four samples were collected from each location. During the characterization, 44 environmental samples were collected. These included 28 muck samples and 16 native material samples. All samples were sent to Paragon Analytics, Inc., for analysis. Analyses performed included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), total *Resource Conservation and Recovery Act* (RCRA) metals, radionuclides, isotopic plutonium (Pu), and strontium (Sr)-90.

- **Concrete Construction Waste Sampling –** Seven locations were hand sampled in and around the Concrete Construction Waste, and 11 environmental samples were collected. All samples were sent to Paragon Analytics, Inc., to be analyzed for the same analytes as the muck samples.

- **Contaminated Area Sampling –** Three locations were hand sampled in the Contaminated Area and six environmental samples were collected, two from each location. All samples were sent to Paragon Analytics, Inc., to be analyzed for the same analytes as the muck samples.

- **Channel sampling –** Thirteen locations were hand sampled in the channel, and 15 environmental samples were collected. All samples were sent to Paragon Analytics, Inc., to be analyzed for the same analytes as the muck samples.

- **Background soil sampling** – Three background soil samples were collected using hand tools at undisturbed location around the Muckpile. All samples were sent to Paragon Analytics, Inc., to be analyzed for RCRA metals, radionuclides, isotopic Pu, and Sr-90.

The conceptual site model (CSM) postulated the following:

- Leaching of the solid contaminants has not impacted soil directly below the Muckpile or other disposal areas.

- Lateral migration may have occurred due to erosion of the Muckpile sides. Lateral migration of trinitite into the ravine downgradient is thought to be the source of the elevated readings in CAS 16-23-02.

- Groundwater contamination is highly unlikely because environmental conditions at the site – such as an arid climate, depth to groundwater, and low permeabilities – are not conducive to downward migration.

- System dynamics are such that there are no driving forces other than the limited precipitation.

The Muckpile and channel were shown to be contaminated with radiological constituents at activities above their PALs in more than isolated occurrences. In addition, the channel also had two samples that had arsenic concentrations that exceeded the PAL. The muck samples also exceeded the FALs; however, only one of the channel samples had radionuclide concentrations that exceeded the FALs. The CAI demonstrated that contaminants were not leaching into the native materials beneath the muck, and the elevated readings in the Contamination Area (CAS 16-23-02) were from trinitite and the elevated readings found in the channel were the result of the trinitite migrating down the channel in surface runoff. The other postulates and the assumptions used to develop the CSM (DTRA, 2001) were not violated and the discovery of contamination beyond what was predicted was accounted for during the investigation. Therefore, the CSM is valid for this site.

2.2 Results

The following is a summary of the data obtained during the CAI.

2.2.1 Summary of Analytical Data

The contaminants of potential concern (COPCs) were established in the DQO process as listed in the CAIP (DTRA, 2001). Analytical results obtained from the CAI were evaluated to determine whether COPCs were detected above the PALs. If the PALs were exceeded, those constituents were moved to a Tier 2 evaluation and FALs were determined (Appendix D). If concentrations of the constituents exceeded the FALs, they became COCs for CAU 504 and require corrective action. Based on the results of this evaluation, cobalt (Co)-60, cesium (Cs)-137, Pu-238 and Pu-239 were identified as the COCs for the site.

The future use for the 16a-Tunnel Muckpile, as defined in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996b), is identified to be similar to its current use (Nuclear and High Explosive Test Zone). The industrial preliminary remediation goals (PRGs) for evaluating contaminated sites assume exposure pathway scenarios that are most comparable to the activities conducted at similar DTRA sites on the NTS (i.e., training, high explosive tests, and other industrial uses). Under industrial scenarios, the potential exposure pathways are ingestion, inhalation, and dermal contact with contaminated soil (EPA, 2004). Site workers could potentially be exposed to contaminated soil during excavation activities associated with general maintenance or through construction and maintenance of underground utilities. The results for samples collected in the probable zone of intrusion indicate the presence of Co-60, Cs-137, Pu-238, and Pu-239. Therefore, only man-made radionuclides must be considered during evaluation of the identified exposure pathways of ingestion, dust, inhalation, and dermal contact with contaminated soil.

As part of the CAIP (DTRA, 2001), the conceptual model developed for CAU 504 identified potential pathways for migration of contaminants through large precipitation events and by percolation of water through the Muckpile, the underlying alluvium and bed rock, and into the groundwater. There is evidence that large precipitation events have moved small quantities of trinitite downgradient from the Contamination Area. Analytical results from samples in the native material beneath the Muckpile show no contamination in the underlying native material. This fact demonstrates the limited mobility of the constituents in the Muckpile.

The CAI analytical results (Appendix A) indicate the following:

- Radionuclide results were compared to the recommended screening limits in the National Council of Radiation Protection and Measurements (NCRP) Report No. 129 (NCRP, 1999) as required by the CAIP (DTRA, 2001). Man-made radionuclides were detected above the FALs in eight samples. The man-made radionuclides Co-60, Cs-137,

Pu-238, and Pu-239 were found in samples from the Muckpile, and Pu-239 was found in a single soil sample in the channel.

- No other COCs were identified in concentrations that will pose an unreasonable risk to human health or the environment in any of the samples.

Details of the methods used and results found during the CAI are presented in Appendix A. A statistical analysis of the analytical data from the CAI has demonstrated that the number of samples taken was sufficient and resulted in a greater than 90 percent confidence level that the identified constituents accurately represent the site, and that the mean concentrations are representative of the Muckpile and Contaminated Burial Pit (CASs 16-06-01 and 16-23-01) and the Contaminated Area and channel (CAS 16-23-02). Only biased sampling was conducted at the Concrete Construction Waste (CAS 16-99-01), so a statistical analysis is not appropriate to determine the adequacy of the sampling. Based on these results, the nature and extent of COCs at CAU 504 have been adequately identified and were used to develop and evaluate corrective action alternatives.

2.2.1.1 Muckpile (CAS 16-06-01) and Contaminated Burial Pit (CAS 16-23-01)

None of the inorganic or organic constituents were detected above the PALs, so the PALs were identified as the FALs for those constituents. The maximum concentration of each detected chemical constituent at these two CASs is listed in Table 2-1. A more detailed discussion of the constituents and the determination of the FALs is provided in Appendix D.

Table 2-1
Maximum Reported Chemical Values for CAS 16-06-01, Muckpile, and CAS 16-23-01, Contaminated Burial Pit
(Page 1 of 2)

Contaminant	Result (mg/kg)	Sample No	Depth (ft bgs)	Final Action Level (mg/kg)
Acetone	0.029	AS-01-2	1.5 – 2.5	54,000[a]
Arsenic	8.4	AS-07-0.5	0 – 1	23[b]
Barium	4,300	AS-05-5.5	5 – 6	67,000[a]
Benzo(a)anthracene	0.039	AS-S4-0.5	0 – 1	2.1[a]
Benzo(b)fluoranthene	0.041	AS-S6-1	0.5 – 1.5	2.1[a]
Bis(2-ethylhexyl)phthalate	0.12	AS-14-2	1.5 – 2.5	120[a]
Cadmium	0.42	AS-11-2.5	2 – 3	450[a]
Chromium	12	AS-11-2.5	2 – 3	450[a]
Diesel-Range Organics	82	AS-S6-1	0.5 – 1.5	100[c]

Table 2-1
Maximum Reported Chemical Values for CAS 16-06-01, Muckpile, and CAS 16-23-01, Contaminated Burial Pit
(Page 2 of 2)

Contaminant	Result (mg/kg)	Sample No	Depth (ft bgs)	Final Action Level (mg/kg)
Lead	32	AS-S1-1	0.5 – 1.5	800[a]
Mercury	0.12	AS-10-14.5	14 – 15	310[a]
Methylene Chloride	0.045	AS-12-14	13.5 – 14.5	21[a]
P-Isopropyltoluene	0.017	AS-01-2	1.5 – 2.5	2,000[a]
Selenium	1.3	AS-11-2.5	2 – 3	5,100[a]
Silver	1.4	AS-10-28.5	28 – 29	5,100[a]

[a]Final action level based on *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).
[b]Nevada Test Site background plus two standard deviations.
[c]*Nevada Administrative Code* 445A.2272 (NAC, 2003b)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram

With the exception of Co-60, Cs-137, Pu-238, and Pu-239, none of the radionuclides were detected above their PALs, so the PALs were identified as the FALs for those radionuclides. For those radionuclides that did exceed the PALs, site-specific target levels (SSTLs) were calculated using the Residual Radioactive (RESRAD) computer code, which then became the FALs for those constituents. The maximum concentration of each detected radionuclide found at these two CASs is listed in Table 2-2. A more detailed discussion of the radionuclides and the determination of the FALs is provided in Appendix D.

Table 2-2
Maximum Reported Radiological Values for CAS 16-06-01, Muckpile, and CAS 16-23-01, Contaminated Burial Pit
(Page 1 of 2)

Contaminant	Result (pCi/g)	Sample No	Depth (ft bgs)	Final Action Level (pCi/g)
Actinium-228	2.21	AS-S4-0.5	0 – 1	5[a]
Americium-241	1.48	AS-S6-1	0.5 – 1.5	12.7[a]
Bismuth-212	1.55	AS-11-2.5	2 – 3	5[a]
Bismuth-214	1.02	AS-S5-1	0.5 – 1.5	5[a]
Cesium-137	**1,770**	AS-11-41	40.5 – 41.5	266[b]
Cobalt-60	**5.3**	AS-11-41	40.5 – 41.5	0.8[b]
Lead-212	2.65	AS-08-8.5	8 – 9	5[a]

Table 2-2
Maximum Reported Radiological Values for CAS 16-06-01, Muckpile, and CAS 16-23-01, Contaminated Burial Pit
(Page 2 of 2)

Contaminant	Result (pCi/g)	Sample No	Depth (ft bgs)	Final Action Level (pCi/g)
Lead-214	1.21	AS-08-8.5	8 – 9	5[a]
Plutonium-238	**20.2**	AS-11-41	40.5 – 41.5	3[b]
Plutonium-239	**122**	AS-11-41	40.5 – 41.5	18.4[b]
Strontium-90	117	AS-S1-1	0.5 – 1.5	838[a]
Thorium-234	2.9	AS-07-0.5	0 – 1	105[a]
Thallium-208	0.86	AS-S6-1	0.5 – 1.5	5[a]

[a]Final action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

[b]Final action level based on RESRAD calculation (Yu et al., 2001) for remote scenario.

Bold indicates the result exceeds the FAL.

FAL = Final action level
ft bgs = Feet below ground surface
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive

2.2.1.2 Native Material Under the Muckpile

None of the inorganic or organic constituents found in the native material under the Muckpile exceeded the PALs as identified in the CAIP (DTRA, 2001), so the PALs are identified as the FALs for those constituents. The maximum concentration of each detected chemical contaminant found in the native material at this CAS is listed in Table 2-3.

None of the radionuclides found in the native material under the Muckpile exceeded the PALs as defined in the CAIP (DTRA, 2001), so the PALs for those radionuclides are identified as the FALs. The maximum concentration of each detected radionuclide found in the native material under the Muckpile at this CAS is listed in Table 2-4.

Table 2-3
Maximum Reported Chemical Values for Native Material Under the Muckpile

Contaminant	Result (mg/kg)	Sample No	Depth (ft bgs)	Final Action Level (mg/kg)
Acetone	0.023	AS-03-23	22.5 – 23.5	54,000[a]
Arsenic	7.2	AS-02-18.5	18 – 19	23[b]
Barium	450	AS-06-4	3.5 – 4.5	67,000[a]
Chromium	210	AS-03-23	22.5 – 23.5	450[a]
Diesel-Range Organics	59	AS-03-23	22.5 – 23.5	100[c]
Lead	44	AS-01-7.5	7 – 8	800[a]
Mercury	0.046	AS-09-13.5	13 – 14	310[a]
Methylene Chloride	0.071	AS-12-62.5	62 – 63	21[a]
Phenol	0.055	AS-03-23	22.5 – 23.5	100,000[a]
Selenium	0.5	AS-02-18.5	18 – 19	5,100[a]
Silver	530	AS-03-23	22.5 – 23.5	5,100[a]
Toluene	0.0012	AS-05-15	14.5 – 15.5	520[a]

[a]Final action level based on *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

[b]Nevada Test Site background plus two standard deviations.

[c]*Nevada Administrative Code* 445A.2272 (NAC, 2003b)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram

Table 2-4
Maximum Reported Radiological Values for Native Material Under the Muckpile

Contaminant	Result (pCi/g)	Sample No	Depth (ft bgs)	Final Action Level (pCi/g)
Actinium-228	2.31	AS-05-15	14.5 – 15.5	5[a]
Bismuth-214	1.28	AS-08-11.5	11 – 12	5[a]
Cesium-137	9.9	AS-11-55	54.5 – 55.5	12.2[a]
Lead-212	2.71	AS-08-11.5	11 – 12	5[a]
Lead-214	1.3	AS-08-11.5	11 – 12	5[a]
Plutonium-238	0.071	AS-11-55	54.5 – 55.5	13[a]
Plutonium-239	0.439	AS-11-55	54.5 – 55.5	12.7[a]
Thorium-234	2.39	AS-14-11.5	11 – 12	105[a]
Thallium-208	0.93	AS-15-27.5	27 – 28	5[a]

[a]Final action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled to 25-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

ft bgs = Feet below ground surface
pCi/g = Picocuries per gram

2.2.1.3 Concrete Construction Waste (CAS 16-99-01)

None of the inorganic or organic constituents found in the Concrete Construction Waste soils exceeded the PALs as identified in the CAIP (DTRA, 2001), so the PALs are identified as the FALs. The maximum concentration of each detected chemical contaminant found in the soils at this CAS is listed in Table 2-5.

Table 2-5
Maximum Reported Chemical Values for
Concrete Construction Waste (CAS 16-99-01)

Contaminant	Result (mg/kg)	Sample No	Depth (ft bgs)	Final Action Level (mg/kg)
Arsenic	5.2	AS-C5-0.5	0 – 1	23[a]
Barium	2,900	AS-C2-0.5	0 – 1	67,000[b]
Bis(2-ethylhexyl)phthalate	0.069	AS-C9-C	Composite	120[b]
Chromium	5.6	AS-C2-0.5	0 – 1	450[b]
Diesel-Range Organics	8.9	AS-C6-0.5	0 – 1	100[c]
Lead	14	AS-C5-0.5	0 – 1	800[b]
Mercury	0.2	AS-C1-B	1 – 1.5	310[b]
Methylene Chloride	0.023	AS-C6-0.5	0 – 1	21[b]
Selenium	0.28	AS-C6-0.5	0 – 1	5,100[b]

[a]Nevada Test Site background plus two standard deviations.

[b]Final action level based on *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

[c]*Nevada Administrative Code* 445A.2272 (NAC, 2003b)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram

None of the radionuclides found in the channel soils exceeded the PALs as defined in the CAIP (DTRA, 2001) except for Cs-137, so the PALs for those radionuclides are identified as the FALs. For Cs-137 which exceeded the PAL, an SSTL was calculated using the RESRAD computer code (Yu et al., 2001). The SSTL then became the FAL for that constituent. The maximum concentration of each detected radionuclide found at this CAS is listed in Table 2-6.

Table 2-6
Maximum Reported Radiological Values for
Concrete Construction Waste (CAS 16-99-01)

Contaminant	Result (pCi/g)	Sample No	Depth (ft bgs)	Final Action Level (pCi/g)
Actinium-228	2.64	AS-C2-B	1.0 – 1.5	5[a]
Bismuth-214	1.09	AS-C8-C	Composite	5[a]
Cesium-137	49	AS-C9-C	Composite	266[b]
Lead-212	2.27	AS-C9-20	1.5 – 2.0	5[a]
Lead-214	1.15	AS-C5-0.5	0 – 1	5[a]
Plutonium-238	0.109	AS-C9-C	Composite	13[a]
Plutonium-239	1.15	AS-C5-0.5	0 – 1	12.7[a]
Strontium-90	1.11	AS-C9-C	Composite	838[a]
Thallium-208	0.86	AS-C9-20	1.5 – 2.0	5[a]

[a]Final action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).
[b]Final action level based on RESRAD calculation (Yu et al., 2001) for remote scenario.

ft bgs = Feet below ground surface
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive

2.2.1.4 Contaminated Area (CAS 16-23-02)

None of the inorganic or organic constituents found in the Contaminated Area soils exceeded the PALs as identified in the CAIP (DTRA, 2001), so the PALs are identified as the FALs. The maximum concentration of each detected chemical contaminant found at this CAS is listed in Table 2-7.

Table 2-7
Maximum Reported Chemical Values for
the Contaminated Area (CAS 16-23-02)
(Page 1 of 2)

Contaminant	Result (mg/kg)	Sample No	Depth (in. bgs)	Final Action Level (mg/kg)
Arsenic	4.1	AS-R2-C	Composite	23[a]
Barium	220	AS-R3-C	Composite	67,000[b]
Bis(2-ethylhexyl)phthalate	0.071	AS-R2-C	Composite	120[b]
Cadmium	0.16	AS-R1-12	11 – 13	450[b]
Chromium	3	AS-R2-C	Composite	450[b]
Diesel-Range Organics	9.1	AS-R2-19	18 – 20	100[c]
Lead	30	AS-R2-19	18 – 20	800[b]

Table 2-7
Maximum Reported Chemical Values for
the Contaminated Area (CAS 16-23-02)
(Page 2 of 2)

Contaminant	Result (mg/kg)	Sample No	Depth (in. bgs)	Final Action Level (mg/kg)
Lead	30	AS-R2-19	18 – 20	800[b]
Mercury	0.066	AS-R1-C	Composite	310[b]
Methylene Chloride	0.032	AS-R1-12	11 – 13	21[b]

[a]Nevada Test Site background plus two standard deviations.

[b]Final action level based on *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

[c]*Nevada Administrative Code* 445A.2272 (NAC, 2003b)

in. bgs = Inches below ground surface
mg/kg = Milligrams per kilogram

None of the radionuclides found in the Contaminated Area soils exceeded the PALs as defined in the CAIP (DTRA, 2001) except for Cs-137, so the PALs for those radionuclides are identified as the FALs. For Cs-137, which exceeded the PAL, an SSTL was calculated using the RESRAD computer code (Yu et at., 2001). The SSTL then became the FAL for that constituent. The maximum concentration of each detected radionuclide found at this CAS is listed in Table 2-8.

Table 2-8
Maximum Reported Radiological Values for
the Contaminated Area (CAS 16-23-02)

Contaminant	Result (pCi/g)	Sample No	Depth (in. bgs)	Final Action Level (pCi/g)
Actinium-228	2.15	AS-R2-C	Composite	5[a]
Bismuth-214	1.25	AS-R3-27	26 – 28	5[a]
Cesium-137	112	AS-R3-C	Composite	266[b]
Lead-212	2.37	AS-R1-C	Composite	5[a]
Lead-214	1.33	AS-R3-27	26 – 28	5[a]
Plutonium-238	0.11	AS-R1-C	Composite	13[a]
Plutonium-239	0.76	AS-R1-C	Composite	12.7[a]
Strontium-90	5.7	AS-R3-C	Composite	838[a]
Thallium-208	0.69	AS-R2-19	18 – 20	5[a]

[a]Final action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

[b]Final action level based on RESRAD calculation (Yu et al., 2001) for remote scenario.

in. bgs = Inches below ground surface
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive

2.2.1.5 Channel Soils

Except for arsenic, none of the chemical constituents found in the channel soils below the Contaminated Area exceeded the PALs as identified in the CAIP (DTRA, 2001), so the PALs for those chemicals are identified as the FALs. The FAL for arsenic was calculated using equations which are compliant with the *Risk Assessment Guidelines for Superfund* (RAGS) Part B procedures and were extracted from the Risk Assessment Information System (RAIS) (ORNL, 2005) located online at: http://risk.lsd.ornl.gov/cgi-bin/prg/PRG_search. The maximum concentration of each detected chemical contaminant found in the channel soils at this CAS is listed in Table 2-9.

Table 2-9
Maximum Reported Chemical Values for Channel Soils

Contaminant	Result (mg/kg)	Sample No	Depth (in. bgs)	Final Action Level (mg/kg)
2-Butanone	0.023	AS-R8-02	0 – 2	110,000[a]
Acetone	0.25	AS-R8-02	0 – 2	54,000[a]
Arsenic	77	AS-R14-C	Composite	242[b]
Barium	210	AS-R15-C	Composite	67,000[a]
Cadmium	0.89	AS-R4-02	0 – 2	450[a]
Chromium	27	AS-R6-02	0 – 2	450[a]
Diesel-Range Organics	15	AS-R4-02	0 – 2	100[c]
Lead	21	AS-R11-02	0 – 2	800[a]
Mercury	0.2	AS-R12-04	2 – 4	310[a]
Methylene Chloride	0.061	AS-R8-02	0 – 2	21[a]
P-isopropyltoluene	0.02	AS-R4-02	0 – 2	2,000[a]
Selenium	5.1	AS-R12-04	2 – 4	5,100[a]
Toluene	0.0029	AS-R8-02	0 – 2	520[a]
Trichlorofluoromethane	0.0025	AS-R12-04	2 – 4	2,000[a]

[a]Final action level based on *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).
[b]Site-specific target level calculated using the Risk Assessment Information System (ORNL, 2005).
[c]*Nevada Administrative Code* 445A.2272 (NAC, 2003b)

in. bgs = Inches below ground surface
mg/kg = Milligrams per kilogram

None of the radionuclides found in the channel soils exceeded the PALs as defined in the CAIP (DTRA, 2001) except for Cs-137 and Pu-239, so the PALs for those radionuclides are identified as the FALs. For Cs-137 and Pu-239 that exceeded the PALs, SSTLs were calculated using the RESRAD computer code (Yu et al., 2001). The SSTLs then became the FALs for those

constituents. The maximum concentration of each detected radionuclide found at this CAS is listed in Table 2-10.

Table 2-10
Maximum Reported Radiological Values for Channel Soils

Contaminant	Result (pCi/g)	Sample No	Depth (in. bgs)	Final Action Level (pCi/g)
Actinium-228	1.82	AS-R10-02	0 – 2	5[a]
Bismuth-212	1.27	AS-R12-04	2 – 4	5[a]
Bismuth-214	1.53	AS-R8-02	0 – 2	5[a]
Cesium-137	27.6	AS-R15-C	Composite	266[b]
Lead-212	2.78	AS-R10-02	0 – 2	5[a]
Lead-214	1.65	AS-R8-02	0 – 2	5[a]
Plutonium-238	0.07	AS-R15-C	Composite	13[a]
Plutonium-239	**20.5**	AS-R15-06	4 – 6	18.4[b]
Strontium-90	1.64	AS-R16-02	0 – 2	838[a]
Thallium-208	0.58	AS-R10-02	0 – 2	5[a]

[a]Final action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

[b]Final action level based on RESRAD calculation (Yu et al., 2001) for remote scenario.

Bold indicates the result exceeds the FAL.

FAL = Final action level
in. bgs = Inches below ground surface
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive

2.2.1.6 16a-Tunnel Muckpile Background

The background samples were only analyzed for RCRA metals and radionuclides. Table 2-11 shows the maximum concentration of metals found in the background samples. Table 2-12 shows the maximum concentration of radionuclides found in the background samples.

2.2.2 Data Assessment Summary

The data quality assessment (DQA) is presented in Appendix C and includes an evaluation of the DQIs to determine the degree of acceptability and usability of the reported data in the decision-making process. The DQO process ensures that the right type, quality, and quantity of data are available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps ensure that DQO decisions are sound and defensible.

Table 2-11
Maximum Reported RCRA Metals
for 16a-Tunnel Muckpile Background

Contaminant	Result (mg/kg)	Sample No	Depth (ft bgs)	Final Action Level (mg/kg)
Arsenic	4.4	AS-B1-S	0 – 0.5	23[a]
Barium	170	AS-B3-S	0 – 0.5	67,000[b]
Cadmium	0.17	AS-B1-S	0 – 0.5	450[b]
Chromium	4.7	AS-B2-S	0 – 0.5	450[b]
Lead	22	AS-B3-S	0 – 0.5	800[b]
Mercury	0.033	AS-B2-S	0 – 0.5	310[b]
Selenium	0.51	AS-B1-S	0 – 0.5	5,100[b]
Silver	1	AS-B3-S	0 – 0.5	5,100[b]

[a]Nevada Test Site background plus two standard deviations.

[b]Final action level based on *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram

Table 2-12
Maximum Reported Radiological Values
for 16a-Tunnel Muckpile Background

Contaminant	Result (pCi/g)	Sample No	Depth (ft bgs)	Final Action Level (pCi/g)
Actinium-228	1.76	AS-B2-S	0 – 0.5	5[a]
Bismuth-214	1.13	AS-B1-S	0 – 0.5	5[a]
Cesium-137	2	AS-B3-S	0 – 0.5	12.2[a]
Lead-212	2.06	AS-B1-S	0 – 0.5	5[a]
Lead-214	1.24	AS-B3-S	0 – 0.5	5[a]
Plutonium-238	0.041	AS-B3-S	0 – 0.5	13[a]
Plutonium-239	2.02	AS-B1-S	0 – 0.5	12.7[a]
Thallium-208	0.7	AS-B3-S	0 – 0.5	5[a]

[a]Final action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

ft bgs = Feet below ground surface
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive

The DQA process as presented in Appendix C is comprised of the following steps:

- Step 1 – Review DQOs and Sampling Design.
- Step 2 – Conduct a Preliminary Data Review.
- Step 3 – Select the Test.
- Step 4 – Verify the Assumptions.
- Step 5 – Draw Conclusions from the Data.

Sample locations that support the presence and/or extent of contamination at CAU 504 are shown in Appendix A. Based on the results of the DQA presented in Appendix C, the DQO requirements have been met, and the close in place with use restrictions corrective action alternative was selected as the closure alternative for CAU 504 (16a-Tunnel Muckpile). The DQA also determined that information generated during the investigation supports the CSM assumptions, and the data collected support the intended use in the decision-making process.

2.3 Justification for No Further Action

Use restriction with no further corrective action is justified based on an evaluation of risk (see Appendix D) to ensure protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2003a), feasibility, and cost effectiveness. The corrective action was determined from DQO decision statements based on a comparison of the analyte concentrations detected in CAI soil samples to the FALs defined in Section 2.3.1. Because the extent of the COCs is limited and the CAI demonstrated that there is no vertical migration through the Muckpile into the native material below, the corrective action to close in place with administrative controls is justified at CAU 504. Appendix D presents an evaluation of risk associated with the recommended closure alternative.

2.3.1 Final Action Levels

The CAU 504 FALs are risk-based cleanup goals that, if met, will ensure that each release site will not pose an unacceptable risk to human health or the environment under the occasional use exposure scenario, and that the conditions at each site are in compliance with all applicable laws and regulations. The process described in this section to define and determine the FALs conforms to NAC Section 445A.2272 (NAC, 2003b), which lists the requirements for sites with soil contamination. For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2003c) recommends the use of American Society for Testing and Materials (ASTM) Method E 1739-95 to "conduct an evaluation of the site, based on the risk it poses to public

health and the environment, to determine the necessary remediation standards (i.e., FALs) or to establish that corrective action is not necessary."

The ASTM procedure (ASTM, 1995) defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses as follows.

Tier 1 Evaluation – Sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the CAIP). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.

Tier 2 Evaluation – Conducted by calculating Tier 2 SSTLs using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Total TPH concentrations are not used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual hazardous constituents in TPH are compared to their SSTLs.

Alternatively, the Tier 2 risk-based corrective action process SSTLs may be compared to the predicted concentration or activity of the contaminant at the point of exposure based on attenuation from the source using relatively simplistic mathematical models. Points of exposure are defined as those locations at which an individual or population may come in contact with a COC originating from a CAS. If a Tier 2 evaluation is conducted, the calculations used to derive the SSTLs and the contaminant attenuation calculations will be provided as an appendix to the investigation report. If remediation to Tier 2 SSTLs is not practical, a Tier 3 evaluation may be conducted.

Tier 3 Evaluation – A Tier 3 evaluation is conducted by calculating SSTLs on the basis of more sophisticated risk analyses using methodologies described in ASTM Method E 1739-95 that consider site-, pathway-, and receptor-specific parameters. Tier 3 evaluation is much more complex than Tiers 1 and 2, because it may include additional site characterization, probabilistic evaluations, and sophisticated chemical fate/transport models. The Tier 3 SSTLs are then compared to the upper 95 percent confidence limit of the mean of sample results from reasonable points of exposure (as opposed to individual sample results as is done in Tier 2). Contaminant concentrations exceeding Tier 3 SSTLs require corrective action. If a Tier 3 evaluation is conducted, the calculations used to derive the SSTLs and the upper confidence limit of the means will be provided as an appendix to the investigation report.

A Tier 1 evaluation was conducted for all COCs to determine whether contaminant levels satisfy the criteria for regulatory closure with no further action or warrant a more site-specific assessment. This was accomplished by comparing individual source area contaminant concentration results to the Tier 1 actions levels (the PALs established in the CAIP). The Tier 1 PALs were established based on an industrial reuse scenario.

The constituents detected at CAU 504 that exceeded Tier 1 action levels were:

- Arsenic
- Co-60
- Cs-137
- Pu-238
- Pu-239

The concentration of all constituents not listed above, were below Tier 1 action levels and the corresponding PALs were established as the Tier 1 FALs. The constituents that exceeded Tier 1 action levels were moved to a Tier 2 evaluation.

The Tier 2 evaluation of arsenic consisted of calculating the SSTL using site-specific information and physical characteristics of the site into equations which are compliant with the RAGS Part B procedures and were extracted from the RAIS (ORNL, 2005) located online at: http://risk.lsd.ornl.gov/cgi-bin/prg/PRG_search. The SSTL established for arsenic was greater than the maximum reported arsenic concentration so the SSTL became the FAL for arsenic. The Tier 2 calculated FAL is presented in Table 2-13. Additional details of the Tier 2 evaluation are provided in Appendix D.

Table 2-13
Final Action Levels

COPCs	Tier 1 FALs	Tier 2 FALs	Tier 3 FALs
VOCs	PALs	N/A	N/A
SVOCs	PALs	N/A	N/A
RCRA metals	PALs except as listed under Tier 2	Arsenic 242 mg/kg	N/A
TPH-DRO	PALs	N/A	N/A
Radionuclides	PALs except as listed under Tier 2	Co-60 0.8 pCi/g, Cs-137 266 pCi/g, Pu-238 3 pCi/g, Pu-239 18 pCi/g	N/A

COPC = Contaminant of potential concern
Co = Cobalt
Cs = Cesium
DRO = Diesel-range organics
FAL = Final action level
N/A = Not applicable
mg/kg = Milligrams per kilogram
PAL = Preliminary action level
pCi/g = Picocuries per gram
Pu = Plutonium
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

Because reported concentrations of other inorganic and organic constituents did not exceed the PALs, a Tier 2 evaluation was not conducted. The PALs were established as the FALs for those chemical constituents.

The Tier 2 evaluation for the radionuclides was conducted by entering site-specific radionuclide information and physical characteristics of the site into the RESRAD program (Yu et at., 2001) to calculate the site-specific action levels. This calculated the site-specific minimum activities needed to sum to an exposure dose of 25 millirem per year (mrem/yr) to a site receptor. These calculated concentrations were established as the FALs for each radionuclide at the CASs that exceeded a Tier 1 action level. The Tier 2 calculated FALs are presented in Table 2-13. Additional details of the Tier 2 evaluation are provided in Appendix D.

3.0 Recommendations

The data generated by the CAI show that the FALs were exceeded for Co-60, Cs-137, Pu-238, and Pu-239 at CAU 504, 16a-Tunnel Muckpile. Therefore, closure in place with use restrictions is considered the best option for closing this site. This recommendation is based on the fact that even though the FALs were exceeded for Co-60, Cs-137, Pu-238, and Pu-239, this remote, controlled access site poses only limited overall risk to public health and the environment. The future use of CAU 504 will be restricted from any activity unless concurrence is obtained from NDEP. The use restriction and posting described in Appendix E will prevent inadvertent contact with the COCs, and meets all applicable state and federal regulations for closure of the site. Post closure monitoring is not recommended.

In conclusion, DTRA requests that NDEP issue a Notice of Completion for this CAU and approval to move the CAU from Appendix III to Appendix IV of the FFACO.

4.0 References

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Appendix A

Corrective Action Investigation Report for CAU 504: 16a-Tunnel Muckpile, Nevada Test Site

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Executive Summary

The Corrective Action Investigation (CAI) of the 16a-Tunnel Muckpile, identified under the *Federal Facility Agreement and Consent Order* (FFACO, 1996) classification as Corrective Action Unit 504, consists of four corrective action sites (CASs): the Muckpile (16-06-01), the Contaminated Burial Pit (16-23-01), the Contaminated Area (16-23-02), and the Concrete Construction Waste (16-99-01). The four activities completed during the CAI were a drive-over radiological survey, a walk-over radiological survey, rotosonic drilling and soil sampling, and surface soil sampling.

The drive-over and walk-over radiological surveys were conducted to locate areas of radiological contamination above background field screening levels. The drive-over radiological survey, which was conducted on May 22, 2001, covered CASs 16-06-01 and 16-23-01 on the upper and lower benches of the Muckpile. Due to the rough topography downgradient and east of the Muckpile, it was necessary to conduct walk-over radiological surveys of CASs 16-99-01 and 16-23-02 and the drainage channel east of the Muckpile. The walk-over survey of CAS 16-23-02 was extended eastward and down the ravine because it was discovered that the contamination continued farther than anticipated. This resulted in the need to extend the walk-over survey and required the collection of additional soil samples to complete the characterization activity. The walk-over surveys were conducted over four workdays on June 15, 16, and 25 and July 9, 2001.

The next stage of the investigation involved the use of rotosonic drilling to collect soil samples from within and under the Muckpile in CASs 16-06-01 and 16-23-01. This was conducted over 12 work days between June 4 and 16, 2001. During this time, 20 boreholes were drilled into and through the Muckpile to characterize the surface of the Muckpile, the subsurface Muckpile material, and the native material under the Muckpile. A total of 429 feet (ft) were drilled in 20 boreholes ranging from 4.5 to 63.0 ft deep. One to three samples were collected from each borehole. During the rotosonic drilling 44 environmental samples (7 surface samples, 21 subsurface Muckpile samples, and 16 native material samples) were collected. In addition, 26 quality control (QC) samples were collected (3 duplicate samples, 3 matrix spike [MS]/matrix spike duplicates [MSDs], 2 rinsates, 2 field blanks, and 16 trip blanks). Additionally, 3 samples were collected to confirm the quality of the water used for decontamination (1 sample of source water and 2 samples from water storage tanks). All soil and water samples were sent to Paragon Analytics, Inc., to be analyzed for volatile organic compounds (VOCs), semivolatile organic

compounds (SVOCs), total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), total *Resource Conservation and Recovery Act* (RCRA) metals, and radionuclides.

The last stage of the CAI consisted of using hand tools to collect soil samples at CASs 16-99-01 and 16-23-02, east of CAS 16-23-02, and at the three undisturbed background locations around the Muckpile. Surface soil sampling was conducted over 10 work days between June 18 and July 16, 2001. Three undisturbed locations were selected around the Muckpile to obtain representative background native soil samples. Sampling at CAS 16-99-01 consisted of sampling the soil beneath the Concrete Construction Waste and up and downgradient from the Concrete Construction Waste. Sampling at CAS 16-23-02, including the extended area downgradient, consisted of collecting soil samples in 2-inch lifts. Nine locations were selected to characterize the soil beneath the Concrete Construction Waste, and 16 locations were selected to characterize the ravine. Sample depths ranged from the surface to depths of 1.7 ft beneath the Concrete Construction Waste, and 2.5 ft below ground surface in the ravine. One to three samples were collected from each location, depending on field screening results. One sample was collected from 0 to 3 inches deep at each of the three background locations. Eleven environmental samples were collected to characterize the Concrete Construction Waste area, and 21 environmental samples were collected to characterize the Contaminated Area. In addition, 13 QC samples were collected (1 duplicate, 1 MS/MSD, 2 rinsates, 2 field blanks, and 7 trip blanks). All soil and water samples were sent to Paragon Analytics, Inc., to be analyzed for VOCs, SVOCs, TPH-DRO, total RCRA metals, and radionuclides.

Resource Conservation and Recovery Act metals and radionuclides were detected in the background samples. Some VOCs, SVOCs, RCRA metals, radionuclides, and TPH-DRO were detected in soil samples from the surface and subsurface of the Muckpile, the native soil from under the Muckpile, the ravine, and the soil from under the Concrete Construction Waste. None of these contaminants had concentrations that exceeded the regulatory limits. Concentrations of americium-241, cobalt-60, cesium-137, plutonium-238, plutonium-239, and strontium-90 did exceed the *Nevada Test Site Performance Objective for Certification of Nonradioactive Waste* (POC) (BN, 1995) "rad added" values. For waste management purposes, none of the samples had concentrations of RCRA metals that exceeded 20 times the toxicity characteristic leaching procedure RCRA metals maximum contaminant concentration. None of the TPH concentrations exceeded the regulatory limit. Radionuclides exceeded the POC "rad added" values in 46 samples. The contents of the drums associated with these samples were reviewed, and it was determined that all but one of these drums did not contain enough soil for the entire drum to be

considered to have "rad added" in excess of the POC screening levels. The one drum that had the potential for containing enough soil to be considered to have "rad added" was sampled directly and determined to not have enough radioactive constituents to be considered to have "rad added." A full evaluation of the analytical results will be completed in the Corrective Action Decision Document/Closure Report.

During the CAI, 25 drums of investigation-derived waste were accumulated: 12 drums of rinsate, 8 drums of personal protective equipment (PPE), 4 drums of plastic liners, and 1 drum of hydrocarbon-impacted soil. The environmental sample analytical results were used to make the waste determination that none of the drums were considered to contain hazardous waste. The drum of hydrocarbon-impacted soil and one drum of rinsate were sampled directly for radiological constituents and were determined to not contain enough to be considered "rad added." All 8 drums of PPE, 4 drums of plastic, and 12 drums of rinsate were disposed of as sanitary waste, and the drum of hydrocarbon-impacted soil was disposed of at the hydrocarbon landfill.

A.1.0 Introduction

The Corrective Action Investigation (CAI) of the 16a-Tunnel Muckpile was conducted in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (FFACO, 1996) that was agreed to by the U.S. Department of Defense, Defense Special Weapons Agency (predecessor to the Defense Threat Reduction Agency [DTRA]); the U.S. Department of Energy, Nevada Operations Office; and the Nevada Division of Environmental Protection. The investigation was controlled and guided by the Corrective Action Unit (CAU) 504 Corrective Action Investigation Plan (CAIP) (DTRA, 2001a); Field Instruction (DTRA, 2001b), which referenced the operational checklists; and the Site-Specific Health and Safety Plan (SSHASP) (ITLV, 2001). The 16a-Tunnel Muckpile is identified in the FFACO as CAU 504, with four Corrective Action Sites (CASs): the Muckpile (16-06-01), the Contaminated Burial Pit (16-23-01), the Contaminated Area (16-23-02), and the Concrete Construction Waste (16-99-01). The 16a-Tunnel Muckpile is an inactive industrial waste site. This report presents a summary of the field activities and the data collected during the field effort.

Section A.1.0 of this report is the introduction, which includes a description of the purpose and scope of the project. Section A.2.0 is the project description. Section A.3.0 covers the Muckpile investigation and provides a description of the sample collection activities and locations. Section A.4.0 is a summary of the sample analytical results. Section A.5.0 provides a description of the waste management activities. Section A.6.0 covers the health and safety aspects of the project. Section A.7.0 covers the lessons learned during the project, and Section A.8.0 lists the references. Attachments A through C provide copies of the field and laboratory data.

A.1.1 Purpose

The purpose of the 16a-Tunnel CAI was to determine if the 16a-Tunnel Muckpile and/or underlying native soils have been impacted by contaminants of potential concern (COPCs) at concentrations that exceed regulatory limits. The data collected during the field effort, which are presented in this report, enabled DTRA to make informed decisions about the future use and closure of the Muckpile site. The Muckpile consists primarily of mining debris (rock) with minor amounts of cementitious mixtures, miscellaneous construction debris, and re-entry material generated during tunnel excavation and construction in support of weapons effects

testing. Due to the unregulated disposal activities commonly associated with early Muckpile operations, a characterization was conducted to achieve the following goals:

- Determine whether identified contaminants of concern (COCs) (both chemical and radiological) are present within or beneath the Muckpile.
- Provide sufficient information and data to develop appropriate corrective action strategies for the Muckpile and associated sites. These strategies are evaluated in this Corrective Action Decision Document/Closure Report.

A.1.2 Scope of Work

The scope of the 16a-Tunnel Muckpile investigation included the following:

- Conduct radiological surveys using field-screening instruments to locate areas of elevated radiation throughout the CASs.
- Drill boreholes using the dry rotosonic drilling method to collect subsurface environmental soil samples for laboratory analysis.
- Log the drill cores to describe soil characteristics, identify the Muckpile/native material contact, and document the presence or absence of COPCs.
- Conduct field screening for health and safety monitoring and to identify the presence of COPCs.
- Use hand tools to collect near surface environmental soil samples for laboratory analyses

The drilling and sampling locations for dry rotosonic drilling were randomly selected using a stratified random sampling approach as described in Chapter 5 of *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987). Biased locations for surface or near-surface samples were selected based on the results of the drive-over and walk-over radiological surveys.

A.2.0 Project Description

The 16a-Tunnel Muckpile, CAU 504, is located approximately 45 miles north of Mercury in Area 16 of the Nevada Test Site (Figure A.2-1). Corrective Action Unit 504 includes four CASs: 16-06-01 (Muckpile), 16-23-01 (Contaminated Burial Pit), 16-23-02 (Contaminated Area), and 16-99-01 (Concrete Construction Waste) (Figure A.2-2). The 16a-Tunnel was operated intermittently between 1962 and 1971 for nuclear weapons effects and Vela Uniform tests, and from 1975 to 1999 for high explosives tests. The Muckpile is estimated to contain approximately 175,000 cubic yards of mining and re-entry debris. Less than 1 percent of this material is thought to be re-entry debris.

A.2.1 Slope Stability Analysis

Given the site conditions and proposed operating parameters, a slope stability analysis was not prepared for 16a-Tunnel. The decision was made to apply the same work restrictions to the 16a-Tunnel as were used for the N- and T-Tunnel drilling. Those restrictions are that drilling could not be safely conducted within 50 feet (ft) of the edge of the lower bench and 25 ft of the edge of the upper bench. Adopting the N-Tunnel restrictions was a very conservative approach, as extremely conservative assumptions were used for the N-Tunnel calculations and the 16a-Tunnel Muckpile is smaller in area and not as high from the toe to the crest as the N-Tunnel Muckpile.

A.2.2 Surface Radiological Surveys

Before beginning drilling and sampling, drive-over and walk-over radiological surveys were conducted to identify surface and near surface areas with elevated readings (see Figures A.3-1, A.3-2, and A.3-3). The drive-over survey was conducted on the Muckpile, and the walk-over surveys were conducted in the ravines directly south and east of the Muckpile.

A.2.3 Deep Borehole Locations

The borehole locations were identified by coordinates which were randomly selected using a stratified random sampling design (Gilbert, 1987). The drilling locations were limited based on the borehole's proximity to the edge of the Muckpile. Before beginning drilling operations, IT Corporation (IT) scientists used a Trimble Global Positioning System (GPS) total station surveying instrument to locate the boreholes on the Muckpile at the randomly selected coordinates. Locations for 60 boreholes were staked. This included the 15 primary holes and

three alternate locations for every primary location. A list of the primary and alternate borehole locations is provided in Table A.2-1.

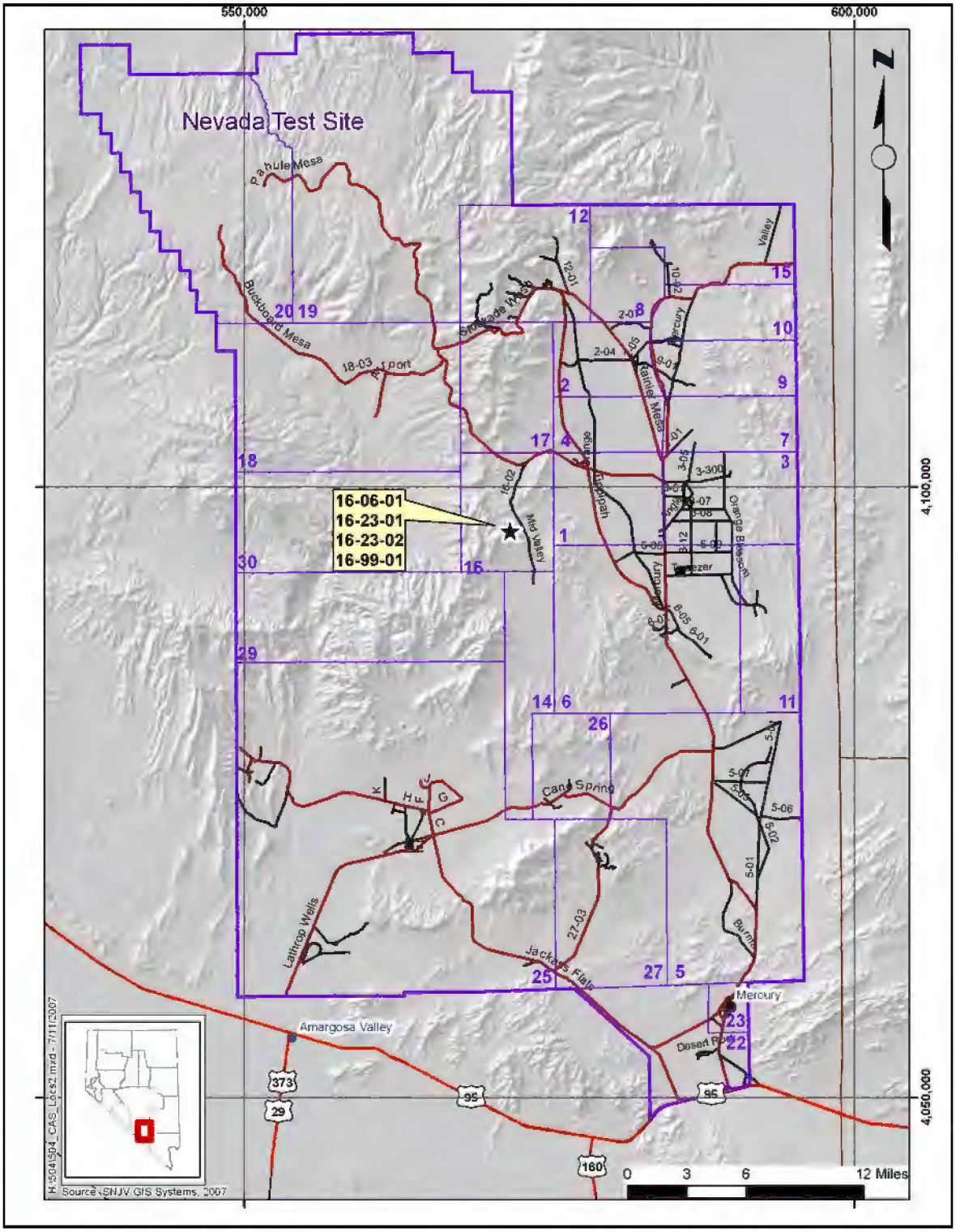


Figure A.2-1
CAU 504, 16a-Tunnel Muckpile Location Map

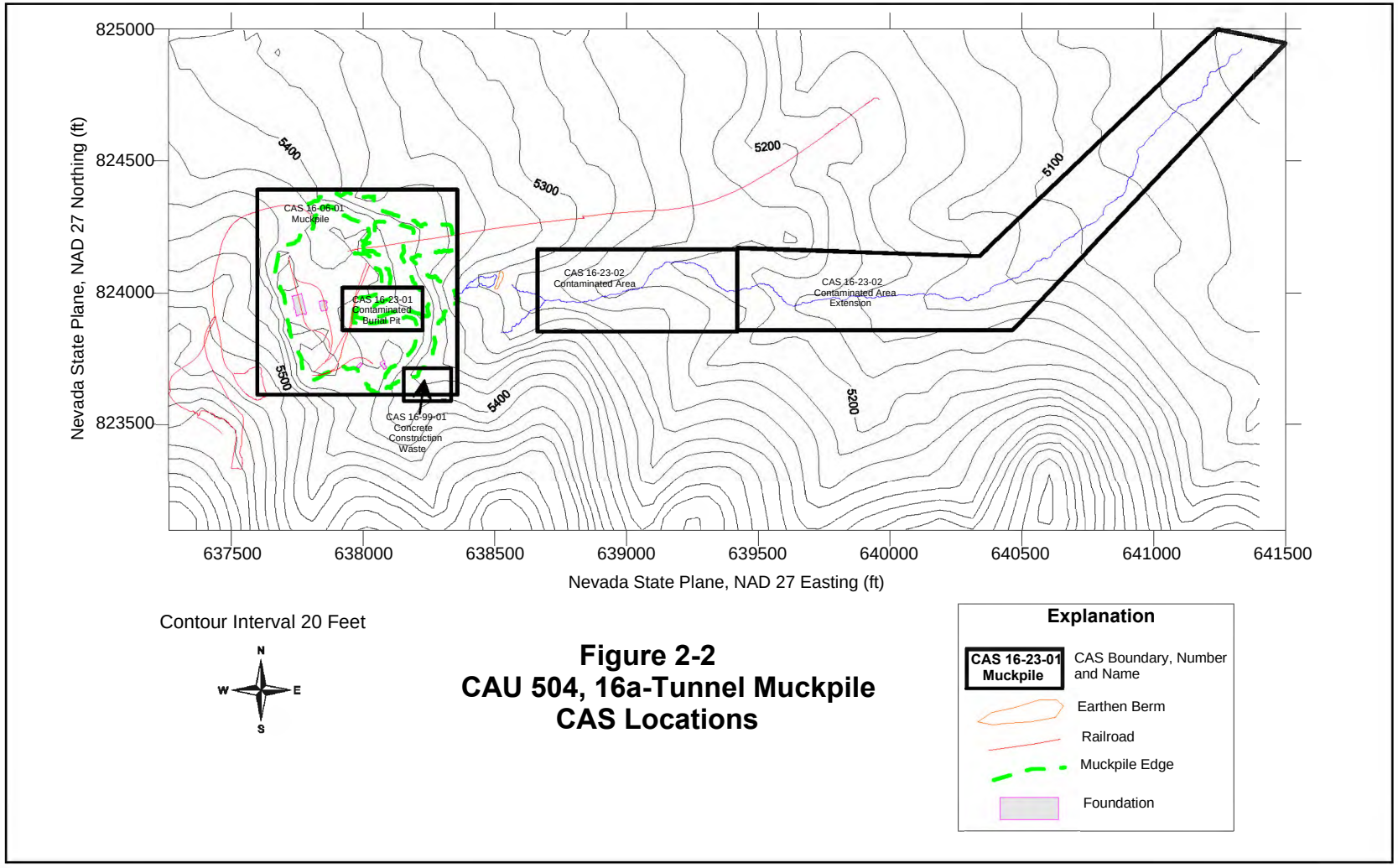


Figure 2-2
CAU 504, 16a-Tunnel Muckpile
CAS Locations

Figure A.2-2
CAU 504, 16a-Tunnel Muckpile CAS Locations

Table A.2-1
Proposed Borehole Locations

Hole #	Northing	Easting	Hole #	Northing	Easting
Primary Locations			**Alternate A Locations**		
1	824,191	638,067	1A	824,188	638,098
2	824,077	638,125	2A	824,027	638,131
3	824,011	638,140	3A	824,019	638,128
4	823,998	638,113	4A	823,978	638,148
5	823,945	638,048	5A	823,921	638,040
6	824,033	637,817	6A	824,113	637853
7	823,909	637,811	7A	823,875	637,830
8	824,066	637,968	8A	824,038	637,968
9	824,090	638,013	9A	824,020	637,987
10	823,856	638,108	10A	823,824	638,015
11	823,859	638,132	11A	823,836	638,070
12	823,836	638,029	12A	823,833	638,110
13	823,765	638,054	13A	823,744	637,991
14	823,770	637,997	14A	823,783	637,982
15	823,742	638,051	15A	823,800	638,082
Alternate B Locations			**Alternate C Locations**		
1B	824,201	638,082	1C	824,190	638,054
2B	824,011	638,126	2C	824,056	638,108
3B	824,170	638,091	3C	824,056	638,135
4B	823,974	638,139	4C	824,001	638,134
5B	823,919	638,033	5C	823,942	638,105
6B	824,089	637,748	6C	824,038	637,828
7B	823,773	637,774	7C	823,749	637,776
8B	824,024	638,025	8C	824,066	638,031
9B	824,080	638,007	9C	824,119	637,992
10B	823,849	638,153	10C	823,845	638,151
11B	823,820	637,973	11C	823,875	638,154
12B	823,830	637,962	12C	823,838	638,126
13B	823,708	637,999	13C	823,768	637,982
14B	823,720	637,962	14C	823,768	637,986
15B	823,737	637,968	15C	823,759	637,965

A.2.4 Shallow Borehole Locations

In addition to the deep boreholes, six shallow borehole locations were identified. These locations were identified after drilling started on the deep boreholes. The locations were picked based on elevated radioactivity readings as measured during the drive-over radiological survey using a dual large-area plastic scintillation (DLAPS) detector. After completion of the drilling, the location of each shallow borehole was surveyed using the Trimble GPS surveying instrument.

A.2.5 Other Sample Locations

After completion of the drilling activities, other soil samples were collected using hand tools. Background samples were collected at biased locations in undisturbed areas outside the Muckpile, and biased and random sample locations were selected for sampling in CASs 16-99-01 and 16-23-01 and in the extension of CAS 16-23-01 down the ravine. The biased samples were selected based on the results of the walk-over surveys, and the random samples were selected using a simple random number generator in the Excel computer program.

A.2.6 Checklists

To increase the efficiency and completeness of the field effort, checklists originally developed for the N-Tunnel work, and revised based on comments and observations from the T-Tunnel field effort and lessons learned, were used at 16a-Tunnel to track each step of the individual field tasks. Table A.2-2 is a list of the checklists that tells when and how often each checklist is to be used. Thirteen checklists were used during the project to ensure all of the required work activities were completed.

Table A.2-2
Checklists
(Page 1 of 2)

Checklist	Purpose	Primary Responsible Person	Frequency
RCT - Initial	Ensure necessary documentation is in place and has been reviewed and signed, and that required monitoring instruments are available and operational. These tasks mitigate the potential for personnel exposure.	Site Radiological Control Technician (RCT)	Once at the beginning of the project
Mobilization	Ensure that the site is ready for the field activities, that all documentation is in place, and that equipment and supplies are available on site.	IT Site Supervisor	Once before mobilization
Drill Rig Safety Inspection	Ensure the drill rig meets all required safety standards to mitigate possible personnel injury resulting from faulty or worn equipment and/or inadequate safety devices.	IT Site Supervisor and/or IT Rig Geologist and IT Site Safety Officer	Once before the start of fieldwork
Health & Safety Pre-Field and Mobilization	Ensure all documents and required forms have been prepared and are available, that all facilities have been notified, that all personnel have the required training and certifications, that all health and safety (H&S) monitoring equipment is available and operational, and that all H&S supplies are available at the site. This will mitigate potential exposures to personnel and reduce the risk of accidents.	IT Site Safety Officer	Once before and once during mobilization to the field
Health and Safety Periodic Inspection	Ensure safety equipment is available and up to date, that all postings are current, and that monitoring results are being disseminated to the workers.	IT Site Safety Officer	Once each week
Health and Safety Daily Inspection	Ensure that equipment is safe and ready for operation.	IT Site Safety Officer	Once each day when equipment is in use
Decontamination (DTRA)	Ensure that all drilling and sampling equipment is properly decontaminated.	DTRA Representative	Once before each borehole
Decontamination (IT)	Ensure adequate decontamination equipment and supplies are available for the day, that decontaminated equipment is properly handled and screened if contamination is encountered, and that the rinsate and any sediment generated is properly handled.	IT Rig Geologist and/or IT Sampler	Once each day that decontamination is done, starting in the morning
Drilling	Ensure the right hole is being drilled, the core is handled properly, equipment is properly decontaminated, and the hole is properly abandoned.	DTRA Representative	Once for each borehole

Table A.2-2
Checklists
(Page 2 of 2)

Checklist	Purpose	Primary Responsible Person	Frequency
Sampling	Ensure all supplies are ready for the day's sampling, that the samples are collected and handled properly, that required quality assurance (QA)/quality control (QC) samples are collected, and that all paperwork is completed correctly.	IT Sampler	Once per day, starting in the morning
Rig Geologist	Ensure the hole is properly field screened and logged, all required information is entered on the borehole log, and that the hole is properly abandoned and marked.	DTRA Representative	Once for each borehole
RCT Daily	Ensure equipment is operational, there is adequate personal protective equipment, and that monitoring information is collected and disseminated as required.	Site RCT	Daily at the beginning of the shift
Quality Assurance/Quality Control	Ensure activities are being conducted and documented in accordance with approved plans and procedures.	IT QA Officer	Random

A.3.0 Muckpile Investigation

The CAI for the 16a-Tunnel Muckpile was conducted over 23 work days between May 22 and July 16, 2001. Work was initially scheduled to be completed on June 16; however, contamination from CAS 16-23-02 extended farther downgradient than originally anticipated, requiring an extended field effort to adequately characterize the extent of the contamination. The drive-over radiological survey was conducted on May 22 and the drillers mobilized to the site on June 4. Drilling commenced on June 5 and continued to June 16 when the drillers demobilized. The initial walk-over radiological survey was conducted on June 15 and 16 with additional surveys being conducted on June 25 and July 9 as the extent of the contamination was followed downgradient from the Muckpile. Soil sampling using hand tools in CASs 16-99-01 and 16-23-02 and in the extension of CAS 16-23-02 started on June 18, 2001. Sampling was completed and the job site was demobilized on July 16. During the project, a delay of 3.5 hours was caused by high winds.

A.3.1 Work Packages

The DTRA is the primary Real Estate/Operations Permit (REOP) holder (REOP Number DTRA-0011-01) and is responsible for safety at the site. Three Work Packages were prepared by IT and approved by DTRA so that the work could be conducted under the DTRA REOP. Work Package IT-16A-07 covered mobilization and demobilization from the site, Work Package IT-16A-01 covered all activities involved in the Muckpile characterization, and Work Package IT-16A-08 covered the waste management activities which continued after the fieldwork was completed. All visitors coming on site had to check in with the Facility Manager Representative, the Site Supervisor (SS), or the Site Safety Officer (SSO) to receive a site-specific health and safety briefing and the Tailgate Safety Briefing (TSB) before being allowed on site.

Before beginning fieldwork, and each time there was a change in the site status or site activities, a Nevada Test Site Operations Schedule form was filled out and sent to the Site Operations Center and the Management and Operating (M&O) Contractor to advise them of the changes.

A.3.2 Surface Radiological Surveys

The drive-over radiological survey was conducted on May 22, 2001 (Figure A.3-1). The initial walk-over radiological survey of CAS 16-23-02 was conducted on June 15 and 16, 2001 (Figure A.3-2). The walk-over surveys of CAS 16-99-01 and the CAS 16-23-02 extension downgradient in the ravine were conducted on June 25 and July 9, 2001 (Figure A.3 3).

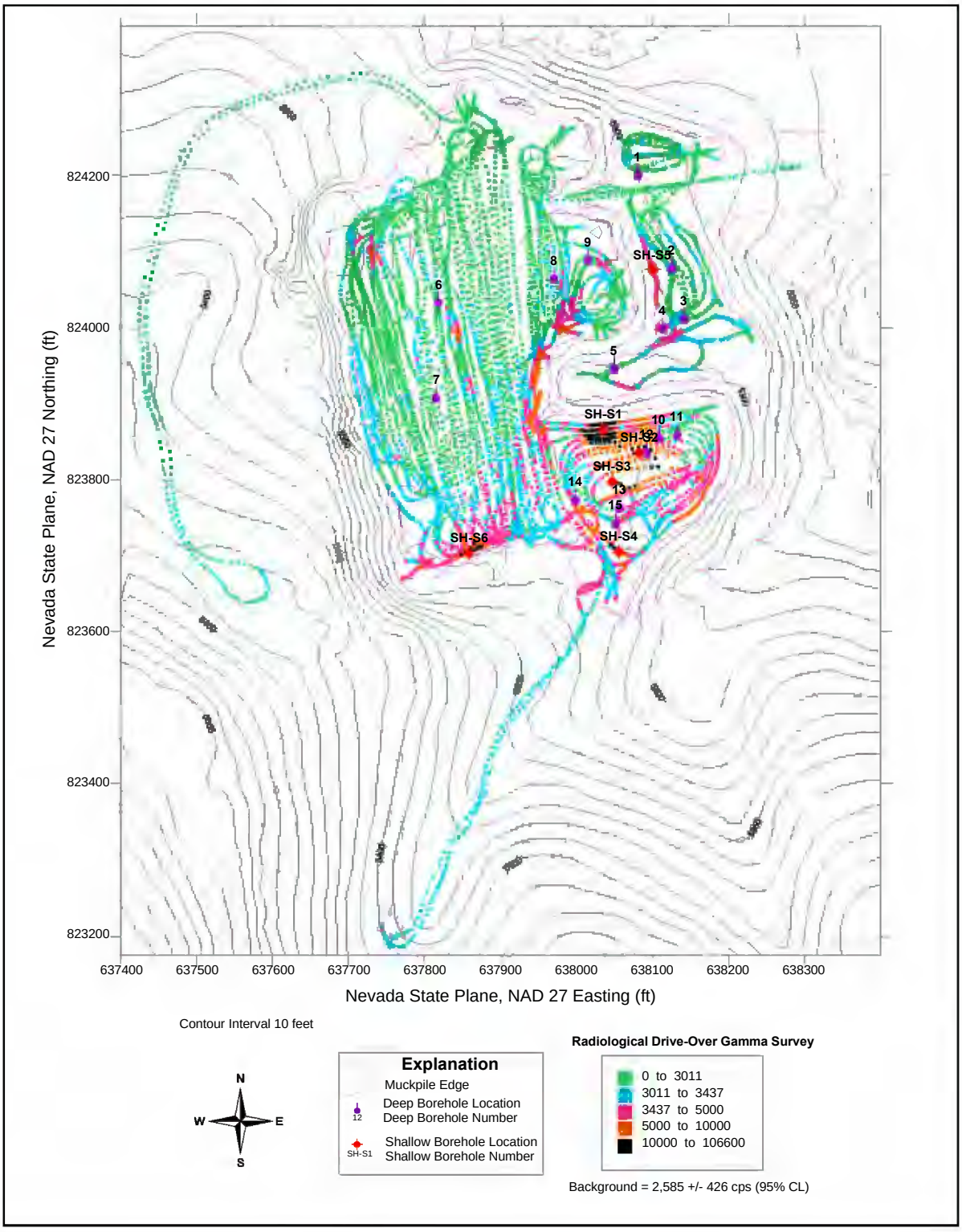


Figure A.3-1
Drive-Over Radiological Survey, CASs 16-06-01 and CAS 16-23-01

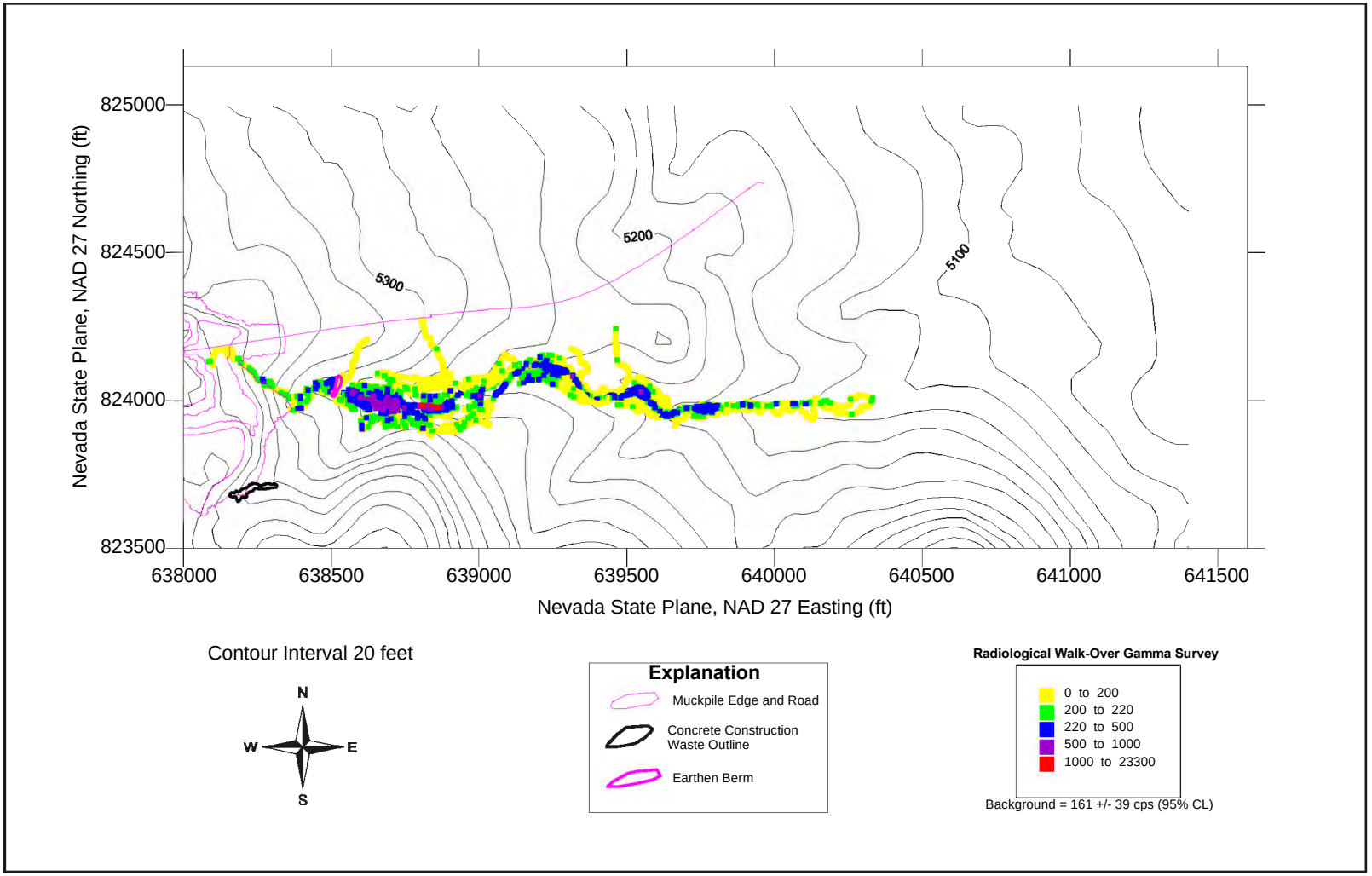


Figure A.3-2
Contaminated Area (CAS 16-23-02) and Extension
Initial Walk-Over Gamma Survey

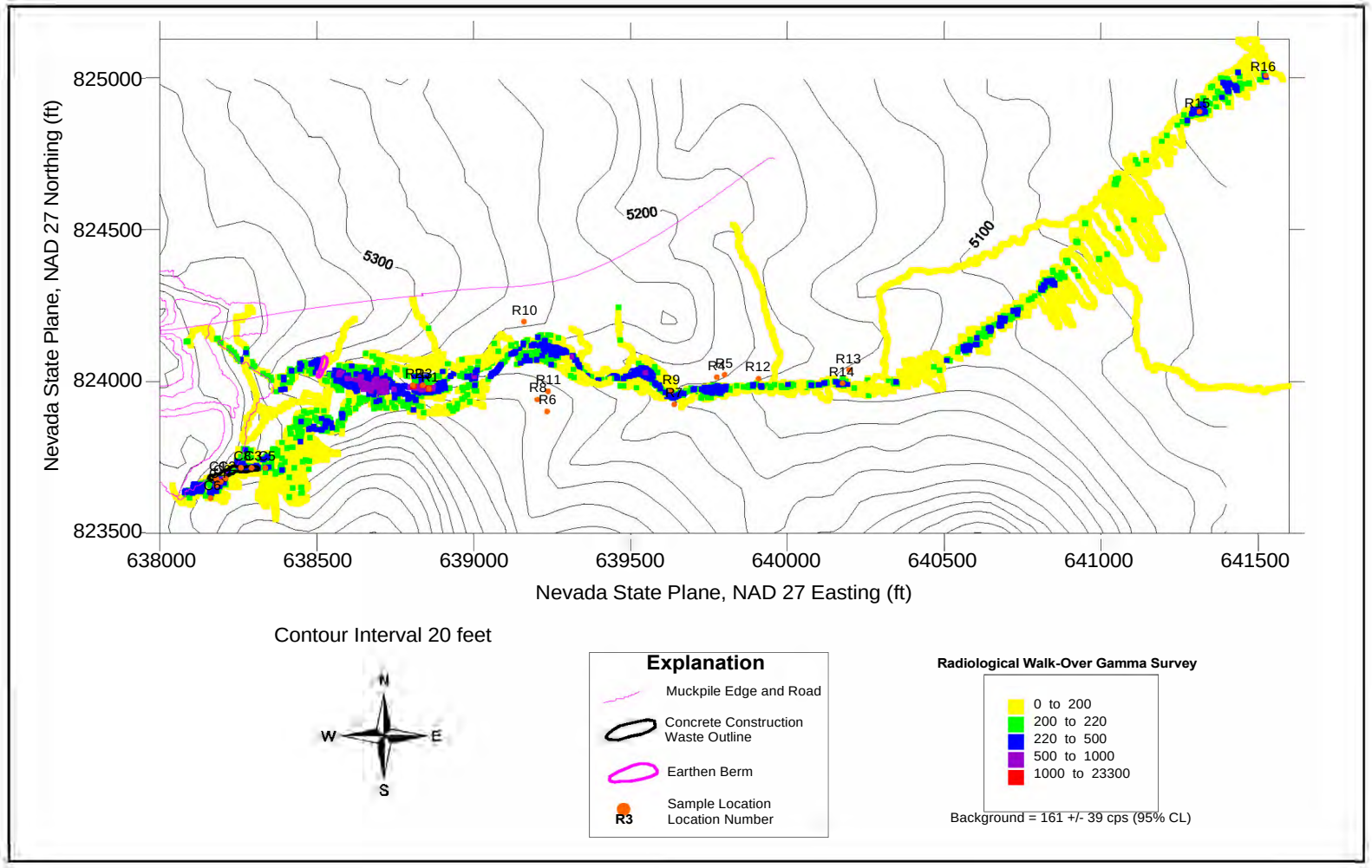


Figure A.3-3
Concrete Construction Waste (CAS 16-99-01), Contaminated Area (CAS 16-23-02), and Extension Walk-Over Gamma Surveys and Sample Locations

The flat surface of the upper and lower benches of the Muckpile allowed CASs 16-06-01 and 16-23-01 to be surveyed using the truck-mounted survey unit. However, CASs 16-23-02 and 16-23-01 and the CAS 16-23-02 extension had to be surveyed with the backpack-mounted instruments due to the rough topography, brush, and boulders. The walk-over surveys covered 165 ft north and 98 ft south of the dry stream bed and downgradient from the Muckpile to Mid Valley Road, a distance of approximately 3,610 ft. The drive-over radiological survey of the Muckpile (CASs 16-06-01 and 16-23-01) was conducted by towing a DLAPS detector Model VRM-3, with a TSA Model SC-755 Controller, and a Trimble Pathfinder Pro XRSTM GPS Receiver with a TSC1TM data logger with a four-wheel-drive vehicle. Each radiological measurement was taken with the DLAPS detector and recorded on a TSC1 data logger and stored with its related GPS location measurement in a combined file. Approximately 5 acres were surveyed, and a total of 8,202 beta/gamma measurements were recorded. The highest beta/gamma measurement detected was at Nevada State Plane coordinates E638,035.04, N823,866.21 at 106,571 counts per second (cps), or approximately 520 picocuries per gram of cesium-137. As a result of the DLAPS survey, 6 locations with the highest detected radioactivity were chosen for the Muckpile surface characterization samples. These sample locations were designated as SH-S1 through SH-S6.

The walk-over radiological survey was conducted by walking over CASs 16-23-02 and 16-99-01 with a small-area plastic scintillation (SAPS) detector Model 8204, with a TSA Model SC-755 Controller, and a Trimble Pathfinder Pro XRSTM GPS Receiver with a TSC1TM data logger. Each radiological measurement was taken with a SAPS detector and recorded on a TSC1 data logger and stored with its related GPS measurement in a combined file. Approximately 4 acres were surveyed, and a total of 14,933 gamma measurements were recorded. The highest gamma measurement detected was at Nevada State Plane coordinates E638,858, N823,977 at 23,300 cps, and is associated with a contaminated rock. As a result of the SAPS survey, 16 locations in CAS 16-99-01 and the extension were chosen to be sampled. These sample locations were designated as CA-01 through CA-16.

A.3.3 Background Native Soil Samples (0.5 ft)

Background soil samples were collected at three locations near the 16a-Tunnel Muckpile (Figure A.3-4). These background sample locations were designated as BA-1, BA-2, and BA-3. The samples were collected from the surface to a depth of 3 inches using decontaminated hand tools and disposable Teflon® scoops. The samples were sent to an off-site laboratory to be analyzed for total *Resource Conservation and Recovery Act* (RCRA) metals and radionuclides.

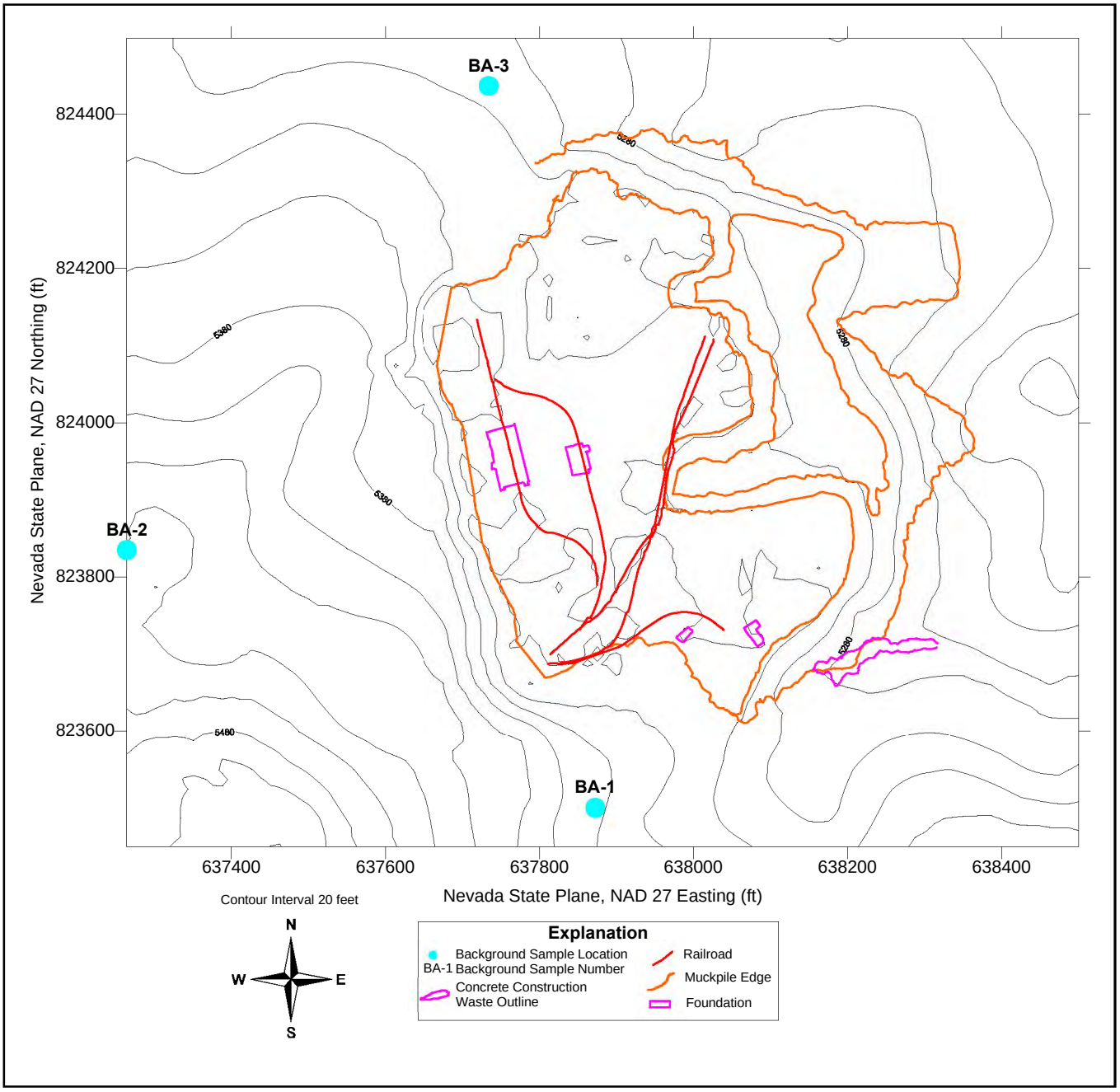


Figure A.3-4
Background Sample Locations

A.3.4 Muckpile Surface Samples (0 to 5 ft); CASs 16-06-01 and 16-23-01

Shallow soil sampling consisted of drilling boreholes 5 ft into the Muckpile using the rotosonic drill rig and collecting a soil sample. A total of 25 ft of rotosonic drilling was completed in five boreholes to characterize the Muckpile surface. The sixth shallow sample location, SH-S4, was hand-sampled to a depth of 1 ft due to its proximity to the edge of the Muckpile. The five shallow boreholes and the hand sample location were selected based on anomalous radiation readings as measured with the DLAPS detector during the drive-over radiological survey (Figure A.3-5). These locations were designated as SH-S1 through SH-S6.

One soil sample was collected from each borehole, although two soil samples were collected from SH-S4 (Table A.3-1). The sample was collected from the section of core with the highest field screening reading or, if there were no field screening hits, the sample was collected near the top of the borehole.

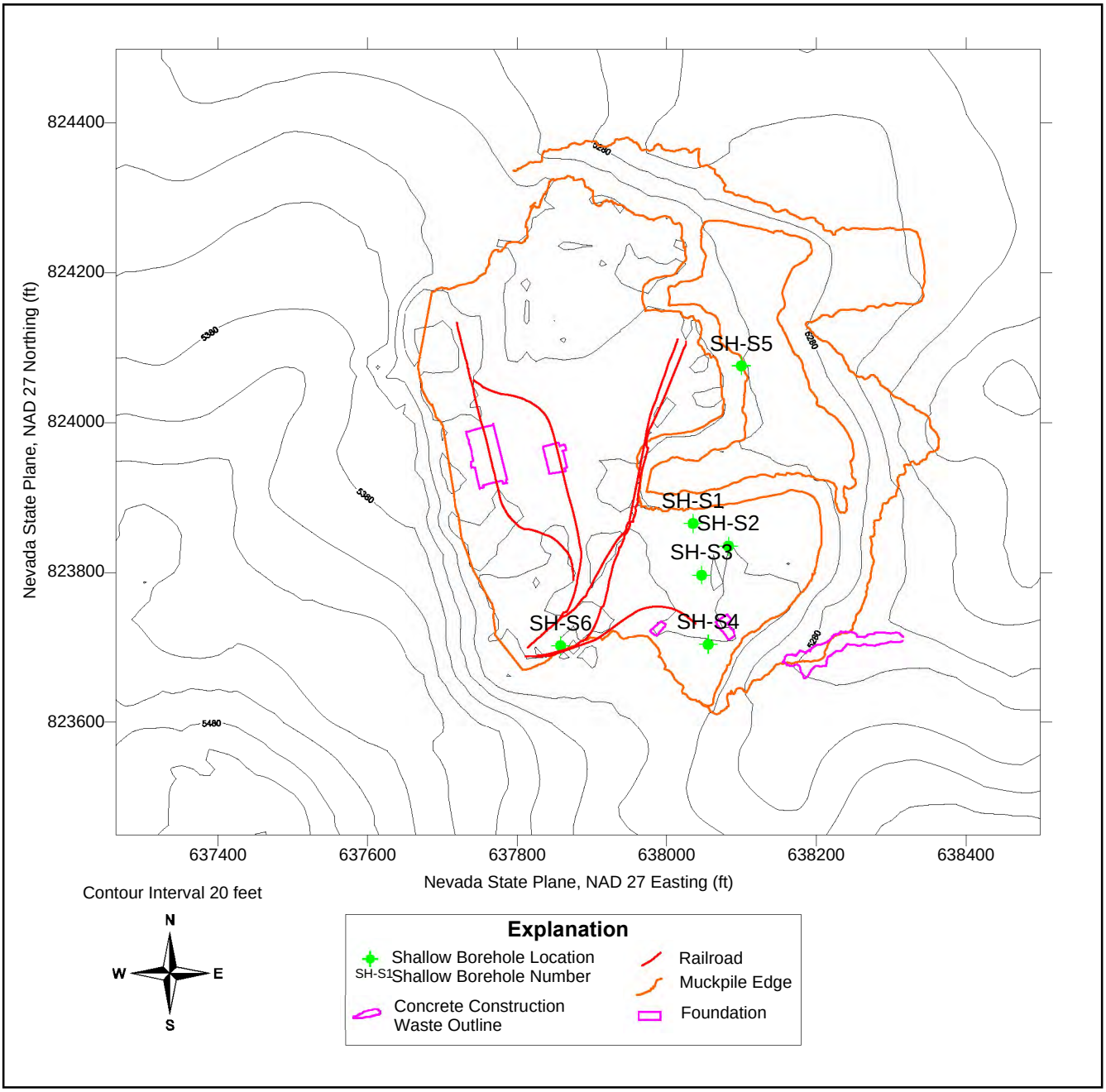


Figure A.3-5
Shallow Borehole Locations

Table A.3-1
As-Built Borehole Locations, Total Depth, and Sampling Depths

Hole #	Northing	Easting	Collar Elevation (ft)	Sample Depth(s) (ft)	Bottom of Muckpile (ft)	Total Depth (ft)/Comments
Deep Boreholes						
BH-1B	824,201	638,081	5383	2, 7.5	5	8 / 1B drilled because 1was not accessible
BH-2	824,076	638,125	5389	1.5, 18.5	16.5	19
BH-3	824,010	638,139	5387	12.5, 23	21	23.5
BH-4	823,998	638,113	5390	7, 18, 20.5	20	22 / bedrock, could not drill deeper
BH-5	823,945	638,048	5390	5.5, 9, 15	10.5	17
BH-6	824,033	637,817	5409	0.5, 4	1	4.5
BH-7	823,908	637,811	5409	0.5, 4	1	4.5
BH-8	824,066	637,968	5410	8.5, 11.5	10	12
BH-9	824,090	638,013	5409	1.5, 13.5	12	14
BH-10	823,856	638,108	5403	14.5, 28.5, 59.5	58	60
BH-11	823,859	638,132	5404	2.5, 41, 55, 58	50.5	58.5 / second native sample collected at 58 ft because of Cs in native sample at 55 ft
BH-12	823,836	638,092	5404	9.5, 14, 62.5	60.5	63
BH-13	823,765	638,054	5406	12, 13, 57.5	54.5	58
BH-14	823,770	637,997	5407	3, 11.5	10	12
BH-15	823,742	638,050	5407	8.5, 27.5	25.5	28
Shallow Boreholes						
S1	823,866	638,035	5404	1	N/A1	5
S2	823,836	638,083	5404	1	N/A	5
S3	823,797	638,047	5407	1	N/A	5
S4	823,705	638,056	5408	0.5, 1	N/A	1.5 / collected with hand tools
S5	824,076	638,100	5389	1	N/A	5
S6	823,703	637,858	5409	1	N/A	5

N/A = Not applicable

A total of seven environmental soil samples were collected to characterize the Muckpile surface. All of the soil samples were sent to an off-site laboratory to be analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons

(TPH)-diesel-range organics (DRO), total RCRA metals, radionuclides, strontium-90, and isotopic plutonium.

A.3.5 Muckpile Subsurface (>5 ft) and Native Soil Samples; CASs 16-06-01 and 16-23-01

Deep soil sampling consisted of drilling boreholes through the Muckpile into the native material underneath using the rotosonic drilling method. If the native material was alluvial in nature, the borehole was advanced 5 ft into the native material. If the native material was bedrock, the borehole was only advanced 2 ft into the native material or until refusal. A total of 403.0 ft of drilling was completed in 15 boreholes to characterize the Muckpile (Figure A.3-6). Soil boring logs are in Attachment A, and cross sections are in Attachment B. These boreholes were designated as BH-01 through BH-15. The boreholes were drilled to depths ranging from 4.5 to 63.0 ft.

Two soil samples were collected from each borehole (Table A.3-1), one at a randomly selected depth (the z-depth) and one from the bottom of the borehole. Additional samples were collected from sections of core where field screening indicated elevated alpha, beta, and/or gamma radiation levels. A total of 21 environmental soil samples were collected to characterize the Muckpile, and 16 environmental soil samples were collected to characterize the native material underneath the Muckpile. All of the soil samples were sent to an off-site laboratory to be analyzed for VOCs, SVOCs, TPH-DRO, total RCRA metals, radionuclides, strontium-90, and isotopic plutonium.

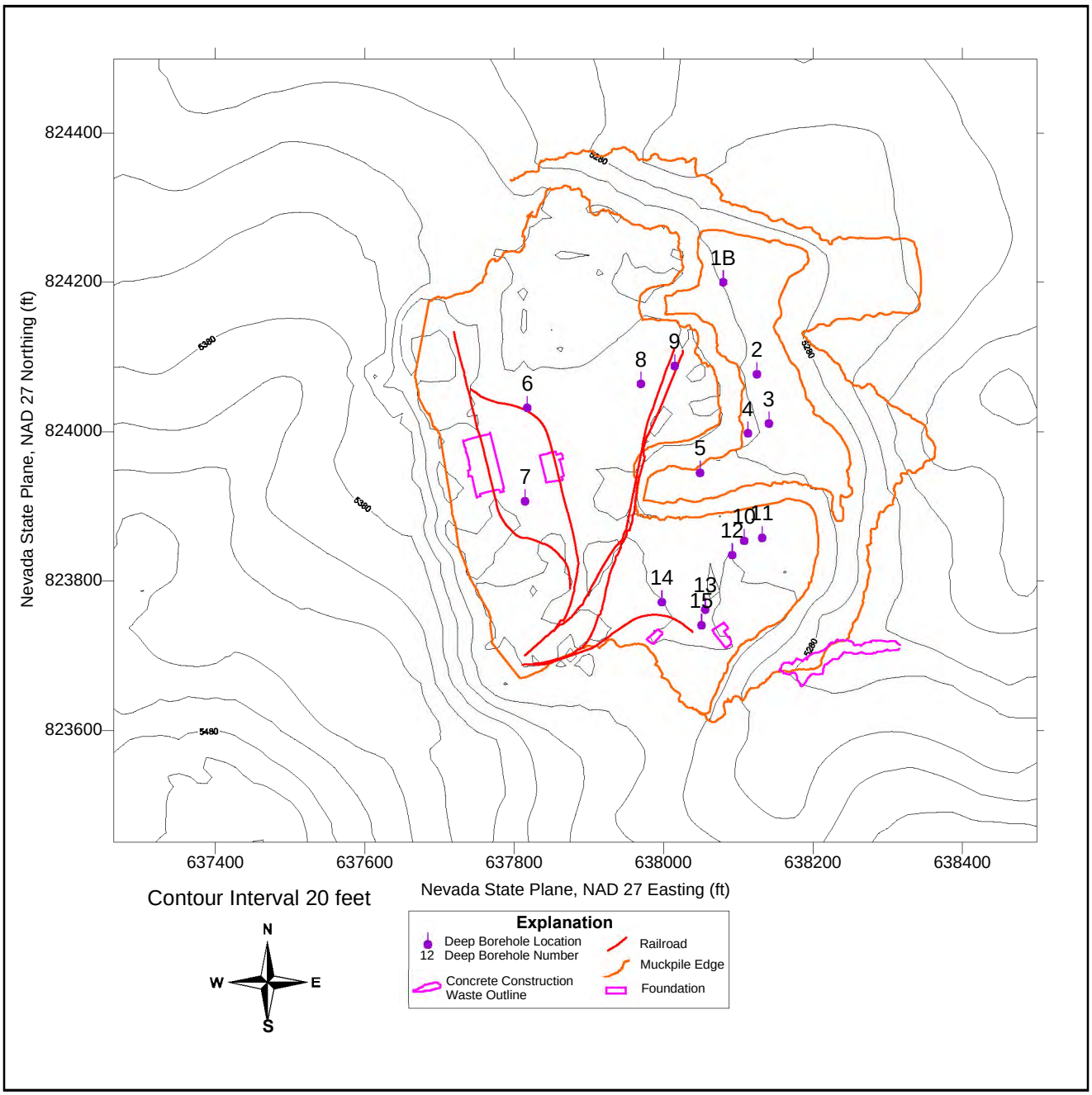


Figure A.3-6
Deep Borehole Locations

A.3.6 Concrete Construction Waste Soil Samples; CAS 16-99-01

The rotosonic drill rig was not used to sample CAS 16-99-01 because the terrain was too rough. A pick and shovel were used to break through the concrete, and a Teflon® scoop was used to collect the soil sample from under the concrete in three locations. In addition, three soil samples were collected upgradient and two soil samples were collected downgradient from the concrete (Figure A.3-7).

The samples were collected in 2-inch lifts starting at the ground surface or the base of the concrete. The samples were field screened with an Electra and an on-site high-purity germanium (HPGe) gamma detector. Sampling continued until a sample was collected that did not exceed the instrument and site-specific field screening level. If the first sample did not exceed the field screening level, it was sent to the laboratory for analysis and sampling was completed at that location. If the sample did exceed the field screening level, another 2-inch lift was collected and screened. This continued until a sample was collected that did not exceed the field screening level. When that occurred, the last, bottom, sample was selected for analysis. Then all of the soil samples collected above this point were composited into a single sample and sent to an off-site laboratory for analysis. The non-composite samples were analyzed for VOCs, SVOCs, TPH-DRO, total RCRA metals, radionuclides, strontium-90, and isotopic plutonium. The composite samples were analyzed for the same analytes, but not for VOCs, since the composite samples were sometimes held overnight while waiting for a deeper, clean sample to be collected from a particular location. Sample depths ranged to a maximum of 20 inches at sample location CW-09. A total of 11 environmental soil samples were collected to characterize the soil under and around the Concrete Construction Waste. Sample locations at the Concrete Construction Waste Area were designated as CW-01 to CW-09.

A.3.7 Contaminated Area Soil Samples; CAS 16-23-02

The rotosonic drill rig was not used to sample CAS 16-23-02 and the extension in the ravine since the terrain was too rough and steep to allow safe access. Decontaminated stainless steel spoons and disposable Teflon® scoops were used to collect both biased and random samples to characterize the area (Figure A.3-8). The biased samples were collected in areas where the walk-over survey results recorded elevated radiological readings. The random samples were selected using a simple random number generator to select northings and eastings within the same boundaries as the walk-over survey (see Figure A.3-3).

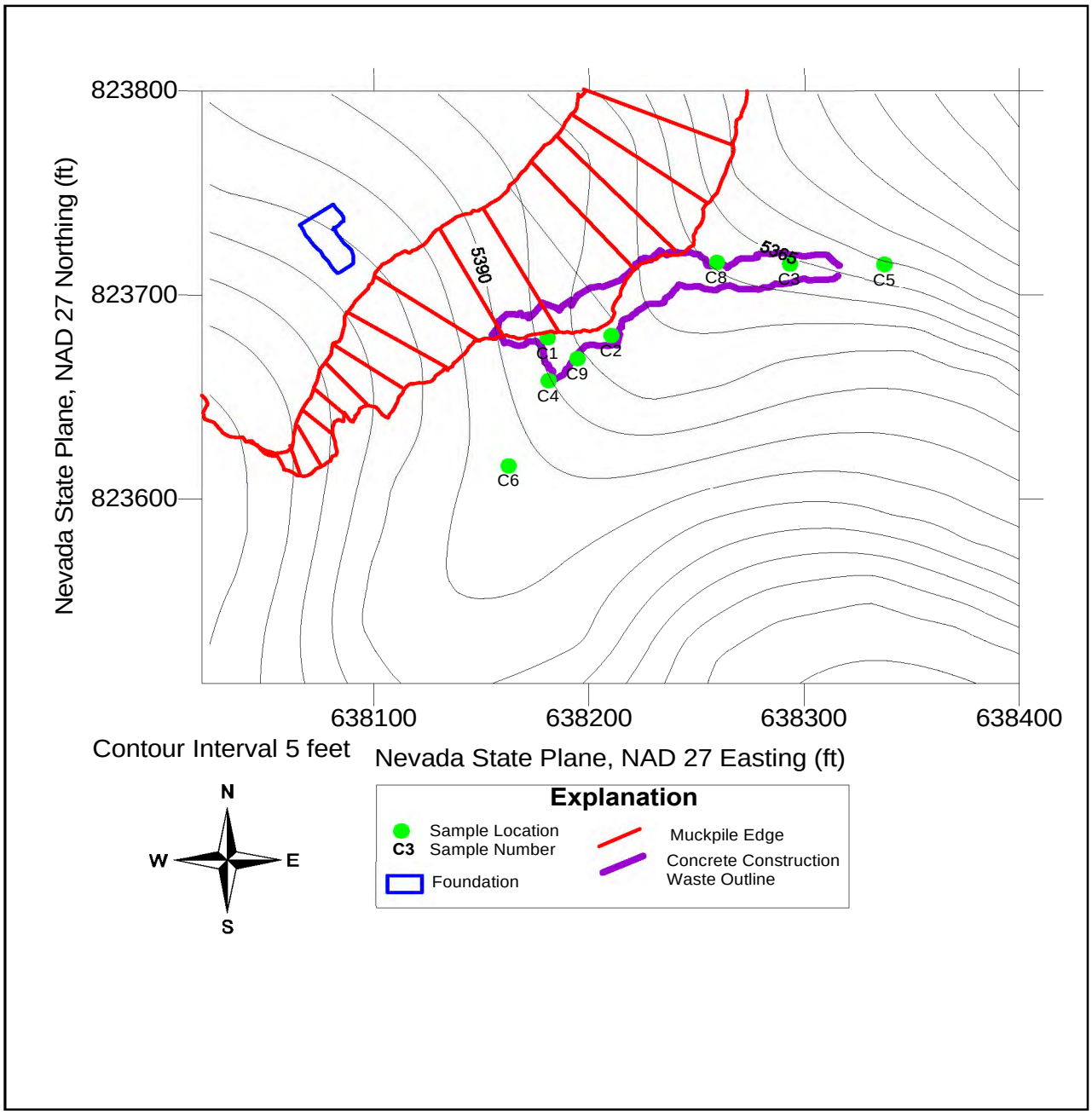


Figure A.3-7
CAS 16-99-01 Soil Sample Locations

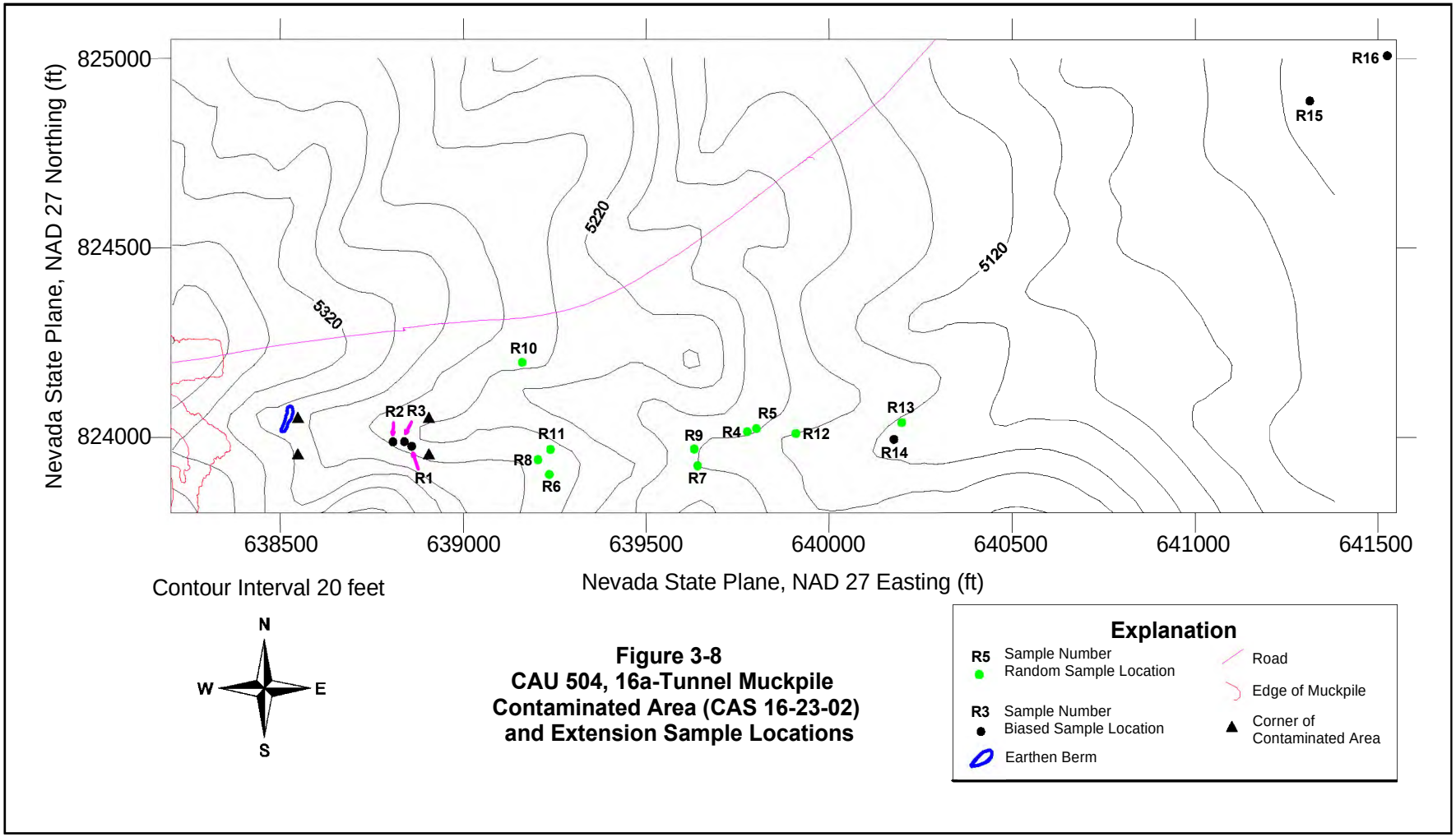


Figure A.3-8
CAS 16-23-02 and Extension Soil Sample Locations

The same strategy used to collect the samples in CAS 16-99-01 was used to collect samples in CAS 16-23-02. The samples were field screened in the same manner and sampling continued until a sample was collected that did not exceed the instrument and site-specific field screening level. Sample depths ranged to a maximum depth of 27 inches at sample location CA-03. A total of 21 environmental soil samples were collected from 16 locations to characterize the soil in the Contaminated Area. Sample locations at this CAS were designated as CA-01 to CA-16. All of the soil samples were sent to an off-site laboratory to be analyzed for VOCs, SVOCs, TPH-DRO, total RCRA metals, radionuclides, strontium-90, and isotopic plutonium. The composite samples were not analyzed for VOCs.

Corrective Action Site 16-23-02 was originally a radiologically posted area measuring 95 by 355 ft, located just downgradient of an earthen berm. However, the results from the walk-over survey determined that the Contaminated Area affected this ravine from the earthen berm down to Mid Valley Road (Figure A.3-8).

A.3.8 Other Sampling

In addition to the environmental samples, 40 quality assurance (QA)/quality control (QC) samples were collected during drilling and surface soil sampling. These QA/QC samples included 4 blind duplicate samples, collected and analyzed to check on the laboratory's precision; 4 matrix spike/matrix spike duplicate samples, collected to check for matrix interference; 4 rinsate samples, collected to check on the effectiveness of the decontamination procedures; 4 field blanks, collected to check on possible environmental interferences; and 24 trip blanks, sent with the VOC samples.

Before beginning fieldwork, a sample of the source water to be used for decontamination was collected from the Area 1 Water Supply well and analyzed. Water was also collected and analyzed from the driller's water truck at the start of drilling, and from the pressure washer water tank before it was used on site. These samples were collected to confirm that water from these sources was not contaminated. Results indicated that there were no COCs present in these sources. All of the QC samples were sent to the off-site laboratory to be analyzed for VOCs, SVOCs, TPH-DRO, total RCRA metals, and radionuclides.

A.4.0 Results

Tables of the analytical results are provided in Attachment C. These tables include only those analytical results where COPCs were detected, even if the detect was qualified as estimated (J qualifier). The complete unedited dataset is maintained in the project files in an electronic format. A detect merely indicates that the parameter was identified in the sample and does not have any reference to action levels or regulatory limits. The analytical results from the investigation are summarized in the following tables. Table A.4-1 is a summary of the detected analytical results in soil for VOCs, SVOCs, TPH-DRO, and total RCRA metals. Table A.4-2 is a summary of the detected analytical results in soil for the radionuclides. An analysis of the data, including comparisons to action levels and regulatory limits, is included in the Corrective Action Decision Document/Closure Report.

Table A.4-1
VOCs, SVOCs, and Total Metals for the 16a-Tunnel Muckpile Investigation
(Page 1 of 3)

	CAU 504		CAS 16-06-01 and CAS 16-23-01						CAS 16-23-02		CAS 16-99-01		All	
	Background Range	No. of detects	Biased Surface Soil Range	No. of detects	Random Subsurface Muckpile Range	No. of detects	Native below the Muckpile Range	No. of detects	Ravine Range	No. of detects	Soil beneath Concrete Construction Debris Range	No. of detects	QA/QC Range	No. of detects
Total No. of Samples Collected		**3**		**7**		**21**		**16**		**21**		**11**		
Volatile Organic Compounds	**µg/kg**		**µg/kg**		**µg/kg**		**µg/kg**		**µg/kg**		**µg/kg**		**mg/L**	
2-butanone	ND	0	ND	0	ND	0	ND	0	23	1	ND	0	ND	0
Acetone	ND	0	ND	0	23-29	2	ND	0	21-250	8	ND	0	8.7-110	10
Acetone (µg/L)													25-50	2
Bromodichloromethane	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	0.9-1.4	6
Bromoform	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	0.53	1
Carbon disulfide	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	12	1
Chloroform	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	1.6-4.5	8
Chloromethane	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	0.68	1
Methylene chloride	ND	0	13-41	4	9.7-45	4	1.9-71	3	4-61	11	1.7-23	7	0.78-43	7
Methylene chloride (µg/L)													2.6-12	2
P-isopropyltoluene	ND	0	ND	0	17	1	ND	0	20	1	ND	0	ND	0
P-isopropyltoluene (µg/L)													3.9-17	2
Styrene	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	1.1-1.4	2
Toluene	ND	0	ND	0	ND	0	1.2	1	2.1-2.9	3	ND	0	ND	0

Table A.4-1
VOCs, SVOCs, and Total Metals for the 16a-Tunnel Muckpile Investigation
(Page 2 of 3)

	CAU 504		CAS 16-06-01 and CAS 16-23-01						CAS 16-23-02		CAS 16-99-01		All	
	Background Range	No. of detects	Biased Surface Soil Range	No. of detects	Random Subsurface Muckpile Range	No. of detects	Native below the Muckpile Range	No. of detects	Ravine Range	No. of detects	Soil beneath Concrete Construction Debris Range	No. of detects	QA/QC Range	No. of detects
Total No. of Samples Collected		**3**		**7**		**21**		**16**		**21**		**11**		
Semivolatile Organic Compounds	**µg/kg**		**µg/kg**		**µg/kg**		**µg/kg**		**µg/kg**		**µg/kg**		**mg/L**	
benzo(A)anthracene	ND	0	39	1	ND	0	ND	0	ND	0	ND	0	ND	0
benzo(B)fluoranthene	ND	0	41	1	ND	0	ND	0	ND	0	ND	0	ND	0
Benzyl alcohol	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	4.3	1
Bis(2-ethylhexyl)phthalate	ND	0	ND	0	120	1	ND	0	71	1	69	1	5.6	1
Phenol	ND	0	ND	0	55	1	ND	0	ND	0	ND	0	ND	0
Trichlorofluoromethane	ND	0	ND	0	ND	0	ND	0	2.2-2.5	2	ND	0	ND	0
Total Petroleum Hydrocarbons	**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**	
Diesel-range organics	ND	0	82	1	1.7-30	4	59	1	1.8-15	6	4.2-8.9	2	1.5-36	3
Metals (total)	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Arsenic	2.9-4.4	3	2.4-4.2	7	2.3-8.4	21	1.9-7.2	16	2.7-77	21	2.3-5.2	11	2.9-4	4
Arsenic (mg/L)													0.0016-0.0054	2
Barium	63-170	3	34-1,000	7	64-4,300	21	30-450	16	92-220	21	90-2,900	11	160-840	4
Barium (mg/L)													0.0055-0.13	4

Table A.4-1
VOCs, SVOCs, and Total Metals for the 16a-Tunnel Muckpile Investigation
(Page 3 of 3)

	CAU 504		CAS 16-06-01 and CAS 16-23-01						CAS 16-23-02		CAS 16-99-01		All	
	Background Range	No. of detects	Biased Surface Soil Range	No. of detects	Random Subsurface Muckpile Range	No. of detects	Native below the Muckpile Range	No. of detects	Ravine Range	No. of detects	Soil beneath Concrete Construction Debris Range	No. of detects	QA/QC Range	No. of detects
Total No. of Samples Collected		**3**		**7**		**21**		**16**		**21**		**11**		
Cadmium	ND	0	0.29	1	0.42	1	ND	0	0.16-0.89	12	ND	0	ND	0
Chromium	3.4-4.7	3	0.47-2	6	0.48-12	21	0.98-210	15	1.3-27	21	0.43-5.6	11	1.7-4.1	4
Chromium (mg/L)													0.0067	1
Lead	10-22	3	6.4-32	7	4.2-31	21	2.4-44	16	6.8-30	21	4-14	11	7.4-19	4
Mercury	0.019-0.033	3	0.052-0.08	5	0.023-0.12	12	0.046	1	0.06-0.2	6	0.032-0.2	8	0.068	1
Selenium	0.22-0.39	2	0.27-0.33	3	0.22-1.3	8	0.23-0.5	6	0.24-5.1	15	0.28	1	0.25-0.59	2
Silver	ND	0	ND	0	1.4	1	0.075-530	7	ND	0	ND	0	ND	0

mg/kg = Milligrams per kilogram
mg/L = Milligrams per liter
ND = Nondetect
QA = Quality assurance
QC = Quality control
µg/kg - Micrograms per kilogram
µg/L = Micrograms per liter

Table A.4-2
Radionuclide Detects for the 16a-Tunnel Muckpile Investigation

	CAU 504		CAS 16-06-01 and CAS 16-23-01						CAS 16-23-02		CAS 16-99-01		All	
	Background Range	No. of detects	Biased Surface Soil Range	No. of detects	Random Subsurface Muckpile Range	No. of detects	Native below the Muckpile Range	No. of detects	Ravine Range	No. of detects	Soil beneath Concrete Construction Debris Range	No. of detects	QA/QC Range	No. of detects
Total No. of Samples Collected		**3**		**7**		**21**		**16**		**22**		**11**		
Radionuclide	**pCi/g**		**pCi/g**		**pCi/g**		**pCi/g**		**pCi/g**		**pCi/g**		**pCi/g**	
Actinium-228	1.69-1.76	2	1.42-2.21	6	0.87-2.08	14	1.26-2.31	16	0.78-2.15	18	1.34-2.64	10	0.85-1.88	4
Americium-241	ND	0	1.48	1	ND	0	ND	0	ND	0	ND	0	ND	0
Bismuth-212	ND	0	ND	0	1.55	1	ND	0	1.27	1	ND	0	1.71	1
Bismuth-214	0.9-1.13	3	1.02	1	0.74-1.01	9	0.55-1.28	14	0.87-1.53	17	0.78-1.09	8	0.85-0.87	2
Cobalt-60	ND	0	0.77	1	1.1-5.3	2	ND	0	ND	0	ND	0	ND	0
Cesium-137	0.65-2	3	0.79-1,320	7	0.5-1770	17	0.83-9.9	2	0.54-112	16	1.17-49	10	0.46-97	4
Potassium-40	27.4-32.9	3	31.2-34.4	7	17-39.4	21	18.2-39.9	16	13.4-34.7	21	25.8-38.8	11	23.3-32.4	4
Lead-212	1.7-2.06	3	1.55-2.28	5	1.15-2.65	15	1.63-2.71	16	0.83-2.78	21	1.52-2.27	11	1.38-1.97	4
Lead-214	0.97-1.24	3	0.88	1	0.81-1.21	10	0.58-1.3	15	0.9-1.65	18	0.84-1.15	10	0.87-0.95	2
Plutonium-238	0.041	1	0.122-2.95	6	0.098-20.2	8	0.071	1	0.041-0.11	5	0.093-0.109	2	0.08-4.47	2
Plutonium-239	0.484-2.02	3	0.444-5.79	6	0.0168-122	14	0.439	1	0.058-20.5	22	0.054-1.15	9	0.435-26.5	2
Strontium-90	ND	0	2.3-117	6	1.11-79	10	ND	0	0.59-5.7	8	1.11	2	1.12-4.12	2
Thorium-234	ND	0	ND	0	2.9	1	2.39	1	ND	0	ND	0	3.4	1
Thallium-208	0.62-0.7	3	0.54-0.86	4	0.324-0.84	12	0.52-0.93	16	0.32-0.69	15	0.53-0.86	10	0.42-0.66	3

ND = Nondetect
pCi/g = Picocuries per gram
QA = Quality assurance
QC = Quality control

A.5.0 Waste Management

Management of the investigation-derived waste (IDW) was guided by the CAIP (DTRA, 2001a) requirements, field observations, and the results of the laboratory analysis of the Muckpile characterization samples. Administrative controls were used to minimize the amount of waste generated during the investigation.

A.5.1 Waste Segregation

The IDW was segregated into solid (personal protective equipment [PPE], plastic liners, soil) and liquid (rinsate) waste streams to limit the amount of potentially contaminated waste. As each exclusion zone was closed the solid IDW was bagged, the bag was sealed with tape, and marked with the associated sample numbers for that exclusion zone; no other waste was put in that bag. The bag was then placed in a lined 55-gallon drum in the hazardous waste accumulation area (HWAA). Liquid waste generated from decontamination activities was pumped into drums and then moved into the HWAA. When the liquid waste was generated and pumped into the drum, the soil borings associated with the decontaminated equipment were recorded in the waste management log book. Each drum is marked with a unique identification number and when the drum was filled, it was sealed with a tamper-indicating device (TID). The type of material in the drum and the date filled were recorded in the waste management log book so that a waste characterization determination could be conducted. This information is retained as hard copy in the project files.

A.5.2 Waste Generation

Waste generated during the fieldwork was either sanitary waste or IDW. The sanitary waste consisted mostly of paper and kitchen debris generated in the field office. This trash was removed from the site on a daily basis by the M&O Contractor. The IDW consisted of rinsates, PPE, used sampling equipment, soil, plastic liners, and plastic sleeves generated during the drilling and sampling efforts. This waste was dealt with as described in the rest of this section. In accordance with the CAIP, the soil cores generated by the drilling were put back in the borehole after sampling was completed so that no soils were containerized as IDW except for a small amount that was generated following a small (less than 5 gallons) diesel spill.

A.5.2.1 Rinsates

Decontamination operations at the main decontamination facility and rig-side portable decontamination tub generated rinsate. The main decontamination facility was a rectangular area lined with a 20 mil Herculine® liner. The pad was sloped to the north. The liner was approximately 50 ft square and was held in place with sandbags. Decontamination activities conducted at the main decontamination facility included decontamination of the drill rig, pipe truck, drill pipe, and hole casing at the beginning and end of the project. The equipment and tools were decontaminated by backing the pipe truck into the decontamination sump and washing everything with high pressure hot water and Alconox®. After being decontaminated, the core barrels were cased in plastic sleeves, and the drill rods and hole casing were covered with plastic to prevent them from getting contaminated before they were used. All rinsate from the decontamination pad was containerized.

After the initial decontamination, all core barrels, bits and drill rods were decontaminated in the portable decontamination tub next to the drill rig. The rinsates generated at the rig-side decontamination unit were from decontamination of the core barrels, drill bits, and the non-disposable sampling equipment (primarily Pyrex® bowls). Once the core barrels, drill bits, and sampling equipment were decontaminated, they were slid into plastic sleeves to protect them from becoming contaminated before their next use. After drilling operations and during surface soil sampling, decontamination of small sampling equipment was completed near the sampling van in buckets. This rinsate was also placed in 55-gallon drums and logged in the waste management log book at the end of each day.

A.5.2.2 Soil

During decontamination of the core barrels and drill bits, a small amount of soil accumulated in the bottom of the decontamination tub. This soil was collected and disposed of in borehole BH-11, which had elevated radiological readings based on the field screening.

Following a spill of approximately 5 gallons of diesel fuel from the pressure washer, 36 gallons of affected soil was containerized in a 55-gallon drum.

A.5.2.3 PPE, Sampling Equipment, and Plastic Sleeves

The PPE generated as IDW in the exclusion zone consisted of the Tyvek® anti-contamination clothing, nitrile gloves, latex surgical gloves, cotton glove liners, rubber boots, tape, and outer

work gloves. These items were containerized as they were removed at the hot line when personnel were exiting the exclusion zone.

Plastic sleeves were used to keep the decontaminated core barrels clean before use and to containerize slough as it was cleaned out of the boreholes. After sampling, the core and slough material was returned to the borehole. The empty sleeves were containerized in a clear plastic bag pending disposal as IDW.

The IDW generated from the sampling equipment consisted of the disposable Teflon® scoops, plastic wrappers, paper label backing, latex gloves, plastic, tape, paper towels, and Kimwipes®. The debris generated inside the exclusion zone was placed in a clear plastic trash bag and labeled with a waste management tracking tag. The date, waste tracking tag number, and associated sample numbers were also written on the bag and it was put in a lined drum in the HWAA.

A.5.2.4 Plastic Liners

Plastic liners were used under the drill rig, the water/pipe truck, and the decontamination tub to prevent hydrocarbon leaks from getting on the ground. To minimize waste generation, each liner was used at several locations unless it was damaged, leaked on, or field screening of the core samples indicated the presence of contamination, in which case the liner was replaced at the completion of the hole.

A.5.3 Waste Accumulation

All IDW was put in U.S. Department of Transportation compliant, 55-gallon, steel drums. For the drums that would receive solid IDW, an absorbent (Stergo®) pad was placed in the bottom and a plastic liner was inserted. After receiving waste, the drums were stored on wooden pallets in a fenced HWAA. The HWAA was lined and bermed in case any of the drums of rinsate leaked. The HWAA was also designated a radiation materials area. The rings for the open-topped 55-gallon drums were provided with drilled bolts to receive either a lock or a TID. Once a drum received waste, it was marked with an identification number and labeled with "Hazardous Waste Pending Analysis" and "Radioactive Material Pending Analysis" stickers and was secured with a TID. A waste management log book was used to track the drums used, the contents of each drum, along with an estimate of how much material was put in the drum. The drums were not filled completely, so the number of gallons for each type of material is an approximation based on the amount of material estimated to have been put in each drum from each waste stream. A drum log spreadsheet was also maintained to help track the waste.

Table A.5-1 provides a tally of the number of drums used, what they contained, and their final disposition.

Table A.5-1
Drum Count

Number of Drums	Volume (Gallons)	Waste Stream	Disposition
12	550	Rinsate	Sanitary Waste
8	311	Personal Protective Equipment (PPE)	Sanitary Waste
4	285[a]	Plastic Liners	Sanitary Waste
1	36	Soil Hydrocarbon	Hydrocarbon Waste
Total Number: 25			

[a]Some of the plastic was disposed of in the PPE drums.

A.5.3.1 Rinsates

Rinsates from decontamination activities were accumulated on a daily basis from the rig-side decontamination unit. Accumulated rinsate was pumped from the rig-side decontamination tub into unlined 55-gallon drums staged next to the decontamination trailer. When a drum was filled (leaving some ullage) it was labeled, sealed with a TID, and moved to the HWAA. If the drum was not full or could not be moved to the HWAA at the end of the day, it was labeled, sealed with a TID, and left inside the exclusion zone for the night.

A.5.3.2 Soil

After the water was removed from the mobile decontamination tub, any remaining solid material was shoveled into a 5-gallon bucket, allowed to dry out, and then disposed of in a known contaminated borehole (BH-11).

The hydrocarbon-impacted soil was not associated with any specific soil samples so it was sampled and analyzed for toxicity characteristic leaching procedure RCRA metals and radionuclides in order to make a waste determination. Based on the results of this sample, the soil was disposed at the hydrocarbon landfill.

A.5.3.3 PPE and Sampling Equipment IDW

The PPE was collected and deposited in a plastic bag at the hot line as personnel exited the exclusion zone. When the exclusion zone was closed, or at the end of the shift, the plastic bag was taped closed and screened for radioactivity before being released. After the bag was

released, a waste tracking tag was prepared to document the contents of the bag. The date, waste tracking tag number, and associated sample numbers were written on the bag. It was then logged into the waste management log book and put in a lined drum in the HWAA.

The disposable sampling equipment was collected in a plastic bag inside the exclusion zone as the sampling was conducted. The IDW was accumulated until the bag was filled, and then it was taped closed. Once the bag was filled, it was handled in the same manner as the PPE.

A.5.3.4 Plastic Liners

When the plastic liners that were placed under the drill rig or the rig-side decontamination unit became ripped or if field screening indicated that contaminated material had been encountered, the liner was placed into a lined drum and moved to the HWAA. When the plastic liners filled a drum, one waste tracking tag was prepared for the entire drum rather than preparing a separate tag for the individual liners.

A.5.4 Waste Characterization

The IDW was considered potentially contaminated waste only by virtue of contact with potentially contaminated media. Therefore, additional sampling and analysis of the IDW, separate from the borehole soil sampling and analysis, was not required. The data generated as a result of the site characterization were used to make waste determinations of the IDW.

The IDW was characterized by identifying the borehole samples associated with each waste container and then comparing the analytical results from those samples to various standards. For the hazardous waste determination, the borehole sample results were compared to the RCRA waste characterization levels for hazardous waste. For total petroleum hydrocarbon wastes, the sample results were compared to the *Nevada Administrative Code* (NAC, 2003) for TPH-DRO determination. For the low-level radioactive waste determination, the sample results were compared to concentrations in soil and water samples taken from background locations in the western and southwestern United States, and to the "rad added" screening levels of the *Nevada Test Site Performance Objective for Certification of Nonradioactive Hazardous Waste* (POC) (BN, 1995).

The hazardous waste determination did not identify any drums that were associated with samples that contained a high enough concentration of hazardous constituents to be considered hazardous. The preliminary radiological waste determination identified one drum that was

associated with samples that were considered to have potential "rad added" in excess of the POC screening levels. As a result samples were collected from that drum and analyzed for radiological constituents. The results of the analyses showed that the drum did not have high enough concentrations of radiological constituents to be considered to have "rad added" in excess of the POC screening levels. In addition to the drum of rinsate, samples were also collected from the drum of hydrocarbon contaminated soil to prove that it was not radiologically contaminated.

A.5.5 Waste Disposal

All of the drums of IDW were disposed of as sanitary waste and the drum of hydrocarbon-impacted soil was disposed of at the Area 6 hydrocarbon landfill.

A.6.0 Health and Safety

At the start of the project, a preliminary hazard assessment was prepared and used to guide the preparation of SSHASP (ITLV, 2001), the Radiation Work Permits, and the CAIP (DTRA, 2001a). The work was then performed in accordance with these documents.

Pre-field health and safety preparation was accomplished using a project-specific health and safety checklist. The checklist was developed to ensure that all required items were verified and/or available before mobilization to the field.

A.6.1 Physical Hazards

The primary physical hazards fell into three general categories: fatigue; heat stress; and slip, trip, and fall. These hazards were the long drive to and from the work site, the general hazards of working around moving machinery, potential heat stress, and the hazards of working on uneven ground and around the slope of the Muckpile.

The hazards associated with fatigue, heat stress, and slip, trip, and fall were dealt with by discussing the long drive, the hazards involved with the machinery, heat stress symptoms, and site specific slip, trip, and fall hazards during the morning TSBs. The length of the work day was limited and workers were observed by the SSO and SS for fatigue and heat stress and were encouraged to drink water. This ensured that workers did not become overly fatigued and could safely drive back to Mercury at the end of the day.

The hazard posed by the slope of the Muckpile was addressed by applying the same restrictions to 16a-Tunnel as were used at N- and T-Tunnels. Those restrictions were to drill no closer than 50 ft from the edge of the lower bench and 25 ft from the edge of the upper bench. These conservative restrictions ensured personnel did not work too close to the edge of the Muckpile and ensured that the vibrations and weight of the rotosonic drill rig would not cause the slope to fail.

A.6.2 Chemical and Radiological Hazards

Chemical hazards believed to be contained within the Muckpile debris included mostly hydrocarbon products, epoxies, and chemical grouts that may have been disposed of on the Muckpile. These products were used for fuels, ground support, and various other applications during mining operations. Radiological hazards were thought to have come from the waste rock deposited on the Muckpile during re-entry mining operations following testing. Before the

regulation of disposal activities on the Muckpile, rock contaminated with low-level radioactivity may have been deposited on the Muckpile (DTRA, 2001a).

Products brought on site to assist with the characterization investigation were required to have a material safety data sheet before receiving approval for use. These items generally consisted of fuels, lubricants, cooling, and cleaning agents.

Action levels for the chemical constituents and radiological hazards were posted on the TSB form as noted in the SSHASP. All intrusive work required that real-time monitoring be conducted and the results documented in the Daily Safety Reports.

Based on field screening results, no concentrations above the established action limits were encountered that posed an occupational threat to personnel during the drilling and sampling operations.

A.6.3 Drilling

An equipment inspection of the Boart-Longyear drill rig was performed by IT personnel upon its arrival on site and before any drilling activity. This inspection was documented on the Drill Rig Inspection form as described in the Field Instruction (DTRA, 2001b). All safety devices were present and operational.

The rotosonic drill rig was operated safely and reliably throughout the project. The drilling team from Boart-Longyear was well skilled and worked both efficiently and safely.

A.6.4 Noise

During rotosonic drilling operations personnel exposure to noise is always a concern. Noise-level monitoring was conducted before startup and during actual drilling, with a sound level meter set on the "A" scale with a slow response. Measurements indicated that average noise levels of 85 to 110 decibels were common within 35 ft of the drill rig. With this knowledge, all personnel working or observing operations within this distance were required to wear hearing protection. Personnel were also diligent in watching out for one another to make certain that hearing protection was available and in use before equipment startup.

A.6.5 Air Monitoring

A Photovac 2020 photoionization detector was used for real-time air monitoring for VOCs during all intrusive work. The 2020 measures concentrations of photoionizable gases and

records the values. It cannot distinguish between individual pollutants, it merely lets the operator know that something is present. During drilling activities at the 16a-Tunnel Muckpile, the 2020 was used to measure concentrations in a worker's breathing zone. All concentrations logged during field activities were well below the established action level of one part per million sustained in the breathing zone.

In addition to the VOC monitoring, radiation monitoring was conducted daily through high volume air sampling. One air sample was collected in the exclusion zone side of the sample van and another sample was collected in the clean side of the sample van. These samples were collected by continuously drawing air through the two filters during work hours. Once work ceased for the day the filters were removed and counted on a Ludlum Model 2929 alpha/beta scaler. The results were discussed at the next morning's TSB. No airborne radioactive particles were detected in the high volume air sample filters during field activities.

A.6.6 Personnel Monitoring

At the beginning of the fieldwork all personnel turned in a bioassay sample to be archived by the laboratory. In the event of a possible radiological uptake, this sample would be used as a baseline to be compared to future samples. All personnel were required to wear a thermal luminescent dosimeter while working at the Muckpile.

In addition all personnel working in the exclusion zone for more than eight hours were required to wear a breathing zone apparatus (BZA) to monitor for possible inhalation uptake. Individual BZAs were set up by the Radiological Control Technician (RCT) on a daily basis to be worn by personnel who worked in the exclusion zone for eight hours or more. The filters from the BZAs were analyzed by the M&O Contractor0 RCT daily. Results of the monitoring showed that the individuals working in the exclusion zone had no exposure to airborne radioactive contaminants. The results were discussed in general at the daily TSB.

A.6.7 Impacts/Delays/Incidents

Weather delays impacted the project on one occasion. Work was delayed for 3.5 hours on June 13 due to high winds. During this time, the sustained wind speed was approximately 20 miles per hour (mph), with gusts to 37 mph.

An additional delay of approximately four hours occurred when the drillers' pressure washer broke down. Drilling was stopped until a backup unit could be brought to the site.

A.6.8 Training

Before assignment, all necessary training documentation for specific tasks was reviewed and verified as to current status. By verifying all documentation before personnel arrived on site, delays to track down missing or incomplete training documentation were minimized.

Training requirements for this project were outlined in the SSHASP and included 40-hour Hazardous Waste Operations and Emergency Response, annual 8-hour refresher, medical surveillance with respirator qualification, and Radiological Worker II. Additional training for specific personnel included 8-hour supervisory training, first aid and cardiopulmonary resuscitation, blood-borne pathogens training, classroom and field waste management training, and training and fit testing for respirator use.

A.7.0 Lessons Learned

On June 16, 2001, the same day that the drilling was completed, the first lessons learned meeting was held in order to get input from the drillers before they demobilized from the site. A second lessons learned meeting was held on July 3, 2001, at the completion of the surface soil sampling. This second meeting was not attended by the drill crew. Eleven people, representing five companies and one federal agency, attended the first meeting and 12 people, representing two companies and two federal agencies, attended the second meeting. The purpose of the meetings was to identify those practices that were done well and should be continued, and to generate improvements on those practices that need to be improved for the next DTRA muckpile characterization project. The results of the lessons learned meetings are summarized in the next two sections, a "did well" section (Section A.7.1) and a "do better" section (Section A.7.2).

A.7.1 Did Well

The following is a listing of the areas that everyone agreed were done well.

A.7.1.1 Drilling

- Having the drilling and sampling locations pre-located with the GPS was helpful.
- The dry run was useful for getting everyone up to speed on what their responsibilities were.
- The confirmation of the contacts and z-depths between the rig geologist, the sampler, and the SS worked very well.
- Casing the holes provided a better sample than having an open hole.

A.7.1.2 Field Activities

- The makeshift plastic bag glove box worked very well for dealing with contaminated samples.
- The computer-generated sample collection logs and sample bottle labels worked well.
- The RCT and Health and Safety support were very good.
- Having the drive-over gamma surveys done before the drilling allowed selection of the biased sample locations before the beginning of the drilling.

- The option of working under the Radiological Work Permit (RWP) or not depending on existing conditions and the graded approach to work under the RWP were good.

- Having the gamma spectrometer on site to do the field screening helped guide the field effort and helped with shipping information on holes where the radiation readings were elevated.

- The downgradable PPE helped limit the impacts of the heat.

- The field projects need to start earlier in the year so that heat is not an issue.

- Waste management was done well and spills were handled efficiently.

- The bioassay program ran smoothly this year.

A.7.1.3 Communications

- The TSB in conjunction with the facility manager representative's pre-shift briefing worked very well for distributing information and saved time in getting the daily activities started.

- Setting up the intercom in the sample van made verifying the contacts and z-depths much easier.

A.7.2 Do Better

The following is a list of the areas where things need to be changed or improved.

A.7.2.1 Checklists

- Need to be better at completing the checklists; they need to be completed before the task is started.

- A walk-down of the individual checklists needs to be done at the dry run so that they can be completed properly once the fieldwork starts.

- Copies of the appropriate checklists need to be provided to the drillers so that they can become familiar with what is expected of them before they come on site.

A.7.2.2 Drilling

- The first day the drillers are on site needs to be a setup day to be sure everything is ready to go and everyone knows what the process is for conducting the drilling before drilling actually starts. May want to have the dry run on this day at the first hole, then have a lessons learned meeting to review the procedure and make sure everything is in order before the drilling continues.

- Drillers need to use a tag line when moving the drill pipe with the pipe truck crane, especially if they are moving more than one piece of pipe in one lift.

- There needs to be a three-person drill crew in order to get the decontamination and pipe handling done in a timely manner. Work can be accomplished with a two-man crew for a short time (two to three days maximum) but if more than that, the job will be halted until a third crew member can be brought in.

- A backup pressure washer is needed on site to prevent delays in the event of a breakdown.

- Rig geologist needs to be more familiar with the area before drilling starts.

- Need better depth estimates, if possible.

- Need to have a rack or wire cage to put in the decontamination tub for decontaminating the smaller sampling equipment.

- The pressure washer needs to have a wand with adjustable pressure for cleaning the different equipment.

- Stainless-steel bowls would work as well as Pyrex® and there is not the breakage problem.

- Having an experienced person in the exclusion zone for the beginning of the project to get things running smoothly would help for consistency in projects and save time in the project start up.

- The hours the drillers work need to be adjusted so that the sampling crew can finish their work without pushing the 15-hour limit everyday.

- Reassess the exclusion zone boundaries for future jobs. If they can be located so that more than one hole can be drilled before moving the exclusion zone the work will go faster.

- The rig geologist needs to be familiar with environmental work and sampling so that he can help with sample preparation and packing at the end of the day.

- The rig geologist needs to be brought in earlier so there will be time to get up to speed and become familiar with the site and expected tasks.

A.7.2.3 Health and Safety

- A ventilation system for the interior of the sample van where the sample table is located would be good.

A.7.2.4 Field Activities

- Work packages need to be completed earlier so they can be approved earlier for site access.
- There needs to be more time for site setup before the drillers arrive on site, two to three days to be sure all equipment and supplies are on site and that the computers are up and running.
- Need a bigger table for the computers and the office work and need a bigger office.
- Need an area separate from the office for the crew lunch and break tables.
- The walk-over surveys need to be completed more in advance of the surface soil sampling so that the sampling strategy can be completed before the crew is in the field.
- Completing the drive-over earlier would also help.
- Waterproof breathable coveralls/rain gear would be good for the decontaminating activity.
- Plan the fieldwork kickoff meeting for 1300 on the first day and then mobilize to the site the next day for start of the fieldwork.
- The HPGe needs to be cooled with liquid nitrogen; the electrically cooled unit is not suitable for the remote field locations because of the potential for power loss.
- The time estimate for completing the fieldwork needs to have more contingency put in to account for the possibility of encountering contamination.
- Power to the back of the sample van would be a help for keeping instruments charged and running additional lighting.

A.7.2.5 Communications

- The on-site communications needed to be checked before the beginning of the fieldwork; the radios provided did not work on site.

A.7.2.6 Management/Attitude

- The guidance documents need to be reviewed more carefully as there were some inconsistencies in the CAIP in hole locations and the number of samples.

A.8.0 References

BN, see Bechtel Nevada.

Bechtel Nevada. 1995. *Nevada Test Site Performance Objective for Certification of Nonhazardous Waste,* Revision 0. North Las Vegas, NV.

DTRA, see Defense Threat Reduction Agency.

Defense Threat Reduction Agency. 2001a. *Corrective Action Investigation Plan for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site,* Revision 0. Prepared by IT Corporation. North Las Vegas, NV.

Defense Threat Reduction Agency. 2001b. *Field Instruction for CAU 504: Area 16 16a-Tunnel Muckpile Characterization,* Revision 0. Prepared by IT Corporation. North Las Vegas, NV.

FFACO, see *Federal Facility Agreement and Consent Order.*

Federal Facility Agreement and Consent Order. 1996. Agreed to by the Nevada Division of Environmental Protection, the U.S. Department of Energy, and the U.S. Department of Defense. Las Vegas, NV.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Reinhold. New York, NY.

ITLV, see IT Corporation, Las Vegas.

IT Corporation, Las Vegas. 2001. *ITLV Site-Specific Health and Safety Plan for DTRA, 16a-Tunnel Muckpile Characterization, Area 16, Nevada Test Site,* Revision 0. North Las Vegas, NV.

NAC, see *Nevada Administrative Code*.

Nevada Administrative Code. 2003. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV.

SNJV GIS Systems, see Stoller-Navarro Joint Venture Geographic Information Systems.

Stoller-Navarro Joint Venture Geographic Information Systems. 2007. ESRI Arc GIS Software.

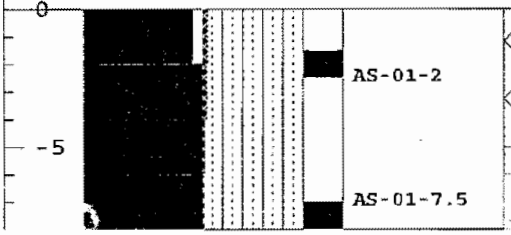
Attachment A

Soil Boring Logs

(25 Pages)

Project Name: CAU 504 (16a-Tunnel Muckpile)	**Date Started:** 6/13/01
Project Number: 799421.0105.0015	**Date Completed:** 6/13/01
Borehole Number: BH-01	**Elevation:** 5383 ft
Logged By: Robert Nabors	**Northing:** 824,201
Drilled By: Boart-Longyear	**Easting:** 638,081
Drilling Method: RotoSonic	**Total Depth:** 8.0 ft

Notes: Contact @ 5 ft. Samples AS-01-2 and AS-01-7.5.



Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0				AS-01-2		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry to slightly moist.	1.1		300
							5.5		300
-5				AS-01-7.5		Native: Silty sand as above, slightly moist. Organic fragments.	14.2		300
							12.8	10.8	3,287
						Native: Red, tuff, dry			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-02
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/14/01
Date Completed: 6/14/01
Elevation: 5389 ft
Northing: 824,076
Easting: 638,125
Total Depth: 19.0 ft

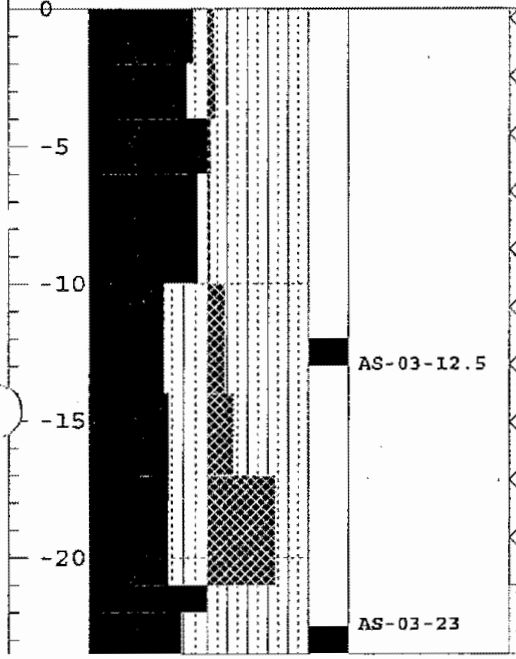
Notes: Contact at 16.5 ft. Samples AS-02-1.5 and AS-02-18.5.

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0				AS-02-1.5		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry.	3.9	5.7	1,473
							3.2		300
-5							5.1		200
							2.7		300
-10							1.0		200
-15							2.0		200
				AS-02-18.5		Native: Silty sand, organics, dry.	1.6	11.4	1,324
						Native: Bedrock, red tuff, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-03
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/14/01
Date Completed: 6/14/01
Elevation: 5387 ft
Northing: 824,010
Easting: 638,139
Total Depth: 23.5 ft

Notes: Contact @ 21.0 ft. Samples AS-03-12.5 and AS-03-23.

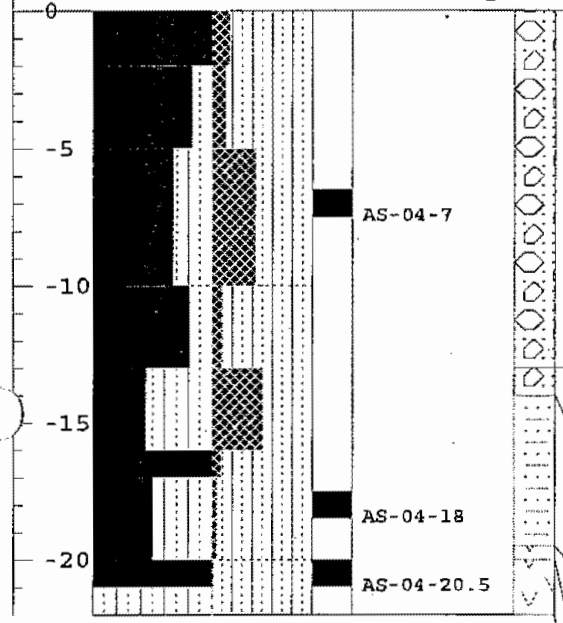


Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
						Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry. Occasional electrical wire fragments.	5.4		500
							2.0		400
							8.5		500
							1.8		400
							1.9		300
				AS-03-12.5			1.1	34.3	1,648
							2.9		500
							1.7		400
							2.1		300
				AS-03-23		Native: Bedrock, red tuff, dry, very hard.	19.1	0.0	1,523

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-04
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/15/01
Date Completed: 6/15/01
Elevation: 5389 ft
Northing: 823,998
Easting: 638,112.8
Total Depth: 22.0 ft

Notes: Contact @ 20.0 ft. Samples AS-04-7, AS-04-18, AS-04-20.5.

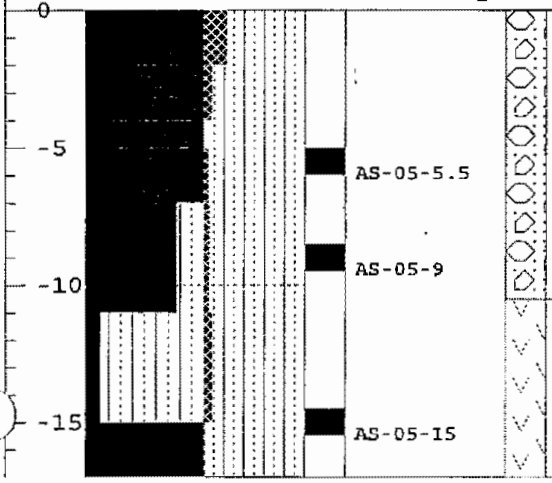


Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry.	1.8		800
-5							1.4		500
				AS-04-7			4.7	17.1	4,361
-10							1.4		350
						Muck: Boulder.			
-15						Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry.	1.5		500
							2.3		400
				AS-04-18			0.5	34.3	2,040
-20				AS-04-20.5		Native: Organics.	1.2	17.1	1,462
						Native: Bedrock, red tuff, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-05
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/15/01
Date Completed: 6/15/01
Elevation: 5390 ft
Northing: 823,945
Easting: 638,048
Total Depth: 17.0 ft

Notes: Contact @ 10.5 ft. Samples AS-05-5.5, AS-05-9, AS-05-15..



Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to cobbble sized tuff fragments, unconsolidated, slightly moist. Occasional electrical wire framents.	2.4		200
							0.5		200
-5							3.6		700
				AS-05-5.5			1.5	11.4	2,435
				AS-05-9			3.4	34.3	1,841
-10						Native: Bedrock, weathered tuff, slightly moist.			
							1.6	17.1	1,454
-15				AS-05-15			3.3	17.1	1,454

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-06
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/5/01
Date Completed: 6/5/01
Elevation: 5409 ft
Northing: 824,033
Easting: 637,817
Total Depth: 4.5 ft

Notes: Contact @ 1.0 ft. Samples AS-06-0.5, AS-06-4.

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0				AS-06-0.5		Muck: Silty sand with gravel to cobble sized tuff fragments, unconsolidated, dry.	1.2	16.1	3,384
				AS-06-4			1.4		
							2.9	32.3	3,463
						Native: Bedrock, red tuff, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-07
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

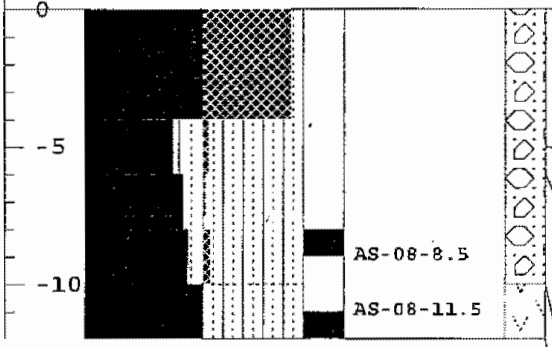
Date Started: 6/6/01
Date Completed: 6/6/01
Elevation: 5409 ft
Northing: 823,908
Easting: 637,811
Total Depth: 4.5 ft

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
Notes: Contact @ 1.0 ft. Samples AS-07-0.5, and AS-07-4.									
0				AS-07-0.5		Muck: Silty sand with gravel to cobble sized tuff fragments, unconsolidated, dry.	3.9	43.0	3,408
				AS-07-4			2.5 1.2	37.6	3,852
						Native: 1 to 2 ft: Bedrock, weathered red tuff, unconsolidated, moist.			
						Native: 2 to 4.5 ft: Bedrock, red tuff, consolidated, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-08
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/6/01
Date Completed: 6/6/01
Elevation: 5410 ft
Northing: 824,066
Easting: 637,968
Total Depth: 12.0 ft

Notes: Contact @ 10.0 ft. Samples AS-08-8.5, and AS-08-11.5.



Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry.	0.9		
-5						Muck: Boulder, tuff.	3.4		
							4.2		
-10				AS-08-8.5		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry.	3.0	26.9	3,158
				AS-08-11.5			3.2	21.5	3,533
						Native: Bedrock, gray tuff, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-09
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/7/01
Date Completed: 6/7/01
Elevation: 5409 ft
Northing: 824,090
Easting: 638,013
Total Depth: 14.0 ft

Notes: Contact @ 12.0 ft. Samples AS-09-1.5, and AS-09-13.5.

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0				AS-09-1.5		Muck: Silty sand with angular gravel to cobble sized tuff fragments, unconsolidated, dry. Minor organics from 1 to 3 ft.	1.1	21.5	3,167
-5							4.2		
-10							6.2		
				AS-09-13.5		Native: Bedrock, red tuff, dry.	18.7	37.6	3,421

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-10
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/7/01
Date Completed: 6/8/01
Elevation: 5403 ft
Northing: 823,856
Easting: 638,108
Total Depth: 60.0 ft

Notes: Contact @ 58 ft. Samples AS-10-14.5, AS-10-28.5, AS-10-59.5.

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to cobble sized tuff fragments and occasional tuff boulders, dry to slightly moist.	0.0		
							0.0		
-5							0.1		
							0.1		
-10							0.2		
							0.2	21.5	11,800
-15				AS-10-14.5					
							0.2		8,000
-20							0.2		9,000
							0.7		1,500
							0.2		1,500
-25							0.3		
							0.0	0.0	12,900
-30				AS-10-28.5					
							0.5		5,000
							0.0		5,000
							0.2		
-35							1.0		6,700
							0.0		750
									750
-40							0.1		
							1.0		
-45							0.3		
							0.3		
-50							0.1		

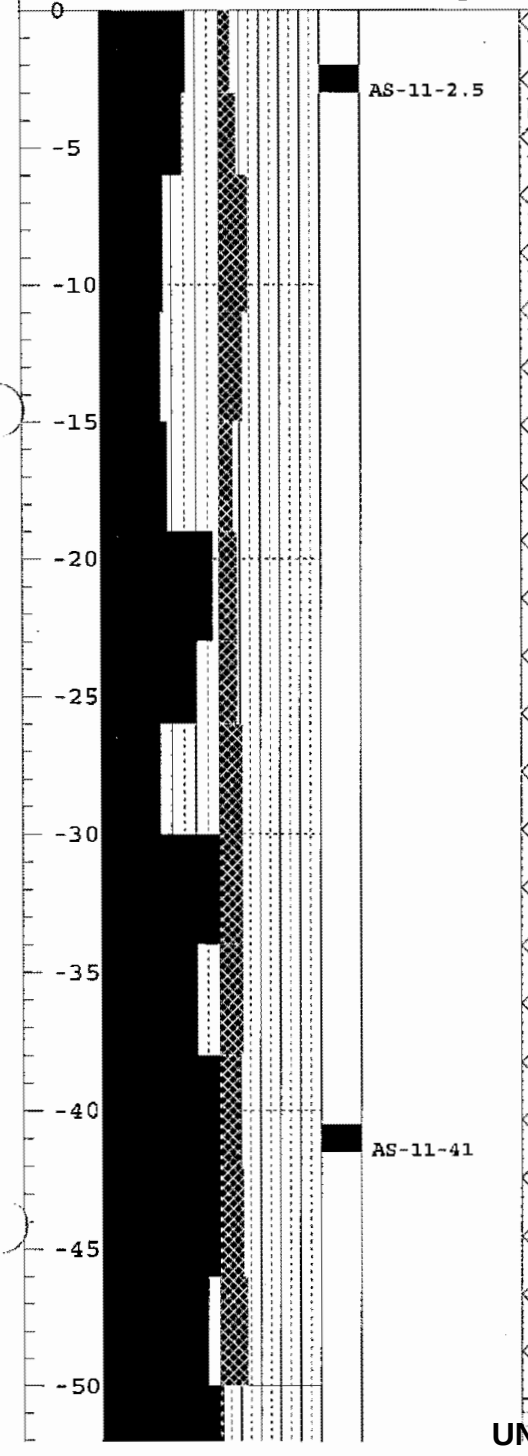
Borehole Number: BH-10

Depth	% Recovery 0-100	Drilling Rate ft/min 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
-55							0.4		
							0.3		
-60				AS-10-59.5		Native: Bedrock, red tuff, dry.	0.7	26.9	4,125

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-11
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/8/01
Date Completed: 6/9/01
Elevation: 5404 ft
Northing: 823,859
Easting: 638,132
Total Depth: 58.5 ft

Notes: Contact@50.5 ft. Samples AS-11-2.5, AS-11-41, AS-11-55, AS-11-58



Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0				AS-11-2.5		Muck: Silty sand with gravel to boulder sized tuff fragments, mottled, minor white mineralization, occasional man-made wood and electrical wire fragments, unconsolidated, dry to slightly moist.	0.4	26.9	3,546
-5							0.2		75
-10							0.0		200
-15							0.2		100
-20							0.0		100
-25							0.2		4,000
-30							0.1		5,000
-35							0.0		1,200
-40				AS-11-41			0.4		1,500
-45							0.2		11,000
-50							0.4		4,500
							0.2		26,000
							0.0	70.0	147,000
							0.0		8,000
							0.0		41,000
							0.0		3,500
							0.4		5,000
						Native: Silty sand with			

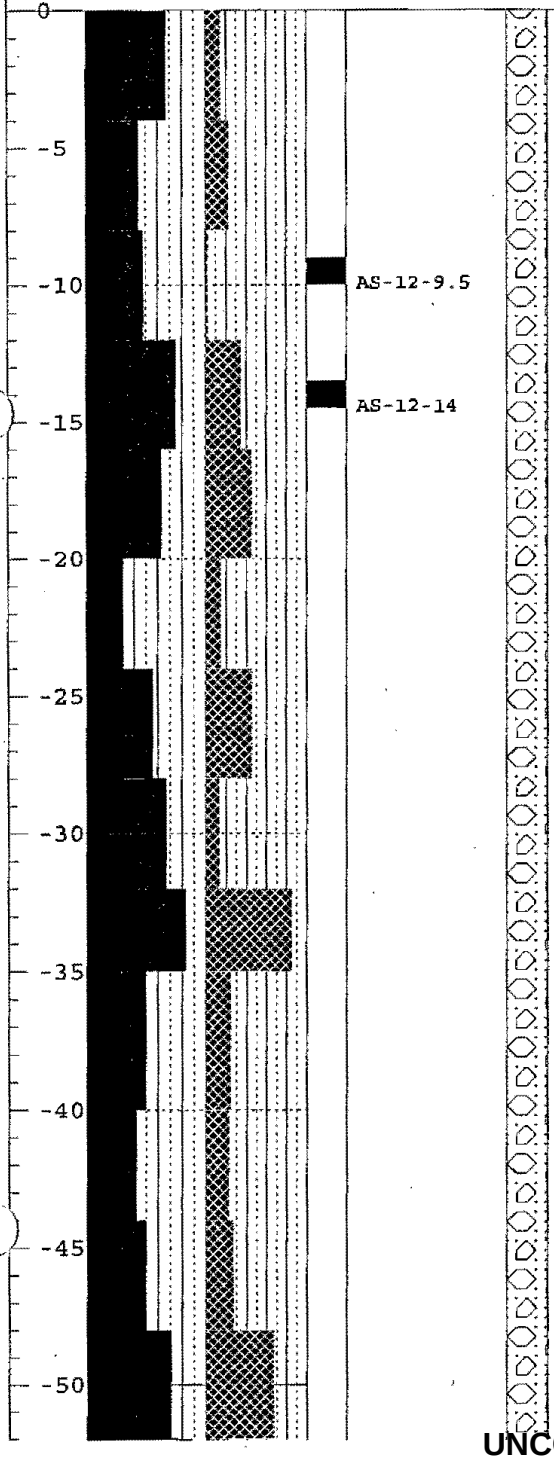
Borehole Number: BH-11

Depth	% Recovery 0-100	Drilling Rate ft/min 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	Field Screening Results VOCs (ppm)	Alpha (dpm)	Beta (dpm)
						gravel, organics, moist.	0.8		350
-55				AS-11-55		Native: Bedrock, weathered red tuff, silty sand with gravel to cobble sized fragments, slightly moist.	0.4		200
							0.9	16.1	4,528
				AS-11-58			4.2	10.8	3,996
						Native: Bedrock, red tuff, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-12
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/12/01
Date Completed: 6/12/01
Elevation: 5404 ft
Northing: 823,836
Easting: 638,092
Total Depth: 63.0 ft

Notes: Contact @ 60.5 ft. Samples AS-12-9.5, AS-12-14, AS-12-62.5.



Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry to slightly moist.	1.8		450
-5							4.3		4,000 1,500
-10				AS-12-9.5			1.3	21.5	3,847
-15				AS-12-14			3.3	0.0	10,800
-20							3.5		1,500
-25							1.1		4,500
-30							4.4		600
-35							3.4		750
-40							3.4		750
-45							5.7		800
-50							2.0		600
							1.3		450
							3.5		350
							3.6		350

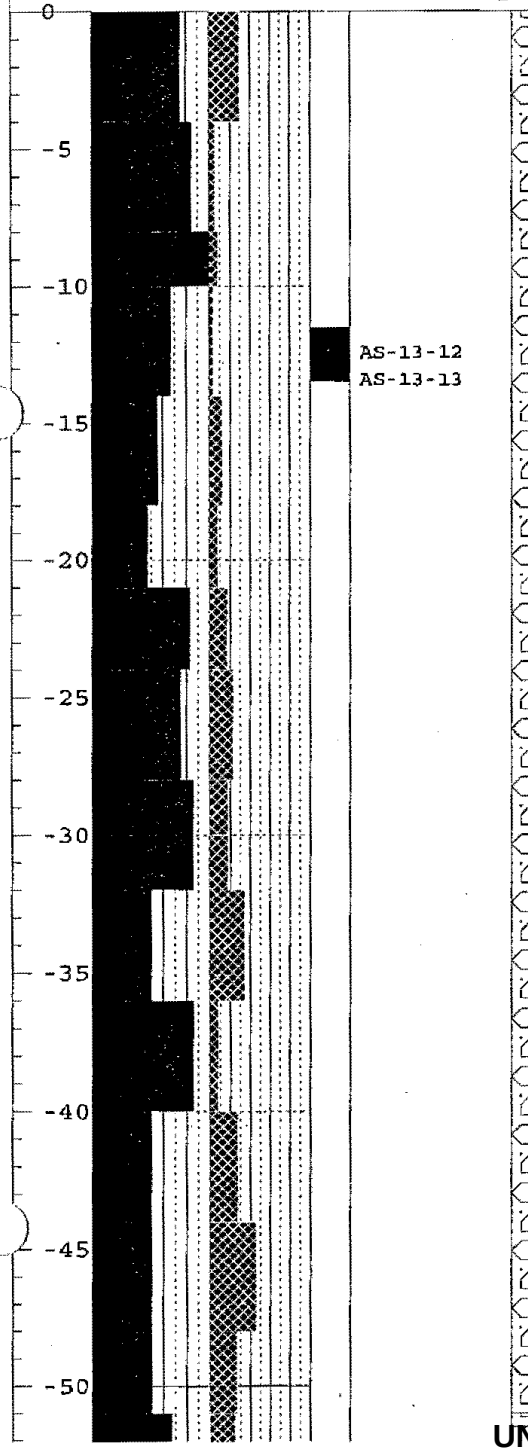
Borehole Number: BH-12

Depth	% Recovery 0-100	Drilling Rate ft/min 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
-55							6.2		450
							1.1		450
-60				AS-12-62.5		Native: Bedrock, tuff, dry.	7.7	21.5	3,778

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-13
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/10/01
Date Completed: 6/11/01
Elevation: 5406 ft
Northing: 823,765.2
Easting: 638,054.3
Total Depth: 58.0 ft

Notes: Contact @ 54.5 ft. Samples AS-13-12, AS-13-13, AS-13-57.5



Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to boulder sized tuff fragments, with minor electrical wire fragments, unconsolidated, dry.	0.9		400
							3.6		500
									1,500
							0.8		5,000
				AS-13-12			2.2	32.3	32,300
				AS-13-13					14,500
							1.8		600
									8,000
							2.2		1,000
							3.2		600
							0.7		200
							4.1		200
							4.1		200
							2.4		0
							11.4		0
							8.1		300
							3.8		300
							9.5		100

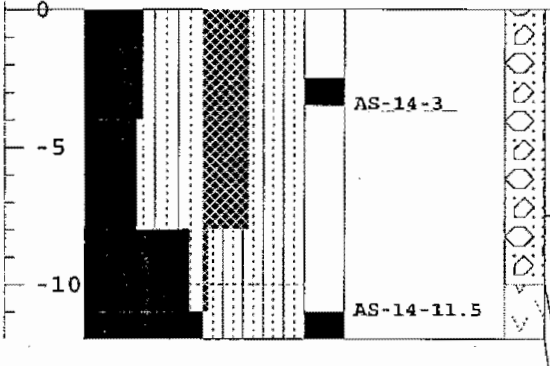
Borehole Number: BH-13

Depth	% Recovery 0-100	Drilling Rate ft/min 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
-55				AS-13-57.5		Muck: 51.0 to 51.5 ft: Silty sand as described above, wet. Perched water zone.	3.1		100
						Muck: 51.5 to 54.5 ft: Silty sand as described above, moist.	6.7		200
						Native: 54.5 to 57.5 ft: Bedrock, zeolitized tuff, weathered, moist.			
						Native: 57.5 to 58.0 ft: Bedrock, zeolitized tuff, weathered, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-14
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/12/01
Date Completed: 6/12/01
Elevation: 5407 ft
Northing: 823,770
Easting: 637,997
Total Depth: 12.0 ft

Notes: Contact @ 10 ft. Samples AS-14-3 and AS-14-11.5.

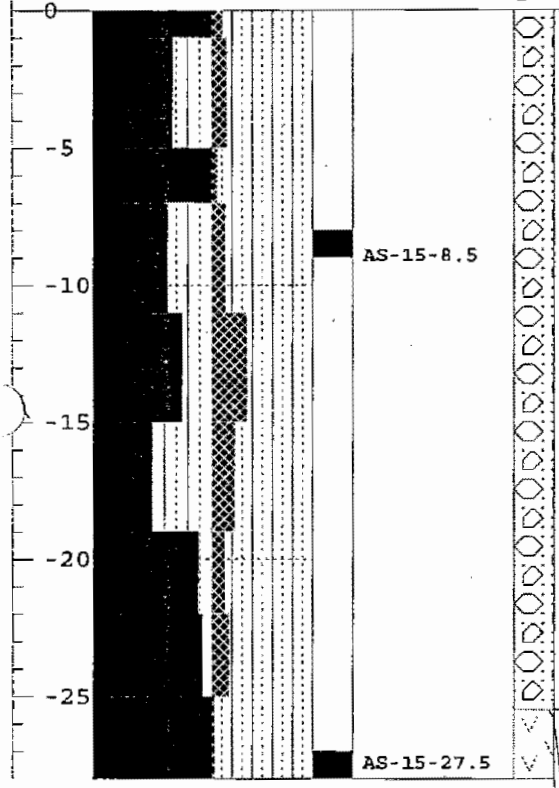


Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry.	3.2	5.4	3,787
-5							2.5		100
-10				AS-14-3		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, slightly moist.	5.3		100
				AS-14-11.5		Native: Bedrock, red tuff, dry.	3.4	43.0	3,269

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: BH-15
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/11/01
Date Completed: 6/11/01
Elevation: 5407 ft
Northing: 823,742
Easting: 638,050
Total Depth: 28.0 ft

Notes: Contact at 25.5 ft. Samples AS-15-8.5 and AS-15-27.5.



Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
0						Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry to slightly moist. Railroad spike found at 10.5 ft.	4.3		0
							11.4		350
-5							6.0		4,000
				AS-15-8.5			6.1	16.1	13,600
-10							0.3		300
-15							2.9		300
-20							2.5		300
							2.2		200
-25				AS-15-27.5		Native: 25.5 to 26.0 ft: Bedrock, tuff, weathered, slightly moist.	9.2	43.0	3,324
						Native: 26.0 to 28.0 ft: Bedrock, tuff, weathered, dry.			

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: SH-S1
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/16/01
Date Completed: 6/16/01
Elevation: 5404 ft
Northing: 823,865.9
Easting: 638,035.3
Total Depth: 5.0 ft

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
Notes: Total depth was 5 ft. Sample AS-S1-1.									
0				AS-S1-1		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, occasional electrical wire fragments, dry to slightly moist.	1.9 1.7	28.6	24,900 2,500
-5									

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: SH-S2
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/16/01
Date Completed: 6/16/01
Elevation: 5404 ft
Northing: 823,835.7
Easting: 638,082.6
Total Depth: 5.0 ft

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
Notes: Total Depth was 5.0 ft. Sample AS-S2-1.									
0				AS-S2-1		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry to slightly moist.	48.0 0.4	40.0	1,820 750
-5									

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: SH-S3
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/16/01
Date Completed: 6/16/01
Elevation: 5407 ft
Northing: 823,796.9
Easting: 638,046.6
Total Depth: 5.0 ft

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
Notes: Total depth was 5 ft. Sample AS-S3-1.									
0				AS-S3-1		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry to slightly moist.	2.4 5.7	17.1	3,173 1,250
-5									

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: SH-S4
Logged By: Rick Deshler/Jill Dale
Drilled By: NA
Drilling Method: Hand sampled.

Date Started: 06/19/01
Date Completed: 06/19/01
Elevation: 5408 ft
Northing: 823,704.5
Easting: 638,055.5
Total Depth: 1.0 ft

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
Notes: Total depth was 1 ft. Samples AS-S4-0.5 and AS-S4-1.									
0				AS-S4-0.5 AS-S4-1		Muck: 0 to 1 ft: Silty sand with gravel to cobble sized tuff fragments, unconsolidated, dry.	2.4 4.5	40.0 51.4	3,753 7,134

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: SH-S5
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

Date Started: 6/14/01
Date Completed: 6/14/01
Elevation: 5389 ft
Northing: 824,076.2
Easting: 638,099.8
Total Depth: 5.0 ft

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
Notes: Total Depth was 5 ft. Sample AS-S5-1.									
0				AS-S5-1		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry.	1.2 1.9 0.9	22.9	1,492 300 30
-5									

Project Name: CAU 504 (16a-Tunnel Muckpile)
Project Number: 799421.0105.0015
Borehole Number: SH-S6
Logged By: Robert Nabors
Drilled By: Boart-Longyear
Drilling Method: RotoSonic

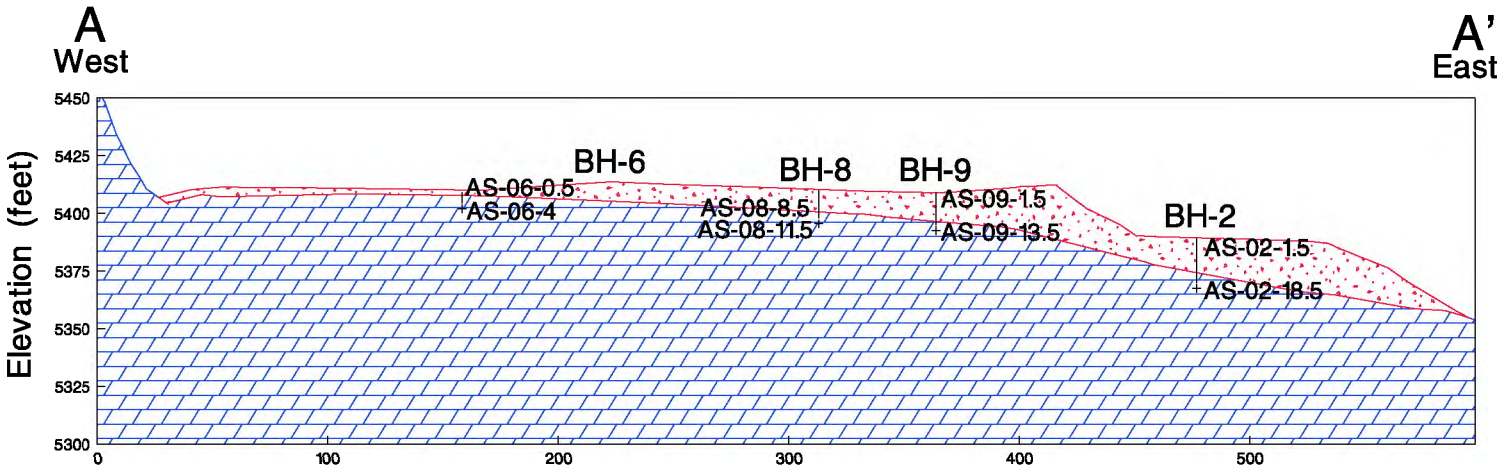
Date Started: 6/16/01
Date Completed: 6/16/01
Elevation: 5409 ft
Northing: 823,702.8
Easting: 637,858.4
Total Depth: 5.0 ft

Depth (ft)	% Recovery 0-100	Drilling Rate (ft/min) 0-35	Sample Interval	Sample Number	Lithology	Lithologic Description / Comments	Field Screening Results: VOCs (ppm)	Alpha (dpm)	Beta (dpm)
Notes: Total depth was 5 ft. Sample AS-S6-1.									
0 -5				AS-S6-1		Muck: Silty sand with gravel to boulder sized tuff fragments, unconsolidated, dry to slightly moist.	3.8 0.6	57.1	2,565 450

Attachment B

Cross Sections

(5 Pages)



Muck

Native

BH-1 Borehole Number

AS-01-2 Sample Number

No Vertical Exaggeration

Figure B-1. 16a Tunnel Muckpile

West-East Cross Section A-A' (looking north)

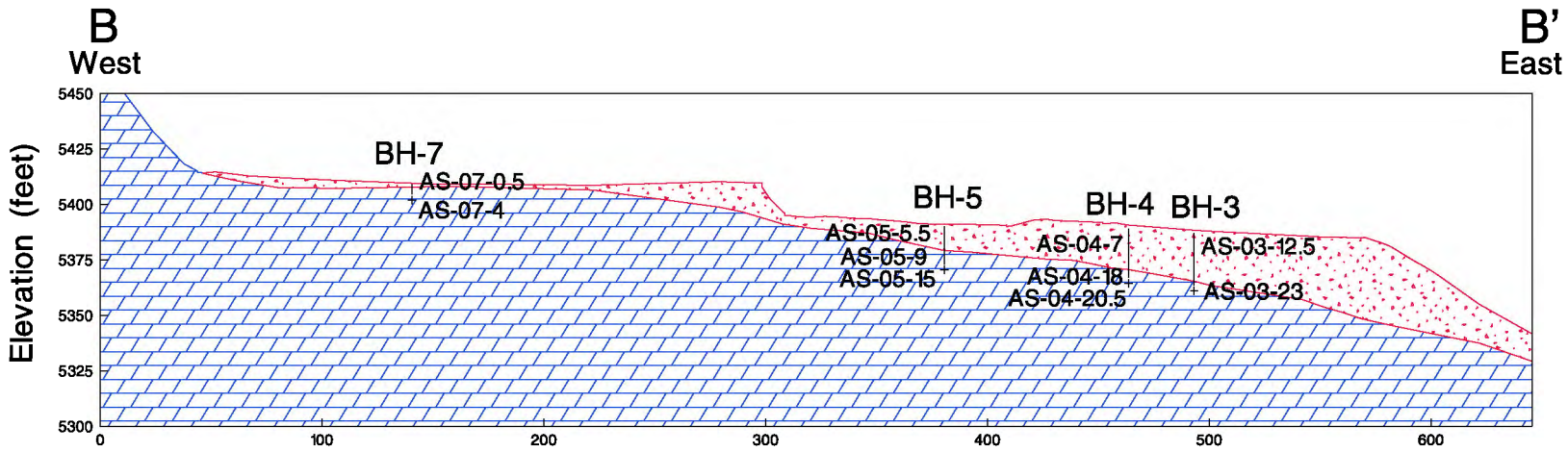
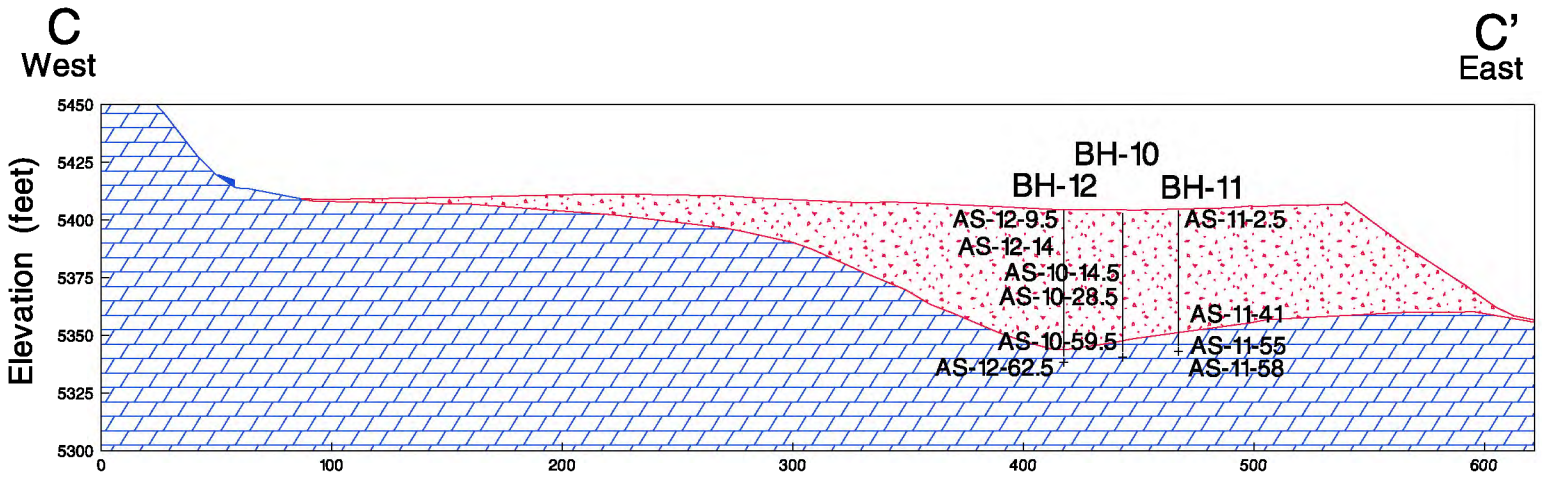


Figure B-2. 16a Tunnel Muckpile

West-East Cross Section B-B' (looking north)



Muck

Native

BH-1 Borehole Number

AS-01-2 Sample Number

No Vertical Exaggeration

Figure B-3. 16a Tunnel Muckpile

West-East Cross Section C-C' (looking north)

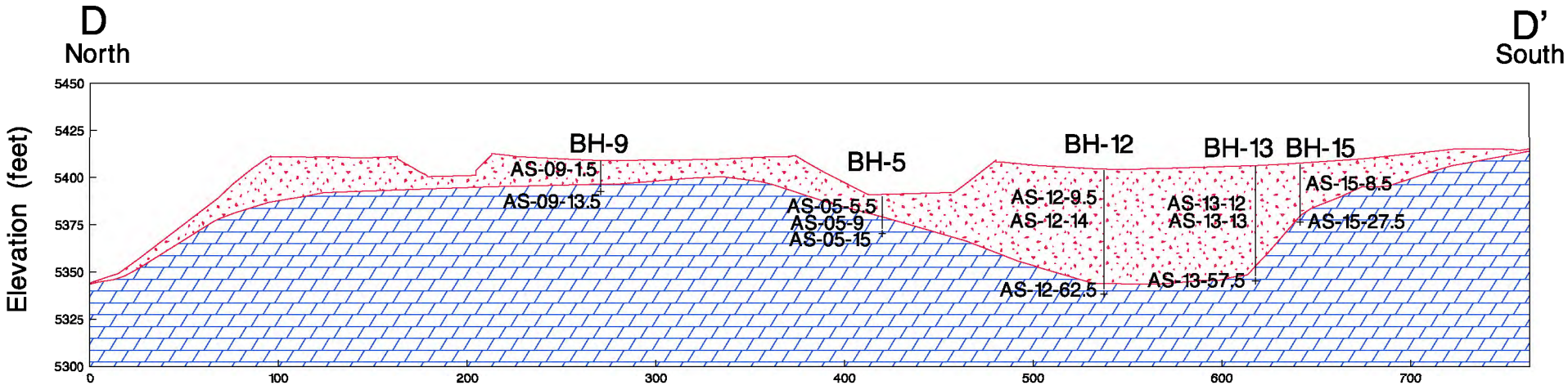
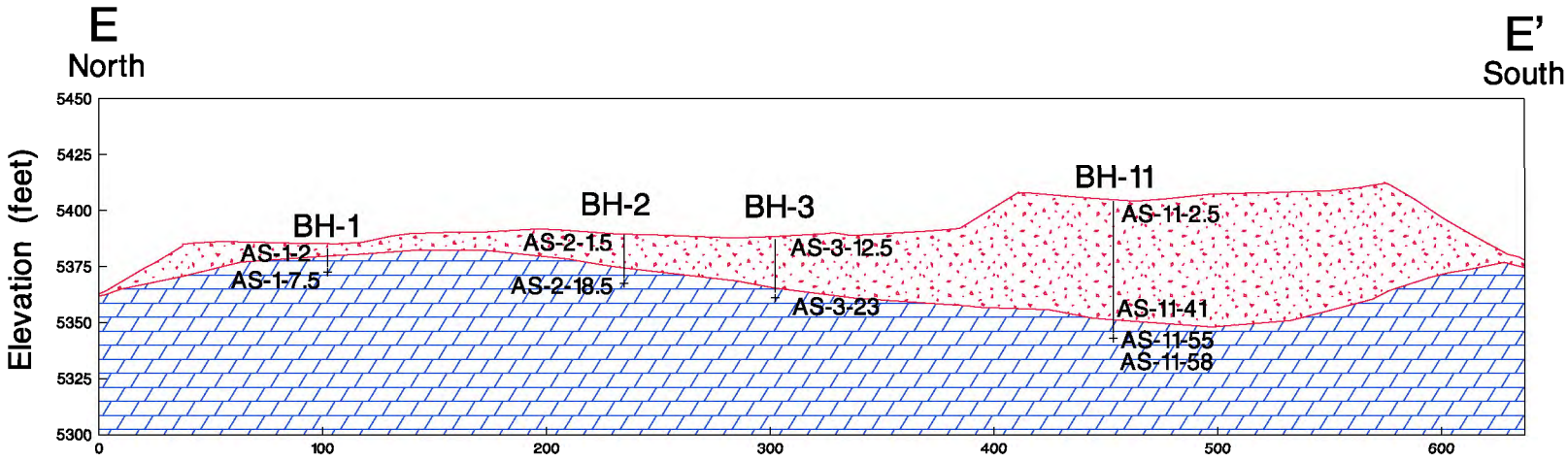


Figure B-4. 16a Tunnel Muckpile

North-South Cross Section D-D' (looking east)



Muck

Native

BH-1 Borehole Number

AS-01-2 Sample Number

No Vertical Exaggeration

Figure B-5. 16a Tunnel Muckpile

North-South Cross Section E-E' (looking east)

Attachment C

Analytical Results Tables

(31 Pages)

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-01-2	6/13/2001	soil	GAMMA	14331-83-0	Ac-228	1.72	pCi/g	0.3		0.35
AS-01-2	6/13/2001	soil	VOCs	67-64-1	Acetone	29	µg/kg	22	J	
AS-01-2	6/13/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.9	mg/kg	1.1		
AS-01-2	6/13/2001	soil	RCRAMETALS	7440-39-3	Barium	200	mg/kg	11		
AS-01-2	6/13/2001	soil	GAMMA	14733-03-0	Bi-214	0.88	pCi/g	0.19		0.21
AS-01-2	6/13/2001	soil	RCRAMETALS	7440-47-3	Chromium	2.2	mg/kg	1.1		
AS-01-2	6/13/2001	soil	GAMMA	10045-97-3	Cs-137	0.61	pCi/g	0.083		0.13
AS-01-2	6/13/2001	soil	DRO	68334-30-5	Diesel-Range Organics	30	mg/kg	5.4		
AS-01-2	6/13/2001	soil	GAMMA	13966-00-2	K-40	27	pCi/g	1.1		4.8
AS-01-2	6/13/2001	soil	RCRAMETALS	7439-92-1	Lead	31	mg/kg	0.32		
AS-01-2	6/13/2001	soil	VOCs	75-09-2	Methylene Chloride	9.7	µg/kg	5.4		
AS-01-2	6/13/2001	soil	GAMMA	15092-94-1	Pb-212	1.93	pCi/g	0.15		0.35
AS-01-2	6/13/2001	soil	GAMMA	15067-28-4	Pb-214	1.01	pCi/g	0.17		0.21
AS-01-2	6/13/2001	soil	VOCs	99-87-6	P-Isopropyltoluene	17	µg/kg	5.4		
AS-01-2	6/13/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.38	mg/kg	0.54	B	
AS-01-2	6/13/2001	soil	GAMMA	14913-50-9	Tl-208	0.6	pCi/g	0.094		0.13
AS-01-7.5	6/13/2001	soil	GAMMA	14331-83-0	Ac-228	1.89	pCi/g	0.31		0.44
AS-01-7.5	6/13/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.8	mg/kg	1.1		
AS-01-7.5	6/13/2001	soil	RCRAMETALS	7440-39-3	Barium	240	mg/kg	11		
AS-01-7.5	6/13/2001	soil	GAMMA	14733-03-0	Bi-214	0.9	pCi/g	0.23		0.27
AS-01-7.5	6/13/2001	soil	RCRAMETALS	7440-47-3	Chromium	2.3	mg/kg	1.1		
AS-01-7.5	6/13/2001	soil	GAMMA	13966-00-2	K-40	18.2	pCi/g	1.5		4.1
AS-01-7.5	6/13/2001	soil	RCRAMETALS	7439-92-1	Lead	44	mg/kg	0.34		
AS-01-7.5	6/13/2001	soil	VOCs	75-09-2	Methylene Chloride	1.9	µg/kg	5.7	J	
AS-01-7.5	6/13/2001	soil	GAMMA	15092-94-1	Pb-212	2.69	pCi/g	0.18		0.51
AS-01-7.5	6/13/2001	soil	GAMMA	15067-28-4	Pb-214	0.69	pCi/g	0.2		0.2
AS-01-7.5	6/13/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.47	mg/kg	0.57	B	
AS-01-7.5	6/13/2001	soil	GAMMA	14913-50-9	Tl-208	0.71	pCi/g	0.14		0.19
AS-02-1.5	6/14/2001	soil	GAMMA	14331-83-0	Ac-228	1.85	pCi/g	0.69		0.58
AS-02-1.5	6/14/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.5	mg/kg	1.1		
AS-02-1.5	6/14/2001	soil	RCRAMETALS	7440-39-3	Barium	180	mg/kg	11		
AS-02-1.5	6/14/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.7	mg/kg	1.1	J	
AS-02-1.5	6/14/2001	soil	GAMMA	13966-00-2	K-40	29.4	pCi/g	2.4		6.7
AS-02-1.5	6/14/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.34		
AS-02-1.5	6/14/2001	soil	METALS	7439-97-6	Mercury	0.055	mg/kg	0.11	B	
AS-02-1.5	6/14/2001	soil	GAMMA	15092-94-1	Pb-212	1.88	pCi/g	0.36		0.46
AS-02-1.5	6/14/2001	soil	GAMMA	15067-28-4	Pb-214	0.82	pCi/g	0.35		0.28
AS-02-1.5	6/14/2001	soil	GAMMA	14913-50-9	Tl-208	0.67	pCi/g	0.2		0.22

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-02-18.5	6/14/2001	soil	GAMMA	14331-83-0	Ac-228	1.49	pCi/g	0.47		0.37
AS-02-18.5	6/14/2001	soil	RCRAMETALS	7440-38-2	Arsenic	7.2	mg/kg	1.2		
AS-02-18.5	6/14/2001	soil	RCRAMETALS	7440-39-3	Barium	190	mg/kg	12		
AS-02-18.5	6/14/2001	soil	GAMMA	14733-03-0	Bi-214	0.83	pCi/g	0.32		0.28
AS-02-18.5	6/14/2001	soil	RCRAMETALS	7440-47-3	Chromium	4	mg/kg	1.2	J	
AS-02-18.5	6/14/2001	soil	GAMMA	13966-00-2	K-40	23.9	pCi/g	1.9		4.7
AS-02-18.5	6/14/2001	soil	RCRAMETALS	7439-92-1	Lead	5.8	mg/kg	0.35		
AS-02-18.5	6/14/2001	soil	GAMMA	15092-94-1	Pb-212	1.63	pCi/g	0.26		0.36
AS-02-18.5	6/14/2001	soil	GAMMA	15067-28-4	Pb-214	0.84	pCi/g	0.24		0.22
AS-02-18.5	6/14/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.5	mg/kg	0.58	B	
AS-02-18.5	6/14/2001	soil	GAMMA	14913-50-9	Tl-208	0.67	pCi/g	0.13		0.17
AS-03-12.5	6/14/2001	soil	GAMMA	14331-83-0	Ac-228	1.7	pCi/g	0.62		0.51
AS-03-12.5	6/14/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.8	mg/kg	1.1		
AS-03-12.5	6/14/2001	soil	RCRAMETALS	7440-39-3	Barium	190	mg/kg	11		
AS-03-12.5	6/14/2001	soil	GAMMA	14733-03-0	Bi-214	0.93	pCi/g	0.37		0.37
AS-03-12.5	6/14/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.74	mg/kg	1.1	J	
AS-03-12.5	6/14/2001	soil	GAMMA	10045-97-3	Cs-137	4.37	pCi/g	0.24		0.86
AS-03-12.5	6/14/2001	soil	GAMMA	13966-00-2	K-40	34.6	pCi/g	2.9		7.7
AS-03-12.5	6/14/2001	soil	RCRAMETALS	7439-92-1	Lead	16	mg/kg	0.34		
AS-03-12.5	6/14/2001	soil	METALS	7439-97-6	Mercury	0.1	mg/kg	0.11	B	
AS-03-12.5	6/14/2001	soil	GAMMA	15092-94-1	Pb-212	1.72	pCi/g	0.38		0.44
AS-03-12.5	6/14/2001	soil	GAMMA	15067-28-4	Pb-214	0.88	pCi/g	0.52		0.35
AS-03-12.5	6/14/2001	soil	GAMMA	14913-50-9	Tl-208	0.48	pCi/g	0.21		0.2
AS-03-23	6/14/2001	soil	GAMMA	14331-83-0	Ac-228	1.43	pCi/g	0.67		0.45
AS-03-23	6/14/2001	soil	VOCs	67-64-1	Acetone	23	µg/kg	21	J	
AS-03-23	6/14/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.6	mg/kg	1.1		
AS-03-23	6/14/2001	soil	RCRAMETALS	7440-39-3	Barium	360	mg/kg	11		
AS-03-23	6/14/2001	soil	GAMMA	14733-03-0	Bi-214	0.96	pCi/g	0.31		0.34
AS-03-23	6/14/2001	soil	RCRAMETALS	7440-47-3	Chromium	210	mg/kg	1.1	J	
AS-03-23	6/14/2001	soil	GAMMA	10045-97-3	Cs-137	0.83	pCi/g	0.19		0.25
AS-03-23	6/14/2001	soil	DRO	68334-30-5	Diesel-Range Organics	59	mg/kg	5.3		
AS-03-23	6/14/2001	soil	GAMMA	13966-00-2	K-40	29.3	pCi/g	1.8		6.4
AS-03-23	6/14/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.64		
AS-03-23	6/14/2001	soil	GAMMA	15092-94-1	Pb-212	1.66	pCi/g	0.24		0.39
AS-03-23	6/14/2001	soil	GAMMA	15067-28-4	Pb-214	0.88	pCi/g	0.36		0.28
AS-03-23	6/14/2001	soil	SVOCs	108-95-2	Phenol	55	µg/kg	360	J	
AS-03-23	6/14/2001	soil	RCRAMETALS	7440-22-4	Silver	530	mg/kg	11		
AS-03-23	6/14/2001	soil	GAMMA	14913-50-9	Tl-208	0.52	pCi/g	0.16		0.18

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-04-18	6/15/2001	soil	GAMMA	14331-83-0	Ac-228	2.08	pCi/g	0.83		0.69
AS-04-18	6/15/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.5	mg/kg	1.1		
AS-04-18	6/15/2001	soil	RCRAMETALS	7440-39-3	Barium	64	mg/kg	11		
AS-04-18	6/15/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.92	mg/kg	1.1	J	
AS-04-18	6/15/2001	soil	GAMMA	10045-97-3	Cs-137	20.4	pCi/g	0.28		3.5
AS-04-18	6/15/2001	soil	GAMMA	13966-00-2	K-40	27.8	pCi/g	2.9		6.8
AS-04-18	6/15/2001	soil	RCRAMETALS	7439-92-1	Lead	11	mg/kg	0.34		
AS-04-18	6/15/2001	soil	METALS	7439-97-6	Mercury	0.088	mg/kg	0.11	B	
AS-04-18	6/15/2001	soil	GAMMA	15092-94-1	Pb-212	2.24	pCi/g	0.45		0.55
AS-04-18	6/15/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.193	pCi/g	0.014		0.052
AS-04-18	6/15/2001	soil	STRONTIUM	10098-97-2	Sr-90	1.11	pCi/g	0.39		0.33
AS-04-18	6/15/2001	soil	GAMMA	14913-50-9	Tl-208	0.74	pCi/g	0.27		0.26
AS-04-20.5	6/15/2001	soil	GAMMA	14331-83-0	Ac-228	1.83	pCi/g	0.74		0.54
AS-04-20.5	6/15/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.5	mg/kg	1.1		
AS-04-20.5	6/15/2001	soil	RCRAMETALS	7440-39-3	Barium	380	mg/kg	11		
AS-04-20.5	6/15/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.2	mg/kg	1.1	J	
AS-04-20.5	6/15/2001	soil	GAMMA	13966-00-2	K-40	26.3	pCi/g	2.2		6.1
AS-04-20.5	6/15/2001	soil	RCRAMETALS	7439-92-1	Lead	21	mg/kg	0.33		
AS-04-20.5	6/15/2001	soil	GAMMA	15092-94-1	Pb-212	2.1	pCi/g	0.29		0.48
AS-04-20.5	6/15/2001	soil	GAMMA	15067-28-4	Pb-214	1	pCi/g	0.35		0.35
AS-04-20.5	6/15/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.29	mg/kg	0.55	B	
AS-04-20.5	6/15/2001	soil	GAMMA	14913-50-9	Tl-208	0.56	pCi/g	0.17		0.19
AS-04-7	6/15/2001	soil	GAMMA	14331-83-0	Ac-228	1.57	pCi/g	0.52		0.42
AS-04-7	6/15/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.2	mg/kg	1.1		
AS-04-7	6/15/2001	soil	RCRAMETALS	7440-39-3	Barium	180	mg/kg	11		
AS-04-7	6/15/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.1	mg/kg	1.1	J	
AS-04-7	6/15/2001	soil	GAMMA	10045-97-3	Cs-137	218	pCi/g	0.34		36
AS-04-7	6/15/2001	soil	GAMMA	13966-00-2	K-40	32.7	pCi/g	1.8		6
AS-04-7	6/15/2001	soil	RCRAMETALS	7439-92-1	Lead	8.8	mg/kg	0.33		
AS-04-7	6/15/2001	soil	GAMMA	15092-94-1	Pb-212	2.03	pCi/g	0.69		0.56
AS-04-7	6/15/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.098	pCi/g	0.018		0.036
AS-04-7	6/15/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.62	pCi/g	0.014		0.11
AS-04-7	6/15/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.54	mg/kg	0.55	B	
AS-04-7	6/15/2001	soil	STRONTIUM	10098-97-2	Sr-90	12.4	pCi/g	0.38		2.3
AS-05-15	6/15/2001	soil	GAMMA	14331-83-0	Ac-228	2.31	pCi/g	0.64		0.72
AS-05-15	6/15/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.8	mg/kg	1.2		
AS-05-15	6/15/2001	soil	RCRAMETALS	7440-39-3	Barium	200	mg/kg	12		
AS-05-15	6/15/2001	soil	GAMMA	14733-03-0	Bi-214	0.99	pCi/g	0.49		0.44

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AS-05-15	6/15/2001	soil	RCRAMETALS	7440-47-3	Chromium	1	mg/kg	1.2	J	
AS-05-15	6/15/2001	soil	GAMMA	13966-00-2	K-40	30.3	pCi/g	2.2		7.3
AS-05-15	6/15/2001	soil	RCRAMETALS	7439-92-1	Lead	8.6	mg/kg	0.35		
AS-05-15	6/15/2001	soil	GAMMA	15092-94-1	Pb-212	2.61	pCi/g	0.31		0.59
AS-05-15	6/15/2001	soil	GAMMA	15067-28-4	Pb-214	0.88	pCi/g	0.39		0.31
AS-05-15	6/15/2001	soil	GAMMA	14913-50-9	Tl-208	0.73	pCi/g	0.28		0.27
AS-05-15	6/15/2001	soil	VOCs	108-88-3	Toluene	1.2	µg/kg	5.8	J	
AS-05-5.5	6/15/2001	soil	GAMMA	14331-83-0	Ac-228	1.89	pCi/g	0.79		0.79
AS-05-5.5	6/15/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.7	mg/kg	1.1		
AS-05-5.5	6/15/2001	soil	RCRAMETALS	7440-39-3	Barium	4300	mg/kg	57		
AS-05-5.5	6/15/2001	soil	RCRAMETALS	7440-47-3	Chromium	11	mg/kg	1.1	J	
AS-05-5.5	6/15/2001	soil	GAMMA	10045-97-3	Cs-137	76	pCi/g	0.61		13
AS-05-5.5	6/15/2001	soil	GAMMA	13966-00-2	K-40	29.3	pCi/g	4.1		7.1
AS-05-5.5	6/15/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.34		
AS-05-5.5	6/15/2001	soil	METALS	7439-97-6	Mercury	0.054	mg/kg	0.11	B	
AS-05-5.5	6/15/2001	soil	GAMMA	15092-94-1	Pb-212	2.22	pCi/g	0.95		0.73
AS-05-5.5	6/15/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.164	pCi/g	0.013		0.046
AS-05-5.5	6/15/2001	soil	STRONTIUM	10098-97-2	Sr-90	4.35	pCi/g	0.35		0.86
AS-05-9	6/15/2001	soil	GAMMA	14331-83-0	Ac-228	1.9	pCi/g	0.44		0.45
AS-05-9	6/15/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.3	mg/kg	1.2		
AS-05-9	6/15/2001	soil	RCRAMETALS	7440-39-3	Barium	220	mg/kg	12		
AS-05-9	6/15/2001	soil	GAMMA	14733-03-0	Bi-214	0.88	pCi/g	0.36		0.28
AS-05-9	6/15/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.6	mg/kg	1.2	J	
AS-05-9	6/15/2001	soil	GAMMA	10045-97-3	Cs-137	21.8	pCi/g	0.21		3.7
AS-05-9	6/15/2001	soil	GAMMA	13966-00-2	K-40	39.4	pCi/g	1.8		7.3
AS-05-9	6/15/2001	soil	RCRAMETALS	7439-92-1	Lead	6.8	mg/kg	0.35		
AS-05-9	6/15/2001	soil	METALS	7439-97-6	Mercury	0.061	mg/kg	0.12	B	
AS-05-9	6/15/2001	soil	GAMMA	15092-94-1	Pb-212	1.97	pCi/g	0.36		0.44
AS-05-9	6/15/2001	soil	GAMMA	15067-28-4	Pb-214	1.01	pCi/g	0.5		0.32
AS-05-9	6/15/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.162	pCi/g	0.014		0.043
AS-05-9	6/15/2001	soil	GAMMA	14913-50-9	Tl-208	0.84	pCi/g	0.19		0.22
AS-06-0.5	6/5/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4.1	mg/kg	1.1		
AS-06-0.5	6/5/2001	soil	RCRAMETALS	7440-39-3	Barium	170	mg/kg	11		
AS-06-0.5	6/5/2001	soil	RCRAMETALS	7440-47-3	Chromium	3	mg/kg	1.1		
AS-06-0.5	6/5/2001	soil	GAMMA	13966-00-2	K-40	26.6	pCi/g	4.6		8.7
AS-06-0.5	6/5/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.34		
AS-06-0.5	6/5/2001	soil	GAMMA	15092-94-1	Pb-212	2.03	pCi/g	0.75		0.73
AS-06-4	6/5/2001	soil	GAMMA	14331-83-0	Ac-228	2.17	pCi/g	0.61		0.55

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AS-06-4	6/5/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4.1	mg/kg	1.2		
AS-06-4	6/5/2001	soil	RCRAMETALS	7440-39-3	Barium	450	mg/kg	12		
AS-06-4	6/5/2001	soil	GAMMA	14733-03-0	Bi-214	0.92	pCi/g	0.31		0.32
AS-06-4	6/5/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.98	mg/kg	1.2	B	
AS-06-4	6/5/2001	soil	GAMMA	13966-00-2	K-40	34.6	pCi/g	1.8		7.1
AS-06-4	6/5/2001	soil	RCRAMETALS	7439-92-1	Lead	34	mg/kg	0.36		
AS-06-4	6/5/2001	soil	GAMMA	15092-94-1	Pb-212	2.4	pCi/g	0.29		0.5
AS-06-4	6/5/2001	soil	GAMMA	15067-28-4	Pb-214	0.83	pCi/g	0.27		0.25
AS-06-4	6/5/2001	soil	RCRAMETALS	7440-22-4	Silver	0.51	mg/kg	1.2	B	
AS-06-4	6/5/2001	soil	GAMMA	14913-50-9	Tl-208	0.91	pCi/g	0.15		0.23
AS-07-0.5	6/6/2001	soil	GAMMA	14331-83-0	Ac-228	1.95	pCi/g	0.4		0.46
AS-07-0.5	6/6/2001	soil	RCRAMETALS	7440-38-2	Arsenic	8.4	mg/kg	1.3		
AS-07-0.5	6/6/2001	soil	RCRAMETALS	7440-39-3	Barium	150	mg/kg	13		
AS-07-0.5	6/6/2001	soil	GAMMA	14733-03-0	Bi-214	0.86	pCi/g	0.3		0.27
AS-07-0.5	6/6/2001	soil	RCRAMETALS	7440-47-3	Chromium	3.1	mg/kg	1.3		
AS-07-0.5	6/6/2001	soil	GAMMA	13966-00-2	K-40	27.6	pCi/g	1.7		5.6
AS-07-0.5	6/6/2001	soil	RCRAMETALS	7439-92-1	Lead	16	mg/kg	0.4		
AS-07-0.5	6/6/2001	soil	METALS	7439-97-6	Mercury	0.06	mg/kg	0.13	B	
AS-07-0.5	6/6/2001	soil	GAMMA	15092-94-1	Pb-212	2.26	pCi/g	0.21		0.45
AS-07-0.5	6/6/2001	soil	GAMMA	15067-28-4	Pb-214	1	pCi/g	0.29		0.26
AS-07-0.5	6/6/2001	soil	GAMMA	15065-10-8	TH-234	2.9	pCi/g	1.7		1
AS-07-0.5	6/6/2001	soil	GAMMA	14913-50-9	Tl-208	0.71	pCi/g	0.14		0.19
AS-07-4	6/6/2001	soil	GAMMA	14331-83-0	Ac-228	1.83	pCi/g	0.87		0.54
AS-07-4	6/6/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.7	mg/kg	1.2		
AS-07-4	6/6/2001	soil	RCRAMETALS	7440-39-3	Barium	160	mg/kg	12		
AS-07-4	6/6/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.1	mg/kg	1.2	B	
AS-07-4	6/6/2001	soil	GAMMA	13966-00-2	K-40	37.6	pCi/g	2.7		7.6
AS-07-4	6/6/2001	soil	RCRAMETALS	7439-92-1	Lead	8	mg/kg	0.36		
AS-07-4	6/6/2001	soil	GAMMA	15092-94-1	Pb-212	2.42	pCi/g	0.37		0.51
AS-07-4	6/6/2001	soil	GAMMA	15067-28-4	Pb-214	1.13	pCi/g	0.37		0.31
AS-07-4	6/6/2001	soil	RCRAMETALS	7440-22-4	Silver	0.075	mg/kg	1.2	B	
AS-07-4	6/6/2001	soil	GAMMA	14913-50-9	Tl-208	0.74	pCi/g	0.2		0.22
AS-08-11.5	6/6/2001	soil	GAMMA	14331-83-0	Ac-228	2.06	pCi/g	0.37		0.46
AS-08-11.5	6/6/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.3	mg/kg	1.2		
AS-08-11.5	6/6/2001	soil	RCRAMETALS	7440-39-3	Barium	68	mg/kg	12		
AS-08-11.5	6/6/2001	soil	GAMMA	14733-03-0	Bi-214	1.28	pCi/g	0.25		0.31
AS-08-11.5	6/6/2001	soil	RCRAMETALS	7440-47-3	Chromium	3.9	mg/kg	1.2		
AS-08-11.5	6/6/2001	soil	GAMMA	13966-00-2	K-40	29.5	pCi/g	1.1		5.6

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AS-08-11.5	6/6/2001	soil	RCRAMETALS	7439-92-1	Lead	9.3	mg/kg	0.37		
AS-08-11.5	6/6/2001	soil	GAMMA	15092-94-1	Pb-212	2.71	pCi/g	0.22		0.51
AS-08-11.5	6/6/2001	soil	GAMMA	15067-28-4	Pb-214	1.3	pCi/g	0.23		0.29
AS-08-11.5	6/6/2001	soil	RCRAMETALS	7440-22-4	Silver	0.4	mg/kg	1.2	B	
AS-08-11.5	6/6/2001	soil	GAMMA	14913-50-9	Tl-208	0.8	pCi/g	0.14		0.19
AS-08-8.5	6/6/2001	soil	GAMMA	14331-83-0	Ac-228	1.77	pCi/g	0.43		0.42
AS-08-8.5	6/6/2001	soil	RCRAMETALS	7440-38-2	Arsenic	5.9	mg/kg	1.1		
AS-08-8.5	6/6/2001	soil	RCRAMETALS	7440-39-3	Barium	110	mg/kg	11		
AS-08-8.5	6/6/2001	soil	GAMMA	14733-03-0	Bi-214	1.01	pCi/g	0.24		0.27
AS-08-8.5	6/6/2001	soil	RCRAMETALS	7440-47-3	Chromium	4.6	mg/kg	1.1		
AS-08-8.5	6/6/2001	soil	GAMMA	13966-00-2	K-40	23.4	pCi/g	1.2		4.7
AS-08-8.5	6/6/2001	soil	RCRAMETALS	7439-92-1	Lead	8.9	mg/kg	0.34		
AS-08-8.5	6/6/2001	soil	GAMMA	15092-94-1	Pb-212	2.65	pCi/g	0.19		0.5
AS-08-8.5	6/6/2001	soil	GAMMA	15067-28-4	Pb-214	1.21	pCi/g	0.26		0.28
AS-08-8.5	6/6/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.39	mg/kg	0.56	B	
AS-08-8.5	6/6/2001	soil	GAMMA	14913-50-9	Tl-208	0.67	pCi/g	0.12		0.17
AS-09-1.5	6/7/2001	soil	GAMMA	14331-83-0	Ac-228	1.17	pCi/g	0.44		0.32
AS-09-1.5	6/7/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4.9	mg/kg	1.1	J	
AS-09-1.5	6/7/2001	soil	RCRAMETALS	7440-39-3	Barium	120	mg/kg	11	J	
AS-09-1.5	6/7/2001	soil	GAMMA	14733-03-0	Bi-214	0.96	pCi/g	0.21		0.25
AS-09-1.5	6/7/2001	soil	RCRAMETALS	7440-47-3	Chromium	7.2	mg/kg	1.1	J	
AS-09-1.5	6/7/2001	soil	GAMMA	10045-97-3	Cs-137	0.5	pCi/g	0.13		0.15
AS-09-1.5	6/7/2001	soil	DRO	68334-30-5	Diesel-Range Organics	1.7	mg/kg	5.4	J	
AS-09-1.5	6/7/2001	soil	GAMMA	13966-00-2	K-40	21.2	pCi/g	1.5		4.3
AS-09-1.5	6/7/2001	soil	RCRAMETALS	7439-92-1	Lead	8.6	mg/kg	0.32	J	
AS-09-1.5	6/7/2001	soil	GAMMA	15092-94-1	Pb-212	1.59	pCi/g	0.18		0.33
AS-09-1.5	6/7/2001	soil	GAMMA	15067-28-4	Pb-214	0.97	pCi/g	0.22		0.23
AS-09-1.5	6/7/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.54	mg/kg	0.54	J	
AS-09-1.5	6/7/2001	soil	GAMMA	14913-50-9	Tl-208	0.49	pCi/g	0.14		0.14
AS-09-13.5	6/7/2001	soil	GAMMA	14331-83-0	Ac-228	2.06	pCi/g	0.61		0.54
AS-09-13.5	6/7/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.1	mg/kg	1.1	J	
AS-09-13.5	6/7/2001	soil	RCRAMETALS	7440-39-3	Barium	43	mg/kg	11	J	
AS-09-13.5	6/7/2001	soil	GAMMA	14733-03-0	Bi-214	1.14	pCi/g	0.35		0.36
AS-09-13.5	6/7/2001	soil	RCRAMETALS	7440-47-3	Chromium	1	mg/kg	1.1	J	
AS-09-13.5	6/7/2001	soil	GAMMA	13966-00-2	K-40	28.6	pCi/g	3.1		6.2
AS-09-13.5	6/7/2001	soil	RCRAMETALS	7439-92-1	Lead	14	mg/kg	0.34	J	
AS-09-13.5	6/7/2001	soil	METALS	7439-97-6	Mercury	0.046	mg/kg	0.11	J	
AS-09-13.5	6/7/2001	soil	GAMMA	15092-94-1	Pb-212	2.34	pCi/g	0.3		0.49

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AS-09-13.5	6/7/2001	soil	GAMMA	15067-28-4	Pb-214	1.07	pCi/g	0.31		0.29
AS-09-13.5	6/7/2001	soil	GAMMA	14913-50-9	Tl-208	0.79	pCi/g	0.17		0.21
AS-10-14.5	6/8/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.7	mg/kg	1.2		
AS-10-14.5	6/8/2001	soil	RCRAMETALS	7440-39-3	Barium	72	mg/kg	12		
AS-10-14.5	6/8/2001	soil	RCRAMETALS	7440-47-3	Chromium	2.4	mg/kg	1.2	J	
AS-10-14.5	6/8/2001	soil	GAMMA	10045-97-3	Cs-137	310	pCi/g	0.74		51
AS-10-14.5	6/8/2001	soil	GAMMA	13966-00-2	K-40	31.5	pCi/g	3.8		7.3
AS-10-14.5	6/8/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.35		
AS-10-14.5	6/8/2001	soil	METALS	7439-97-6	Mercury	0.12	mg/kg	0.12		
AS-10-14.5	6/8/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.414	pCi/g	0.015		0.074
AS-10-14.5	6/8/2001	soil	PLUTONIUM	15117-48-3	Pu-239	1.85	pCi/g	0.016		0.25
AS-10-14.5	6/8/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.58	mg/kg	0.58		
AS-10-14.5	6/8/2001	soil	STRONTIUM	10098-97-2	Sr-90	12.4	pCi/g	0.4		2.3
AS-10-28.5	6/8/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.1	mg/kg	1.2		
AS-10-28.5	6/8/2001	soil	RCRAMETALS	7440-39-3	Barium	210	mg/kg	12		
AS-10-28.5	6/8/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.1	mg/kg	1.2	J	
AS-10-28.5	6/8/2001	soil	GAMMA	10045-97-3	Cs-137	277	pCi/g	1		46
AS-10-28.5	6/8/2001	soil	GAMMA	13966-00-2	K-40	27	pCi/g	5.1		9.8
AS-10-28.5	6/8/2001	soil	RCRAMETALS	7439-92-1	Lead	11	mg/kg	0.36		
AS-10-28.5	6/8/2001	soil	METALS	7439-97-6	Mercury	0.023	mg/kg	0.12	B	
AS-10-28.5	6/8/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.74	pCi/g	0.017		0.12
AS-10-28.5	6/8/2001	soil	PLUTONIUM	15117-48-3	Pu-239	3.99	pCi/g	0.019		0.54
AS-10-28.5	6/8/2001	soil	RCRAMETALS	7440-22-4	Silver	1.4	mg/kg	1.2		
AS-10-28.5	6/8/2001	soil	STRONTIUM	10098-97-2	Sr-90	9	pCi/g	0.37		1.7
AS-10-59.5	6/8/2001	soil	GAMMA	14331-83-0	Ac-228	1.5	pCi/g	0.4		0.39
AS-10-59.5	6/8/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.8	mg/kg	1.2		
AS-10-59.5	6/8/2001	soil	RCRAMETALS	7440-39-3	Barium	280	mg/kg	12		
AS-10-59.5	6/8/2001	soil	GAMMA	14733-03-0	Bi-214	0.55	pCi/g	0.22		0.2
AS-10-59.5	6/8/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.1	mg/kg	1.2	J	
AS-10-59.5	6/8/2001	soil	GAMMA	13966-00-2	K-40	37	pCi/g	1.4		7
AS-10-59.5	6/8/2001	soil	RCRAMETALS	7439-92-1	Lead	5.2	mg/kg	0.35		
AS-10-59.5	6/8/2001	soil	GAMMA	15092-94-1	Pb-212	1.68	pCi/g	0.23		0.36
AS-10-59.5	6/8/2001	soil	GAMMA	15067-28-4	Pb-214	0.86	pCi/g	0.24		0.22
AS-10-59.5	6/8/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.23	mg/kg	0.58	B	
AS-10-59.5	6/8/2001	soil	GAMMA	14913-50-9	Tl-208	0.67	pCi/g	0.13		0.17
AS-11-2.5	6/9/2001	soil	GAMMA	14331-83-0	Ac-228	0.87	pCi/g	0.28		0.22
AS-11-2.5	6/9/2001	soil	RCRAMETALS	7440-38-2	Arsenic	5.7	mg/kg	1.1		
AS-11-2.5	6/9/2001	soil	RCRAMETALS	7440-39-3	Barium	390	mg/kg	11		

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-11-2.5	6/9/2001	soil	GAMMA	14913-49-6	BI-212	1.55	pCi/g	0.85		0.67
AS-11-2.5	6/9/2001	soil	GAMMA	14733-03-0	Bi-214	0.95	pCi/g	0.19		0.22
AS-11-2.5	6/9/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.42	mg/kg	0.56	B	
AS-11-2.5	6/9/2001	soil	RCRAMETALS	7440-47-3	Chromium	12	mg/kg	1.1		
AS-11-2.5	6/9/2001	soil	GAMMA	10045-97-3	Cs-137	0.55	pCi/g	0.08		0.12
AS-11-2.5	6/9/2001	soil	GAMMA	13966-00-2	K-40	17	pCi/g	1.1		3.2
AS-11-2.5	6/9/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	1		
AS-11-2.5	6/9/2001	soil	GAMMA	15092-94-1	Pb-212	1.15	pCi/g	0.14		0.23
AS-11-2.5	6/9/2001	soil	GAMMA	15067-28-4	Pb-214	1.03	pCi/g	0.17		0.21
AS-11-2.5	6/9/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.0168	pCi/g	0.0042	LT	0.0082
AS-11-2.5	6/9/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.3	mg/kg	0.56		
AS-11-2.5	6/9/2001	soil	GAMMA	14913-50-9	Tl-208	0.324	pCi/g	0.081		0.086
AS-11-41	6/9/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.7	mg/kg	1.2		
AS-11-41	6/9/2001	soil	RCRAMETALS	7440-39-3	Barium	210	mg/kg	12		
AS-11-41	6/9/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.1	mg/kg	1.2	B	
AS-11-41	6/9/2001	soil	GAMMA	10198-40-0	Co-60	5.3	pCi/g	0.48		1.1
AS-11-41	6/9/2001	soil	GAMMA	10045-97-3	Cs-137	1770	pCi/g	2.4		290
AS-11-41	6/9/2001	soil	DRO	68334-30-5	Diesel-Range Organics	2.2	mg/kg	6.1	J	
AS-11-41	6/9/2001	soil	GAMMA	13966-00-2	K-40	29.5	pCi/g	6.2		9.6
AS-11-41	6/9/2001	soil	RCRAMETALS	7439-92-1	Lead	9.8	mg/kg	0.36		
AS-11-41	6/9/2001	soil	METALS	7439-97-6	Mercury	0.057	mg/kg	0.12	B	
AS-11-41	6/9/2001	soil	PLUTONIUM	13981-16-3	Pu-238	20.2	pCi/g	0.025		2.5
AS-11-41	6/9/2001	soil	PLUTONIUM	15117-48-3	Pu-239	122	pCi/g	0.02		15
AS-11-41	6/9/2001	soil	STRONTIUM	10098-97-2	Sr-90	15.9	pCi/g	0.38		2.9
AS-11-55	6/9/2001	soil	GAMMA	14331-83-0	Ac-228	1.7	pCi/g	0.46		0.44
AS-11-55	6/9/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3	mg/kg	1.2		
AS-11-55	6/9/2001	soil	RCRAMETALS	7440-39-3	Barium	330	mg/kg	12		
AS-11-55	6/9/2001	soil	GAMMA	14733-03-0	Bi-214	0.55	pCi/g	0.28		0.23
AS-11-55	6/9/2001	soil	RCRAMETALS	7440-47-3	Chromium	6.4	mg/kg	1.2		
AS-11-55	6/9/2001	soil	GAMMA	10045-97-3	Cs-137	9.9	pCi/g	0.2		1.7
AS-11-55	6/9/2001	soil	GAMMA	13966-00-2	K-40	30.7	pCi/g	2.2		6.1
AS-11-55	6/9/2001	soil	RCRAMETALS	7439-92-1	Lead	8	mg/kg	0.35		
AS-11-55	6/9/2001	soil	GAMMA	15092-94-1	Pb-212	2.06	pCi/g	0.34		0.44
AS-11-55	6/9/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.071	pCi/g	0.012		0.019
AS-11-55	6/9/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.439	pCi/g	0.0045		0.068
AS-11-55	6/9/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.33	mg/kg	0.58	B	
AS-11-55	6/9/2001	soil	RCRAMETALS	7440-22-4	Silver	0.48	mg/kg	1.2	B	
AS-11-55	6/9/2001	soil	GAMMA	14913-50-9	Tl-208	0.58	pCi/g	0.16		0.17

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-11-58	6/9/2001	soil	GAMMA	14331-83-0	Ac-228	1.26	pCi/g	0.61		0.39
AS-11-58	6/9/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.7	mg/kg	1.2		
AS-11-58	6/9/2001	soil	RCRAMETALS	7440-39-3	Barium	310	mg/kg	12		
AS-11-58	6/9/2001	soil	GAMMA	14733-03-0	Bi-214	0.76	pCi/g	0.28		0.27
AS-11-58	6/9/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.5	mg/kg	1.2		
AS-11-58	6/9/2001	soil	GAMMA	13966-00-2	K-40	39.9	pCi/g	1.6		7.8
AS-11-58	6/9/2001	soil	RCRAMETALS	7439-92-1	Lead	5.5	mg/kg	0.35		
AS-11-58	6/9/2001	soil	GAMMA	15092-94-1	Pb-212	1.91	pCi/g	0.23		0.4
AS-11-58	6/9/2001	soil	GAMMA	15067-28-4	Pb-214	0.78	pCi/g	0.3		0.24
AS-11-58	6/9/2001	soil	RCRAMETALS	7440-22-4	Silver	1.7	mg/kg	1.2		
AS-11-58	6/9/2001	soil	GAMMA	14913-50-9	Tl-208	0.65	pCi/g	0.15		0.18
AS-12-14	6/12/2001	soil	GAMMA	14331-83-0	Ac-228	1.63	pCi/g	0.52		0.46
AS-12-14	6/12/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.8	mg/kg	1.2		
AS-12-14	6/12/2001	soil	RCRAMETALS	7440-39-3	Barium	110	mg/kg	12		
AS-12-14	6/12/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.6	mg/kg	1.2	B	
AS-12-14	6/12/2001	soil	GAMMA	10045-97-3	Cs-137	193	pCi/g	0.32		32
AS-12-14	6/12/2001	soil	GAMMA	13966-00-2	K-40	35.5	pCi/g	1.3		6.8
AS-12-14	6/12/2001	soil	RCRAMETALS	7439-92-1	Lead	5.8	mg/kg	0.36		
AS-12-14	6/12/2001	soil	VOCs	75-09-2	Methylene Chloride	45	µg/kg	6		
AS-12-14	6/12/2001	soil	GAMMA	15092-94-1	Pb-212	1.97	pCi/g	0.71		0.57
AS-12-14	6/12/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.512	pCi/g	0.0039		0.09
AS-12-14	6/12/2001	soil	PLUTONIUM	15117-48-3	Pu-239	2.23	pCi/g	0.015		0.31
AS-12-14	6/12/2001	soil	STRONTIUM	10098-97-2	Sr-90	8.3	pCi/g	0.38		1.6
AS-12-14	6/12/2001	soil	GAMMA	14913-50-9	Tl-208	0.78	pCi/g	0.35		0.26
AS-12-62.5	6/12/2001	soil	GAMMA	14331-83-0	Ac-228	1.47	pCi/g	0.54		0.4
AS-12-62.5	6/12/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.4	mg/kg	1.2		
AS-12-62.5	6/12/2001	soil	RCRAMETALS	7440-39-3	Barium	330	mg/kg	12		
AS-12-62.5	6/12/2001	soil	GAMMA	14733-03-0	Bi-214	0.66	pCi/g	0.26		0.25
AS-12-62.5	6/12/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.2	mg/kg	1.2		
AS-12-62.5	6/12/2001	soil	GAMMA	13966-00-2	K-40	35.5	pCi/g	1.4		7
AS-12-62.5	6/12/2001	soil	RCRAMETALS	7439-92-1	Lead	13	mg/kg	0.35		
AS-12-62.5	6/12/2001	soil	VOCs	75-09-2	Methylene Chloride	71	µg/kg	5.8		
AS-12-62.5	6/12/2001	soil	GAMMA	15092-94-1	Pb-212	1.96	pCi/g	0.19		0.4
AS-12-62.5	6/12/2001	soil	GAMMA	15067-28-4	Pb-214	0.78	pCi/g	0.25		0.22
AS-12-62.5	6/12/2001	soil	RCRAMETALS	7440-22-4	Silver	1.2	mg/kg	1.2		
AS-12-62.5	6/12/2001	soil	GAMMA	14913-50-9	Tl-208	0.61	pCi/g	0.14		0.17
AS-12-9.5	6/12/2001	soil	GAMMA	14331-83-0	Ac-228	1.9	pCi/g	0.76		0.54
AS-12-9.5	6/12/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.6	mg/kg	1.2		

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-12-9.5	6/12/2001	soil	RCRAMETALS	7440-39-3	Barium	65	mg/kg	12		
AS-12-9.5	6/12/2001	soil	GAMMA	14733-03-0	Bi-214	0.74	pCi/g	0.35		0.3
AS-12-9.5	6/12/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.48	mg/kg	1.2	B	
AS-12-9.5	6/12/2001	soil	GAMMA	10045-97-3	Cs-137	1.91	pCi/g	0.21		0.41
AS-12-9.5	6/12/2001	soil	GAMMA	13966-00-2	K-40	30.7	pCi/g	2.9		6.4
AS-12-9.5	6/12/2001	soil	RCRAMETALS	7439-92-1	Lead	4.2	mg/kg	0.35		
AS-12-9.5	6/12/2001	soil	VOCs	75-09-2	Methylene Chloride	29	µg/kg	5.9		
AS-12-9.5	6/12/2001	soil	GAMMA	15092-94-1	Pb-212	2.27	pCi/g	0.35		0.49
AS-12-9.5	6/12/2001	soil	GAMMA	15067-28-4	Pb-214	0.92	pCi/g	0.36		0.28
AS-12-9.5	6/12/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.083	pCi/g	0.004		0.028
AS-12-9.5	6/12/2001	soil	GAMMA	14913-50-9	Tl-208	0.61	pCi/g	0.23		0.21
AS-13-12	6/11/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.4	mg/kg	1.1		
AS-13-12	6/11/2001	soil	RCRAMETALS	7440-39-3	Barium	130	mg/kg	11		
AS-13-12	6/11/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.59	mg/kg	1.1	J	
AS-13-12	6/11/2001	soil	GAMMA	10045-97-3	Cs-137	700	pCi/g	3.1		120
AS-13-12	6/11/2001	soil	GAMMA	13966-00-2	K-40	29.5	pCi/g	5.7		10
AS-13-12	6/11/2001	soil	RCRAMETALS	7439-92-1	Lead	11	mg/kg	0.34		
AS-13-12	6/11/2001	soil	PLUTONIUM	13981-16-3	Pu-238	2.86	pCi/g	0.016		0.39
AS-13-12	6/11/2001	soil	PLUTONIUM	15117-48-3	Pu-239	16.1	pCi/g	0.0043		2
AS-13-12	6/11/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.22	mg/kg	0.57	B	
AS-13-12	6/11/2001	soil	STRONTIUM	10098-97-2	Sr-90	32.6	pCi/g	0.47		5.9
AS-13-13	6/11/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.4	mg/kg	1.1		
AS-13-13	6/11/2001	soil	RCRAMETALS	7440-39-3	Barium	160	mg/kg	11		
AS-13-13	6/11/2001	soil	RCRAMETALS	7440-47-3	Chromium	1	mg/kg	1.1	J	
AS-13-13	6/11/2001	soil	GAMMA	10198-40-0	Co-60	1.1	pCi/g	0.29		0.28
AS-13-13	6/11/2001	soil	GAMMA	10045-97-3	Cs-137	1650	pCi/g	2.6		270
AS-13-13	6/11/2001	soil	GAMMA	13966-00-2	K-40	33.1	pCi/g	3.1		7.3
AS-13-13	6/11/2001	soil	RCRAMETALS	7439-92-1	Lead	22	mg/kg	0.34		
AS-13-13	6/11/2001	soil	METALS	7439-97-6	Mercury	0.035	mg/kg	0.11	B	
AS-13-13	6/11/2001	soil	PLUTONIUM	13981-16-3	Pu-238	5.52	pCi/g	0.016		0.72
AS-13-13	6/11/2001	soil	PLUTONIUM	15117-48-3	Pu-239	33.2	pCi/g	0.015		4.2
AS-13-13	6/11/2001	soil	STRONTIUM	10098-97-2	Sr-90	79	pCi/g	0.45		14
AS-13-57.5	6/11/2001	soil	GAMMA	14331-83-0	Ac-228	1.66	pCi/g	0.41		0.41
AS-13-57.5	6/11/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.5	mg/kg	1.2		
AS-13-57.5	6/11/2001	soil	RCRAMETALS	7440-39-3	Barium	240	mg/kg	12		
AS-13-57.5	6/11/2001	soil	GAMMA	14733-03-0	Bi-214	0.55	pCi/g	0.27		0.23
AS-13-57.5	6/11/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.3	mg/kg	1.2	J	
AS-13-57.5	6/11/2001	soil	GAMMA	13966-00-2	K-40	32.8	pCi/g	1.1		6.3

)4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-13-57.5	6/11/2001	soil	RCRAMETALS	7439-92-1	Lead	4.2	mg/kg	0.36		
AS-13-57.5	6/11/2001	soil	GAMMA	15092-94-1	Pb-212	2.44	pCi/g	0.18		0.47
AS-13-57.5	6/11/2001	soil	GAMMA	15067-28-4	Pb-214	0.94	pCi/g	0.24		0.24
AS-13-57.5	6/11/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.26	mg/kg	0.6	B	
AS-13-57.5	6/11/2001	soil	GAMMA	14913-50-9	Tl-208	0.72	pCi/g	0.15		0.18
AS-14-11.5	6/12/2001	soil	GAMMA	14331-83-0	Ac-228	1.71	pCi/g	0.48		0.44
AS-14-11.5	6/12/2001	soil	RCRAMETALS	7440-38-2	Arsenic	1.9	mg/kg	1.2		
AS-14-11.5	6/12/2001	soil	RCRAMETALS	7440-39-3	Barium	72	mg/kg	12		
AS-14-11.5	6/12/2001	soil	GAMMA	14733-03-0	Bi-214	0.9	pCi/g	0.28		0.29
AS-14-11.5	6/12/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.2	mg/kg	1.2		
AS-14-11.5	6/12/2001	soil	GAMMA	13966-00-2	K-40	27.7	pCi/g	1.5		5.6
AS-14-11.5	6/12/2001	soil	RCRAMETALS	7439-92-1	Lead	20	mg/kg	0.35		
AS-14-11.5	6/12/2001	soil	VOCs	75-09-2	Methylene Chloride	41	µg/kg	5.9		
AS-14-11.5	6/12/2001	soil	GAMMA	15092-94-1	Pb-212	2.05	pCi/g	0.25		0.42
AS-14-11.5	6/12/2001	soil	GAMMA	15067-28-4	Pb-214	0.91	pCi/g	0.25		0.23
AS-14-11.5	6/12/2001	soil	GAMMA	15065-10-8	TH-234	2.39	pCi/g	1.4		0.94
AS-14-11.5	6/12/2001	soil	GAMMA	14913-50-9	Tl-208	0.6	pCi/g	0.13		0.17
AS-14-2	6/12/2001	soil	GAMMA	14331-83-0	Ac-228	1.61	pCi/g	0.53		0.47
AS-14-2	6/12/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.2	mg/kg	1.2		
AS-14-2	6/12/2001	soil	RCRAMETALS	7440-39-3	Barium	100	mg/kg	12		
AS-14-2	6/12/2001	soil	GAMMA	14733-03-0	Bi-214	0.91	pCi/g	0.34		0.32
AS-14-2	6/12/2001	soil	SVOCs	117-81-7	Bis(2-ethylhexyl)phthalate	120	µg/kg	390	J	
AS-14-2	6/12/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.5	mg/kg	1.2		
AS-14-2	6/12/2001	soil	GAMMA	10045-97-3	Cs-137	2.23	pCi/g	0.16		0.45
AS-14-2	6/12/2001	soil	GAMMA	13966-00-2	K-40	30.5	pCi/g	1.5		6.3
AS-14-2	6/12/2001	soil	RCRAMETALS	7439-92-1	Lead	11	mg/kg	0.35		
AS-14-2	6/12/2001	soil	METALS	7439-97-6	Mercury	0.055	mg/kg	0.12	B	
AS-14-2	6/12/2001	soil	VOCs	75-09-2	Methylene Chloride	25	µg/kg	5.9		
AS-14-2	6/12/2001	soil	GAMMA	15092-94-1	Pb-212	1.76	pCi/g	0.27		0.39
AS-14-2	6/12/2001	soil	GAMMA	15067-28-4	Pb-214	0.81	pCi/g	0.3		0.25
AS-14-2	6/12/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.056	pCi/g	0.01		0.023
AS-14-2	6/12/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.62	mg/kg	0.59		
AS-14-2	6/12/2001	soil	GAMMA	14913-50-9	Tl-208	0.68	pCi/g	0.16		0.19
AS-15-27.5	6/11/2001	soil	GAMMA	14331-83-0	Ac-228	1.78	pCi/g	0.83		0.51
AS-15-27.5	6/11/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.4	mg/kg	1.2		
AS-15-27.5	6/11/2001	soil	RCRAMETALS	7440-39-3	Barium	30	mg/kg	12		
AS-15-27.5	6/11/2001	soil	GAMMA	14733-03-0	Bi-214	0.67	pCi/g	0.35		0.29
AS-15-27.5	6/11/2001	soil	GAMMA	13966-00-2	K-40	26.4	pCi/g	2.8		5.8

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-15-27.5	6/11/2001	soil	RCRAMETALS	7439-92-1	Lead	2.4	mg/kg	0.35		
AS-15-27.5	6/11/2001	soil	GAMMA	15092-94-1	Pb-212	2.11	pCi/g	0.33		0.46
AS-15-27.5	6/11/2001	soil	GAMMA	15067-28-4	Pb-214	0.58	pCi/g	0.33		0.22
AS-15-27.5	6/11/2001	soil	GAMMA	14913-50-9	Tl-208	0.93	pCi/g	0.15		0.23
AS-15-8.5	6/11/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.8	mg/kg	1.1		
AS-15-8.5	6/11/2001	soil	RCRAMETALS	7440-39-3	Barium	200	mg/kg	11		
AS-15-8.5	6/11/2001	soil	RCRAMETALS	7440-47-3	Chromium	3	mg/kg	1.1	J	
AS-15-8.5	6/11/2001	soil	GAMMA	10045-97-3	Cs-137	205	pCi/g	0.81		34
AS-15-8.5	6/11/2001	soil	DRO	68334-30-5	Diesel-Range Organics	3.8	mg/kg	5.6	J	
AS-15-8.5	6/11/2001	soil	GAMMA	13966-00-2	K-40	26.1	pCi/g	4		8.7
AS-15-8.5	6/11/2001	soil	RCRAMETALS	7439-92-1	Lead	10	mg/kg	0.33		
AS-15-8.5	6/11/2001	soil	METALS	7439-97-6	Mercury	0.048	mg/kg	0.11	B	
AS-15-8.5	6/11/2001	soil	PLUTONIUM	13981-16-3	Pu-238	1.03	pCi/g	0.028		0.17
AS-15-8.5	6/11/2001	soil	PLUTONIUM	15117-48-3	Pu-239	5.73	pCi/g	0.014		0.77
AS-15-8.5	6/11/2001	soil	STRONTIUM	10098-97-2	Sr-90	9.4	pCi/g	0.38		1.8
AS-B1-S	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	1.69	pCi/g	0.63		0.53
AS-B1-S	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4.4	mg/kg	1		
AS-B1-S	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	63	mg/kg	10		
AS-B1-S	6/19/2001	soil	GAMMA	14733-03-0	Bi-214	1.13	pCi/g	0.31		0.34
AS-B1-S	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	4.7	mg/kg	1		
AS-B1-S	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	0.65	pCi/g	0.22		0.22
AS-B1-S	6/19/2001	soil	GAMMA	13966-00-2	K-40	32.9	pCi/g	1.7		6.9
AS-B1-S	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	10	mg/kg	0.31		
AS-B1-S	6/19/2001	soil	METALS	7439-97-6	Mercury	0.031	mg/kg	0.1	B	
AS-B1-S	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	2.06	pCi/g	0.36		0.48
AS-B1-S	6/19/2001	soil	GAMMA	15067-28-4	Pb-214	0.97	pCi/g	0.36		0.3
AS-B1-S	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	2.02	pCi/g	0.012		0.3
AS-B1-S	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.62	pCi/g	0.16		0.19
AS-B2-S	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	1.76	pCi/g	0.7		0.53
AS-B2-S	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.7	mg/kg	1		
AS-B2-S	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	130	mg/kg	10		
AS-B2-S	6/19/2001	soil	GAMMA	14733-03-0	Bi-214	0.96	pCi/g	0.39		0.36
AS-B2-S	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	4.7	mg/kg	1		
AS-B2-S	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	0.73	pCi/g	0.2		0.23
AS-B2-S	6/19/2001	soil	GAMMA	13966-00-2	K-40	27.8	pCi/g	2.3		6.2
AS-B2-S	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	14	mg/kg	0.3		
AS-B2-S	6/19/2001	soil	METALS	7439-97-6	Mercury	0.033	mg/kg	0.1	B	
AS-B2-S	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	1.85	pCi/g	0.29		0.43

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AS-B2-S	6/19/2001	soil	GAMMA	15067-28-4	Pb-214	0.98	pCi/g	0.32		0.29
AS-B2-S	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.484	pCi/g	0.012		0.093
AS-B2-S	6/19/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.22	mg/kg	0.51	J	
AS-B2-S	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.64	pCi/g	0.18		0.21
AS-B3-S	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.9	mg/kg	1		
AS-B3-S	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	170	mg/kg	10		
AS-B3-S	6/19/2001	soil	GAMMA	14733-03-0	Bi-214	0.9	pCi/g	0.44		0.35
AS-B3-S	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	3.4	mg/kg	1		
AS-B3-S	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	2	pCi/g	0.24		0.46
AS-B3-S	6/19/2001	soil	GAMMA	13966-00-2	K-40	27.4	pCi/g	2.7		6.3
AS-B3-S	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	22	mg/kg	0.3		
AS-B3-S	6/19/2001	soil	METALS	7439-97-6	Mercury	0.019	mg/kg	0.1	B	
AS-B3-S	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	1.7	pCi/g	0.48		0.46
AS-B3-S	6/19/2001	soil	GAMMA	15067-28-4	Pb-214	1.24	pCi/g	0.4		0.35
AS-B3-S	6/19/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.041	pCi/g	0.018	LT	0.021
AS-B3-S	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	1.81	pCi/g	0.016		0.27
AS-B3-S	6/19/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.39	mg/kg	0.51	J	
AS-B3-S	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.7	pCi/g	0.25		0.24
AS-C1-0.5	6/18/2001	soil	GAMMA	14331-83-0	Ac-228	1.67	pCi/g	0.59		0.52
AS-C1-0.5	6/18/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.3	mg/kg	1.1		
AS-C1-0.5	6/18/2001	soil	RCRAMETALS	7440-39-3	Barium	770	mg/kg	11		
AS-C1-0.5	6/18/2001	soil	GAMMA	14733-03-0	Bi-214	0.83	pCi/g	0.37		0.35
AS-C1-0.5	6/18/2001	soil	RCRAMETALS	7440-47-3	Chromium	2	mg/kg	1.1		
AS-C1-0.5	6/18/2001	soil	GAMMA	13966-00-2	K-40	31.6	pCi/g	2.6		7
AS-C1-0.5	6/18/2001	soil	RCRAMETALS	7439-92-1	Lead	4	mg/kg	0.34		
AS-C1-0.5	6/18/2001	soil	METALS	7439-97-6	Mercury	0.16	mg/kg	0.11		
AS-C1-0.5	6/18/2001	soil	VOCs	75-09-2	Methylene Chloride	14	µg/kg	5.6		
AS-C1-0.5	6/18/2001	soil	GAMMA	15092-94-1	Pb-212	1.9	pCi/g	0.4		0.48
AS-C1-0.5	6/18/2001	soil	GAMMA	15067-28-4	Pb-214	0.84	pCi/g	0.47		0.31
AS-C1-0.5	6/18/2001	soil	GAMMA	14913-50-9	Tl-208	0.7	pCi/g	0.17		0.22
AS-C1-B	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	1.83	pCi/g	0.64		0.65
AS-C1-B	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.7	mg/kg	1.1		
AS-C1-B	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	290	mg/kg	11		
AS-C1-B	6/19/2001	soil	GAMMA	14733-03-0	Bi-214	0.88	pCi/g	0.37		0.36
AS-C1-B	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.6	mg/kg	1.1		
AS-C1-B	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	4.67	pCi/g	0.16		0.9
AS-C1-B	6/19/2001	soil	GAMMA	13966-00-2	K-40	25.8	pCi/g	2.1		6.1
AS-C1-B	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	6	mg/kg	0.34		

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AS-C1-B	6/19/2001	soil	METALS	7439-97-6	Mercury	0.2	mg/kg	0.11		
AS-C1-B	6/19/2001	soil	VOCs	75-09-2	Methylene Chloride	19	µg/kg	5.6		
AS-C1-B	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	2.06	pCi/g	0.39		0.5
AS-C1-B	6/19/2001	soil	GAMMA	15067-28-4	Pb-214	1.11	pCi/g	0.47		0.35
AS-C1-B	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.054	pCi/g	0.011		0.024
AS-C1-B	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.67	pCi/g	0.21		0.22
AS-C2-0.5	6/18/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.3	mg/kg	1.1		
AS-C2-0.5	6/18/2001	soil	RCRAMETALS	7440-39-3	Barium	2900	mg/kg	110		
AS-C2-0.5	6/18/2001	soil	GAMMA	14733-03-0	Bi-214	0.83	pCi/g	0.41		0.36
AS-C2-0.5	6/18/2001	soil	RCRAMETALS	7440-47-3	Chromium	5.6	mg/kg	1.1		
AS-C2-0.5	6/18/2001	soil	GAMMA	10045-97-3	Cs-137	6.8	pCi/g	0.27		1.3
AS-C2-0.5	6/18/2001	soil	GAMMA	13966-00-2	K-40	28.9	pCi/g	2.5		6.8
AS-C2-0.5	6/18/2001	soil	RCRAMETALS	7439-92-1	Lead	7.9	mg/kg	0.34		
AS-C2-0.5	6/18/2001	soil	METALS	7439-97-6	Mercury	0.061	mg/kg	0.11	B	
AS-C2-0.5	6/18/2001	soil	VOCs	75-09-2	Methylene Chloride	3.1	µg/kg	5.6	J	
AS-C2-0.5	6/18/2001	soil	GAMMA	15092-94-1	Pb-212	1.52	pCi/g	0.39		0.42
AS-C2-0.5	6/18/2001	soil	GAMMA	15067-28-4	Pb-214	0.84	pCi/g	0.5		0.33
AS-C2-0.5	6/18/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.124	pCi/g	0.02		0.041
AS-C2-0.5	6/18/2001	soil	GAMMA	14913-50-9	Tl-208	0.53	pCi/g	0.19		0.2
AS-C2-B	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	2.64	pCi/g	0.89		0.95
AS-C2-B	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.1	mg/kg	1.1		
AS-C2-B	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	1200	mg/kg	110		
AS-C2-B	6/19/2001	soil	GAMMA	14733-03-0	Bi-214	0.78	pCi/g	0.38		0.35
AS-C2-B	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.5	mg/kg	1.1		
AS-C2-B	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	1.17	pCi/g	0.28		0.34
AS-C2-B	6/19/2001	soil	GAMMA	13966-00-2	K-40	33.6	pCi/g	4		7.8
AS-C2-B	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	6	mg/kg	0.33		
AS-C2-B	6/19/2001	soil	METALS	7439-97-6	Mercury	0.062	mg/kg	0.11	B	
AS-C2-B	6/19/2001	soil	VOCs	75-09-2	Methylene Chloride	15	µg/kg	5.6		
AS-C2-B	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	1.88	pCi/g	0.54		0.52
AS-C2-B	6/19/2001	soil	GAMMA	15067-28-4	Pb-214	1.12	pCi/g	0.4		0.35
AS-C2-B	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.78	pCi/g	0.29		0.27
AS-C3-0.5	6/18/2001	soil	GAMMA	14331-83-0	Ac-228	1.34	pCi/g	0.65		0.54
AS-C3-0.5	6/18/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4.2	mg/kg	1.1		
AS-C3-0.5	6/18/2001	soil	RCRAMETALS	7440-39-3	Barium	420	mg/kg	11		
AS-C3-0.5	6/18/2001	soil	GAMMA	14733-03-0	Bi-214	0.94	pCi/g	0.44		0.39
AS-C3-0.5	6/18/2001	soil	RCRAMETALS	7440-47-3	Chromium	4.3	mg/kg	1.1		
AS-C3-0.5	6/18/2001	soil	GAMMA	10045-97-3	Cs-137	15.4	pCi/g	0.23		2.7

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AS-C3-0.5	6/18/2001	soil	GAMMA	13966-00-2	K-40	28.1	pCi/g	2.9		6.5
AS-C3-0.5	6/18/2001	soil	RCRAMETALS	7439-92-1	Lead	8.6	mg/kg	0.32		
AS-C3-0.5	6/18/2001	soil	METALS	7439-97-6	Mercury	0.041	mg/kg	0.11	B	
AS-C3-0.5	6/18/2001	soil	VOCs	75-09-2	Methylene Chloride	1.7	µg/kg	5.3	J	
AS-C3-0.5	6/18/2001	soil	GAMMA	15092-94-1	Pb-212	1.64	pCi/g	0.4		0.43
AS-C3-0.5	6/18/2001	soil	GAMMA	15067-28-4	Pb-214	0.98	pCi/g	0.55		0.36
AS-C3-0.5	6/18/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.443	pCi/g	0.017		0.087
AS-C3-0.5	6/18/2001	soil	GAMMA	14913-50-9	Tl-208	0.57	pCi/g	0.24		0.22
AS-C5-0.5	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	1.85	pCi/g	0.49		0.58
AS-C5-0.5	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	5.2	mg/kg	1.1		
AS-C5-0.5	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	160	mg/kg	11		
AS-C5-0.5	6/19/2001	soil	GAMMA	14733-03-0	Bi-214	1.07	pCi/g	0.44		0.38
AS-C5-0.5	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	3.5	mg/kg	1.1		
AS-C5-0.5	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	15.8	pCi/g	0.22		2.7
AS-C5-0.5	6/19/2001	soil	DRO	68334-30-5	Diesel-Range Organics	4.2	mg/kg	5.3	J	
AS-C5-0.5	6/19/2001	soil	GAMMA	13966-00-2	K-40	28.2	pCi/g	2.1		6.2
AS-C5-0.5	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	14	mg/kg	0.32		
AS-C5-0.5	6/19/2001	soil	METALS	7439-97-6	Mercury	0.051	mg/kg	0.11	B	
AS-C5-0.5	6/19/2001	soil	VOCs	75-09-2	Methylene Chloride	18	µg/kg	5.3		
AS-C5-0.5	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	2.07	pCi/g	0.47		0.52
AS-C5-0.5	6/19/2001	soil	GAMMA	15067-28-4	Pb-214	1.15	pCi/g	0.48		0.37
AS-C5-0.5	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	1.15	pCi/g	0.019		0.19
AS-C5-0.5	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.54	pCi/g	0.24		0.21
AS-C6-0.5	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	1.47	pCi/g	0.79		0.56
AS-C6-0.5	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4	mg/kg	1		
AS-C6-0.5	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	180	mg/kg	10		
AS-C6-0.5	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	3.3	mg/kg	1		
AS-C6-0.5	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	1.5	pCi/g	0.33		0.42
AS-C6-0.5	6/19/2001	soil	DRO	68334-30-5	Diesel-Range Organics	8.9	mg/kg	5.2		
AS-C6-0.5	6/19/2001	soil	GAMMA	13966-00-2	K-40	36.5	pCi/g	2.2		8.4
AS-C6-0.5	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	9.9	mg/kg	0.31		
AS-C6-0.5	6/19/2001	soil	METALS	7439-97-6	Mercury	0.032	mg/kg	0.1	B	
AS-C6-0.5	6/19/2001	soil	VOCs	75-09-2	Methylene Chloride	23	µg/kg	5.2		
AS-C6-0.5	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	1.96	pCi/g	0.33		0.49
AS-C6-0.5	6/19/2001	soil	GAMMA	15067-28-4	Pb-214	0.94	pCi/g	0.45		0.34
AS-C6-0.5	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.279	pCi/g	0.016		0.062
AS-C6-0.5	6/19/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.28	mg/kg	0.52	J	
AS-C6-0.5	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.82	pCi/g	0.21		0.27

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AS-C8-12	6/28/2001	soil	GAMMA	14331-83-0	Ac-228	1.91	pCi/g	0.59		0.47
AS-C8-12	6/28/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3	mg/kg	1.1		
AS-C8-12	6/28/2001	soil	RCRAMETALS	7440-39-3	Barium	210	mg/kg	11	J	
AS-C8-12	6/28/2001	soil	GAMMA	14733-03-0	Bi-214	1.02	pCi/g	0.34		0.3
AS-C8-12	6/28/2001	soil	RCRAMETALS	7440-47-3	Chromium	2	mg/kg	1.1		
AS-C8-12	6/28/2001	soil	GAMMA	10045-97-3	Cs-137	7.2	pCi/g	0.17		1.3
AS-C8-12	6/28/2001	soil	GAMMA	13966-00-2	K-40	34.5	pCi/g	1.8		6.5
AS-C8-12	6/28/2001	soil	RCRAMETALS	7439-92-1	Lead	7	mg/kg	0.32	J	
AS-C8-12	6/28/2001	soil	GAMMA	15092-94-1	Pb-212	2.26	pCi/g	0.27		0.46
AS-C8-12	6/28/2001	soil	GAMMA	15067-28-4	Pb-214	1.05	pCi/g	0.32		0.28
AS-C8-12	6/28/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.072	pCi/g	0.011		0.027
AS-C8-12	6/28/2001	soil	GAMMA	14913-50-9	Tl-208	0.61	pCi/g	0.15		0.17
AS-C8-C	6/28/2001	soil	GAMMA	14331-83-0	Ac-228	1.94	pCi/g	0.67		0.66
AS-C8-C	6/28/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.8	mg/kg	1.1		
AS-C8-C	6/28/2001	soil	RCRAMETALS	7440-39-3	Barium	900	mg/kg	11	J	
AS-C8-C	6/28/2001	soil	GAMMA	14733-03-0	Bi-214	1.09	pCi/g	0.53		0.45
AS-C8-C	6/28/2001	soil	RCRAMETALS	7440-47-3	Chromium	3.1	mg/kg	1.1		
AS-C8-C	6/28/2001	soil	GAMMA	10045-97-3	Cs-137	30.5	pCi/g	0.24		5.2
AS-C8-C	6/28/2001	soil	GAMMA	13966-00-2	K-40	33.3	pCi/g	1.5		7.3
AS-C8-C	6/28/2001	soil	RCRAMETALS	7439-92-1	Lead	6.8	mg/kg	0.32	J	
AS-C8-C	6/28/2001	soil	GAMMA	15092-94-1	Pb-212	1.76	pCi/g	0.49		0.49
AS-C8-C	6/28/2001	soil	GAMMA	15067-28-4	Pb-214	1.05	pCi/g	0.61		0.41
AS-C8-C	6/28/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.093	pCi/g	0.015		0.031
AS-C8-C	6/28/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.493	pCi/g	0.004		0.091
AS-C8-C	6/28/2001	soil	STRONTIUM	10098-97-2	Sr-90	1.11	pCi/g	0.33		0.3
AS-C9-20	6/28/2001	soil	GAMMA	14331-83-0	Ac-228	1.88	pCi/g	0.46		0.56
AS-C9-20	6/28/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.5	mg/kg	1.1		
AS-C9-20	6/28/2001	soil	RCRAMETALS	7440-39-3	Barium	94	mg/kg	11	J	
AS-C9-20	6/28/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.3	mg/kg	1.1		
AS-C9-20	6/28/2001	soil	GAMMA	10045-97-3	Cs-137	6.6	pCi/g	0.23		1.2
AS-C9-20	6/28/2001	soil	GAMMA	13966-00-2	K-40	37.4	pCi/g	2		8
AS-C9-20	6/28/2001	soil	RCRAMETALS	7439-92-1	Lead	4.9	mg/kg	0.33	J	
AS-C9-20	6/28/2001	soil	METALS	7439-97-6	Mercury	0.083	mg/kg	0.11	B	
AS-C9-20	6/28/2001	soil	GAMMA	15092-94-1	Pb-212	2.27	pCi/g	0.5		0.57
AS-C9-20	6/28/2001	soil	GAMMA	15067-28-4	Pb-214	1.03	pCi/g	0.42		0.39
AS-C9-20	6/28/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.3	pCi/g	0.01		0.063
AS-C9-20	6/28/2001	soil	GAMMA	14913-50-9	Tl-208	0.86	pCi/g	0.25		0.27
AS-C9-C	6/28/2001	soil	GAMMA	14331-83-0	Ac-228	1.74	pCi/g	0.77		0.61

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AS-C9-C	6/28/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.1	mg/kg	1.1		
AS-C9-C	6/28/2001	soil	RCRAMETALS	7440-39-3	Barium	90	mg/kg	11	J	
AS-C9-C	6/28/2001	soil	SVOCs	117-81-7	Bis(2-ethylhexyl)phthalate	69	µg/kg	350	J	
AS-C9-C	6/28/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.43	mg/kg	1.1	B	
AS-C9-C	6/28/2001	soil	GAMMA	10045-97-3	Cs-137	49	pCi/g	0.35		8.2
AS-C9-C	6/28/2001	soil	GAMMA	13966-00-2	K-40	38.8	pCi/g	2.5		8.2
AS-C9-C	6/28/2001	soil	RCRAMETALS	7439-92-1	Lead	5.6	mg/kg	0.32	J	
AS-C9-C	6/28/2001	soil	GAMMA	15092-94-1	Pb-212	1.91	pCi/g	0.67		0.57
AS-C9-C	6/28/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.109	pCi/g	0.014		0.035
AS-C9-C	6/28/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.65	pCi/g	0.011		0.11
AS-C9-C	6/28/2001	soil	STRONTIUM	10098-97-2	Sr-90	1.11	pCi/g	0.33		0.3
AS-C9-C	6/28/2001	soil	GAMMA	14913-50-9	Tl-208	0.7	pCi/g	0.35		0.29
AS-D07-01	10/10/2001	water	GAMMA	10045-97-3	Cs-137	73	pCi/L	8.8		15
AS-D07-01	10/10/2001	water	STRONTIUM	10098-97-2	Sr-90	3.72	pCi/L	0.44		0.8
AS-D18-01	10/10/2001	soil	GAMMA	14331-83-0	Ac-228	1.66	pCi/g	0.3		0.35
AS-D18-01	10/10/2001	soil	TCLPMETALS	7440-39-3	Barium	0.69	mg/L	1	B	
AS-D18-01	10/10/2001	soil	GAMMA	14733-03-0	Bi-214	0.82	pCi/g	0.21		0.2
AS-D18-01	10/10/2001	soil	GAMMA	10045-97-3	Cs-137	5.08	pCi/g	0.1		0.87
AS-D18-01	10/10/2001	soil	GAMMA	13966-00-2	K-40	27	pCi/g	1		4.8
AS-D18-01	10/10/2001	soil	GAMMA	15092-94-1	Pb-212	1.79	pCi/g	0.18		0.34
AS-D18-01	10/10/2001	soil	GAMMA	15067-28-4	Pb-214	0.99	pCi/g	0.21		0.22
AS-D18-01	10/10/2001	soil	PLUTONIUM	13981-16-3	Pu-238	1.5	pCi/g	0.0046		0.23
AS-D18-01	10/10/2001	soil	PLUTONIUM	15117-48-3	Pu-239	8.7	pCi/g	0.011		1.2
AS-D18-01	10/10/2001	soil	GAMMA	14913-50-9	Tl-208	0.51	pCi/g	0.096		0.12
AS-R10-02	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	1.82	pCi/g	0.84		0.65
AS-R10-02	6/21/2001	soil	VOCs	67-64-1	Acetone	21	µg/kg	21	J	
AS-R10-02	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	6.6	mg/kg	1		
AS-R10-02	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	130	mg/kg	10		
AS-R10-02	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	5	mg/kg	1		
AS-R10-02	6/21/2001	soil	DRO	68334-30-5	Diesel-Range Organics	1.8	mg/kg	5.1	J	
AS-R10-02	6/21/2001	soil	GAMMA	13966-00-2	K-40	29.3	pCi/g	2.6		6.9
AS-R10-02	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	17	mg/kg	0.31	J	
AS-R10-02	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	4.5	µg/kg	5.1	J	
AS-R10-02	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	2.78	pCi/g	0.33		0.61
AS-R10-02	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	1.09	pCi/g	0.49		0.36
AS-R10-02	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.203	pCi/g	0.013	J	0.054
AS-R10-02	6/21/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.7	mg/kg	0.51		
AS-R10-02	6/21/2001	soil	GAMMA	14913-50-9	Tl-208	0.58	pCi/g	0.24		0.23

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AS-R11-02	6/21/2001	soil	VOCs	67-64-1	Acetone	30	µg/kg	21	J	
AS-R11-02	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	7.3	mg/kg	1		
AS-R11-02	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	160	mg/kg	10		
AS-R11-02	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	1.07	pCi/g	0.51		0.44
AS-R11-02	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	12	mg/kg	1		
AS-R11-02	6/21/2001	soil	GAMMA	13966-00-2	K-40	19.2	pCi/g	3.1		5.1
AS-R11-02	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	21	mg/kg	0.31	J	
AS-R11-02	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	42	µg/kg	5.2		
AS-R11-02	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	1.52	pCi/g	0.43		0.43
AS-R11-02	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	1.17	pCi/g	0.44		0.36
AS-R11-02	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.096	pCi/g	0.0047	J	0.033
AS-R11-02	6/21/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.4	mg/kg	0.52		
AS-R11-02	6/21/2001	soil	GAMMA	14913-50-9	Tl-208	0.4	pCi/g	0.21		0.18
AS-R1-12	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	1.51	pCi/g	0.49		0.39
AS-R1-12	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.2	mg/kg	1.1		
AS-R1-12	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	160	mg/kg	11		
AS-R1-12	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	1.03	pCi/g	0.32		0.29
AS-R1-12	6/21/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.16	mg/kg	0.55	B	
AS-R1-12	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	2.2	mg/kg	1.1		
AS-R1-12	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	10.4	pCi/g	0.17		1.8
AS-R1-12	6/21/2001	soil	GAMMA	13966-00-2	K-40	32.1	pCi/g	1.6		6
AS-R1-12	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	9.5	mg/kg	0.33	J	
AS-R1-12	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	32	µg/kg	5.5		
AS-R1-12	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	2.01	pCi/g	0.31		0.43
AS-R1-12	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	0.9	pCi/g	0.39		0.27
AS-R1-12	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.061	pCi/g	0.015	J	0.026
AS-R1-12	6/21/2001	soil	GAMMA	14913-50-9	Tl-208	0.53	pCi/g	0.14		0.15
AS-R12-04	6/28/2001	soil	GAMMA	14331-83-0	Ac-228	0.78	pCi/g	0.39		0.24
AS-R12-04	6/28/2001	soil	VOCs	67-64-1	Acetone	57	µg/kg	20	J	
AS-R12-04	6/28/2001	soil	RCRAMETALS	7440-38-2	Arsenic	6.9	mg/kg	1		
AS-R12-04	6/28/2001	soil	RCRAMETALS	7440-39-3	Barium	130	mg/kg	10	J	
AS-R12-04	6/28/2001	soil	GAMMA	14913-49-6	BI-212	1.27	pCi/g	0.97		0.73
AS-R12-04	6/28/2001	soil	GAMMA	14733-03-0	Bi-214	0.97	pCi/g	0.25		0.25
AS-R12-04	6/28/2001	soil	RCRAMETALS	7440-47-3	Chromium	15	mg/kg	1		
AS-R12-04	6/28/2001	soil	GAMMA	13966-00-2	K-40	20.8	pCi/g	1.4		4
AS-R12-04	6/28/2001	soil	RCRAMETALS	7439-92-1	Lead	6.9	mg/kg	0.3	J	
AS-R12-04	6/28/2001	soil	METALS	7439-97-6	Mercury	0.2	mg/kg	0.1		
AS-R12-04	6/28/2001	soil	VOCs	75-09-2	Methylene Chloride	4	µg/kg	5.1	J	

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AS-R12-04	6/28/2001	soil	GAMMA	15092-94-1	Pb-212	0.83	pCi/g	0.18		0.21
AS-R12-04	6/28/2001	soil	GAMMA	15067-28-4	Pb-214	1.22	pCi/g	0.21		0.27
AS-R12-04	6/28/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.455	pCi/g	0.004		0.085
AS-R12-04	6/28/2001	soil	RCRAMETALS	7782-49-2	Selenium	5.1	mg/kg	0.51		
AS-R12-04	6/28/2001	soil	GAMMA	14913-50-9	Tl-208	0.32	pCi/g	0.1		0.1
AS-R12-04	6/28/2001	soil	VOCs	75-69-4	Trichlorofluoromethane	2.5	µg/kg	5.1	J	
AS-R13-04	6/28/2001	soil	GAMMA	14331-83-0	Ac-228	1.08	pCi/g	0.53		0.36
AS-R13-04	6/28/2001	soil	RCRAMETALS	7440-38-2	Arsenic	7.1	mg/kg	1		
AS-R13-04	6/28/2001	soil	RCRAMETALS	7440-39-3	Barium	97	mg/kg	10	J	
AS-R13-04	6/28/2001	soil	GAMMA	14733-03-0	Bi-214	1.28	pCi/g	0.28		0.36
AS-R13-04	6/28/2001	soil	RCRAMETALS	7440-47-3	Chromium	21	mg/kg	1		
AS-R13-04	6/28/2001	soil	GAMMA	13966-00-2	K-40	24.8	pCi/g	1.6		5.4
AS-R13-04	6/28/2001	soil	RCRAMETALS	7439-92-1	Lead	7	mg/kg	0.31	J	
AS-R13-04	6/28/2001	soil	METALS	7439-97-6	Mercury	0.096	mg/kg	0.1	B	
AS-R13-04	6/28/2001	soil	GAMMA	15092-94-1	Pb-212	1.46	pCi/g	0.26		0.36
AS-R13-04	6/28/2001	soil	GAMMA	15067-28-4	Pb-214	1.43	pCi/g	0.25		0.35
AS-R13-04	6/28/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.093	pCi/g	0.022		0.043
AS-R13-04	6/28/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.24	mg/kg	0.51	B	
AS-R14-08	7/10/2001	soil	GAMMA	14331-83-0	Ac-228	1.09	pCi/g	0.49		0.34
AS-R14-08	7/10/2001	soil	RCRAMETALS	7440-38-2	Arsenic	55	mg/kg	1	J	
AS-R14-08	7/10/2001	soil	RCRAMETALS	7440-39-3	Barium	200	mg/kg	10	J	
AS-R14-08	7/10/2001	soil	GAMMA	14733-03-0	Bi-214	1.04	pCi/g	0.33		0.32
AS-R14-08	7/10/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.21	mg/kg	0.52	J	
AS-R14-08	7/10/2001	soil	RCRAMETALS	7440-47-3	Chromium	5	mg/kg	1	J	
AS-R14-08	7/10/2001	soil	GAMMA	10045-97-3	Cs-137	10.9	pCi/g	0.23		1.9
AS-R14-08	7/10/2001	soil	GAMMA	13966-00-2	K-40	24.8	pCi/g	1.7		5
AS-R14-08	7/10/2001	soil	RCRAMETALS	7439-92-1	Lead	9.6	mg/kg	0.31	J	
AS-R14-08	7/10/2001	soil	GAMMA	15092-94-1	Pb-212	1.36	pCi/g	0.32		0.33
AS-R14-08	7/10/2001	soil	GAMMA	15067-28-4	Pb-214	1.2	pCi/g	0.48		0.33
AS-R14-08	7/10/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.195	pCi/g	0.0063	J	0.057
AS-R14-08	7/10/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.7	mg/kg	0.52	J	
AS-R14-08	7/10/2001	soil	STRONTIUM	10098-97-2	Sr-90	0.63	pCi/g	0.28		0.22
AS-R14-08	7/10/2001	soil	GAMMA	14913-50-9	Tl-208	0.5	pCi/g	0.16		0.15
AS-R14-C	7/10/2001	soil	GAMMA	14331-83-0	Ac-228	1.35	pCi/g	0.27		0.29
AS-R14-C	7/10/2001	soil	RCRAMETALS	7440-38-2	Arsenic	77	mg/kg	1	J	
AS-R14-C	7/10/2001	soil	RCRAMETALS	7440-39-3	Barium	180	mg/kg	10	J	
AS-R14-C	7/10/2001	soil	GAMMA	14733-03-0	Bi-214	1	pCi/g	0.18		0.22
AS-R14-C	7/10/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.21	mg/kg	0.51	J	

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AS-R14-C	7/10/2001	soil	RCRAMETALS	7440-47-3	Chromium	4.3	mg/kg	1	J	
AS-R14-C	7/10/2001	soil	GAMMA	10045-97-3	Cs-137	10.6	pCi/g	0.095		1.8
AS-R14-C	7/10/2001	soil	GAMMA	13966-00-2	K-40	23.4	pCi/g	0.94		4.2
AS-R14-C	7/10/2001	soil	RCRAMETALS	7439-92-1	Lead	6.9	mg/kg	0.31	J	
AS-R14-C	7/10/2001	soil	GAMMA	15092-94-1	Pb-212	1.46	pCi/g	0.18		0.28
AS-R14-C	7/10/2001	soil	GAMMA	15067-28-4	Pb-214	1.04	pCi/g	0.22		0.22
AS-R14-C	7/10/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.227	pCi/g	0.012	J	0.056
AS-R14-C	7/10/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.85	mg/kg	0.51	J	
AS-R14-C	7/10/2001	soil	STRONTIUM	10098-97-2	Sr-90	0.85	pCi/g	0.27		0.24
AS-R14-C	7/10/2001	soil	GAMMA	14913-50-9	Tl-208	0.49	pCi/g	0.091		0.11
AS-R15-06	7/11/2001	soil	GAMMA	14331-83-0	Ac-228	1.42	pCi/g	0.33		0.35
AS-R15-06	7/11/2001	soil	RCRAMETALS	7440-38-2	Arsenic	14	mg/kg	1	J	
AS-R15-06	7/11/2001	soil	RCRAMETALS	7440-39-3	Barium	130	mg/kg	10	J	
AS-R15-06	7/11/2001	soil	GAMMA	14733-03-0	Bi-214	1.2	pCi/g	0.23		0.29
AS-R15-06	7/11/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.35	mg/kg	0.51	J	
AS-R15-06	7/11/2001	soil	RCRAMETALS	7440-47-3	Chromium	6	mg/kg	1	J	
AS-R15-06	7/11/2001	soil	GAMMA	10045-97-3	Cs-137	4.86	pCi/g	0.13		0.86
AS-R15-06	7/11/2001	soil	GAMMA	13966-00-2	K-40	26.8	pCi/g	1		5.2
AS-R15-06	7/11/2001	soil	RCRAMETALS	7439-92-1	Lead	16	mg/kg	0.31	J	
AS-R15-06	7/11/2001	soil	GAMMA	15092-94-1	Pb-212	1.71	pCi/g	0.2		0.35
AS-R15-06	7/11/2001	soil	GAMMA	15067-28-4	Pb-214	1.25	pCi/g	0.28		0.29
AS-R15-06	7/11/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.36	pCi/g	0.0049	J	0.078
AS-R15-06	7/11/2001	soil	PLUTONIUM	15117-48-3	Pu-239	20.5	pCi/g	0.0093	J	2.8
AS-R15-06	7/11/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.3	mg/kg	0.51	J	
AS-R15-06	7/11/2001	soil	GAMMA	14913-50-9	Tl-208	0.54	pCi/g	0.13		0.15
AS-R15-C	7/11/2001	soil	GAMMA	14331-83-0	Ac-228	1.24	pCi/g	0.3		0.28
AS-R15-C	7/11/2001	soil	RCRAMETALS	7440-38-2	Arsenic	28	mg/kg	1	J	
AS-R15-C	7/11/2001	soil	RCRAMETALS	7440-39-3	Barium	210	mg/kg	10	J	
AS-R15-C	7/11/2001	soil	GAMMA	14733-03-0	Bi-214	1.02	pCi/g	0.24		0.24
AS-R15-C	7/11/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.32	mg/kg	0.51	J	
AS-R15-C	7/11/2001	soil	RCRAMETALS	7440-47-3	Chromium	6.5	mg/kg	1	J	
AS-R15-C	7/11/2001	soil	GAMMA	10045-97-3	Cs-137	27.6	pCi/g	0.13		4.6
AS-R15-C	7/11/2001	soil	GAMMA	13966-00-2	K-40	27.5	pCi/g	0.99		4.8
AS-R15-C	7/11/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.31	J	
AS-R15-C	7/11/2001	soil	GAMMA	15092-94-1	Pb-212	1.66	pCi/g	0.23		0.33
AS-R15-C	7/11/2001	soil	GAMMA	15067-28-4	Pb-214	1.26	pCi/g	0.31		0.28
AS-R15-C	7/11/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.07	pCi/g	0.017	J	0.029
AS-R15-C	7/11/2001	soil	PLUTONIUM	15117-48-3	Pu-239	2.01	pCi/g	0.015	J	0.31

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AS-R15-C	7/11/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.5	mg/kg	0.51	J	
AS-R15-C	7/11/2001	soil	STRONTIUM	10098-97-2	Sr-90	1.41	pCi/g	0.25	Y1	0.32
AS-R15-C	7/11/2001	soil	GAMMA	14913-50-9	Tl-208	0.45	pCi/g	0.12		0.11
AS-R16-02	7/10/2001	soil	GAMMA	14331-83-0	Ac-228	1.26	pCi/g	0.49		0.43
AS-R16-02	7/10/2001	soil	VOCs	67-64-1	Acetone	29	µg/kg	20	J	
AS-R16-02	7/10/2001	soil	RCRAMETALS	7440-38-2	Arsenic	20	mg/kg	1	J	
AS-R16-02	7/10/2001	soil	RCRAMETALS	7440-39-3	Barium	180	mg/kg	10	J	
AS-R16-02	7/10/2001	soil	GAMMA	14733-03-0	Bi-214	1.21	pCi/g	0.49		0.37
AS-R16-02	7/10/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.6	mg/kg	0.51	J	
AS-R16-02	7/10/2001	soil	RCRAMETALS	7440-47-3	Chromium	6.7	mg/kg	1	J	
AS-R16-02	7/10/2001	soil	GAMMA	10045-97-3	Cs-137	23.2	pCi/g	0.29		3.9
AS-R16-02	7/10/2001	soil	GAMMA	13966-00-2	K-40	27.7	pCi/g	2.3		5.7
AS-R16-02	7/10/2001	soil	RCRAMETALS	7439-92-1	Lead	11	mg/kg	0.31	J	
AS-R16-02	7/10/2001	soil	GAMMA	15092-94-1	Pb-212	1.49	pCi/g	0.4		0.38
AS-R16-02	7/10/2001	soil	GAMMA	15067-28-4	Pb-214	1.1	pCi/g	0.56		0.35
AS-R16-02	7/10/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.041	pCi/g	0.012	J	0.021
AS-R16-02	7/10/2001	soil	PLUTONIUM	15117-48-3	Pu-239	1.75	pCi/g	0.012	J	0.27
AS-R16-02	7/10/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.4	mg/kg	0.51	J	
AS-R16-02	7/10/2001	soil	STRONTIUM	10098-97-2	Sr-90	1.64	pCi/g	0.27		0.37
AS-R16-02	7/10/2001	soil	GAMMA	14913-50-9	Tl-208	0.54	pCi/g	0.21		0.18
AS-R16-04	7/10/2001	soil	GAMMA	14331-83-0	Ac-228	1.48	pCi/g	0.33		0.33
AS-R16-04	7/10/2001	soil	RCRAMETALS	7440-38-2	Arsenic	21	mg/kg	1	J	
AS-R16-04	7/10/2001	soil	RCRAMETALS	7440-39-3	Barium	140	mg/kg	10	J	
AS-R16-04	7/10/2001	soil	GAMMA	14733-03-0	Bi-214	0.92	pCi/g	0.25		0.23
AS-R16-04	7/10/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.54	mg/kg	0.51	J	
AS-R16-04	7/10/2001	soil	RCRAMETALS	7440-47-3	Chromium	6.7	mg/kg	1	J	
AS-R16-04	7/10/2001	soil	GAMMA	10045-97-3	Cs-137	10.2	pCi/g	0.11		1.7
AS-R16-04	7/10/2001	soil	GAMMA	13966-00-2	K-40	28	pCi/g	1.3		5
AS-R16-04	7/10/2001	soil	RCRAMETALS	7439-92-1	Lead	10	mg/kg	0.31	J	
AS-R16-04	7/10/2001	soil	GAMMA	15092-94-1	Pb-212	1.67	pCi/g	0.21		0.33
AS-R16-04	7/10/2001	soil	GAMMA	15067-28-4	Pb-214	1.27	pCi/g	0.26		0.27
AS-R16-04	7/10/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.365	pCi/g	0.0047	J	0.077
AS-R16-04	7/10/2001	soil	RCRAMETALS	7782-49-2	Selenium	1.1	mg/kg	0.51	J	
AS-R16-04	7/10/2001	soil	STRONTIUM	10098-97-2	Sr-90	0.59	pCi/g	0.29		0.22
AS-R16-04	7/10/2001	soil	GAMMA	14913-50-9	Tl-208	0.49	pCi/g	0.11		0.12
AS-R1-C	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	1.78	pCi/g	0.64		0.55
AS-R1-C	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3	mg/kg	1.1		
AS-R1-C	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	140	mg/kg	11		

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AS-R1-C	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.4	mg/kg	1.1		
AS-R1-C	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	102	pCi/g	0.33		17
AS-R1-C	6/21/2001	soil	DRO	68334-30-5	Diesel-Range Organics	5.3	mg/kg	5.3		
AS-R1-C	6/21/2001	soil	GAMMA	13966-00-2	K-40	34.7	pCi/g	1.9		7.3
AS-R1-C	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	6.9	mg/kg	0.32	J	
AS-R1-C	6/21/2001	soil	METALS	7439-97-6	Mercury	0.066	mg/kg	0.11	B	
AS-R1-C	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	2.37	pCi/g	0.71		0.64
AS-R1-C	6/21/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.11	pCi/g	0.02		0.037
AS-R1-C	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.76	pCi/g	0.018	J	0.13
AS-R1-C	6/21/2001	soil	STRONTIUM	10098-97-2	Sr-90	4.63	pCi/g	0.34		0.9
AS-R2-19	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	1.66	pCi/g	0.64		0.59
AS-R2-19	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.2	mg/kg	1.1		
AS-R2-19	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	150	mg/kg	11		
AS-R2-19	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	0.88	pCi/g	0.35		0.35
AS-R2-19	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	2.1	mg/kg	1.1		
AS-R2-19	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	9.7	pCi/g	0.21		1.7
AS-R2-19	6/21/2001	soil	DRO	68334-30-5	Diesel-Range Organics	9.1	mg/kg	5.5		
AS-R2-19	6/21/2001	soil	GAMMA	13966-00-2	K-40	27.3	pCi/g	2		6.2
AS-R2-19	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	30	mg/kg	0.33	J	
AS-R2-19	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	7.7	µg/kg	5.5		
AS-R2-19	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	2.36	pCi/g	0.44		0.56
AS-R2-19	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	0.96	pCi/g	0.55		0.38
AS-R2-19	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.058	pCi/g	0.013	J	0.026
AS-R2-19	6/21/2001	soil	GAMMA	14913-50-9	Tl-208	0.69	pCi/g	0.23		0.24
AS-R2-C	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	2.15	pCi/g	0.94		0.84
AS-R2-C	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4.1	mg/kg	1.1		
AS-R2-C	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	210	mg/kg	11		
AS-R2-C	6/21/2001	soil	SVOCs	117-81-7	Bis(2-ethylhexyl)phthalate	71	µg/kg	360	J	
AS-R2-C	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	3	mg/kg	1.1		
AS-R2-C	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	67	pCi/g	0.55		11
AS-R2-C	6/21/2001	soil	DRO	68334-30-5	Diesel-Range Organics	7.7	mg/kg	5.3		
AS-R2-C	6/21/2001	soil	GAMMA	13966-00-2	K-40	23.4	pCi/g	4.2		6.2
AS-R2-C	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	10	mg/kg	0.32	J	
AS-R2-C	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	2.19	pCi/g	0.9		0.71
AS-R2-C	6/21/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.057	pCi/g	0.027		0.028
AS-R2-C	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.323	pCi/g	0.017	J	0.074
AS-R2-C	6/21/2001	soil	STRONTIUM	10098-97-2	Sr-90	2.49	pCi/g	0.29		0.52
AS-R3-27	6/22/2001	soil	GAMMA	14331-83-0	Ac-228	1.82	pCi/g	0.48		0.44

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AS-R3-27	6/22/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.7	mg/kg	1.1		
AS-R3-27	6/22/2001	soil	RCRAMETALS	7440-39-3	Barium	92	mg/kg	11		
AS-R3-27	6/22/2001	soil	GAMMA	14733-03-0	Bi-214	1.25	pCi/g	0.3		0.32
AS-R3-27	6/22/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.3	mg/kg	1.1		
AS-R3-27	6/22/2001	soil	GAMMA	10045-97-3	Cs-137	8.5	pCi/g	0.14		1.5
AS-R3-27	6/22/2001	soil	GAMMA	13966-00-2	K-40	31.4	pCi/g	1.5		5.8
AS-R3-27	6/22/2001	soil	RCRAMETALS	7439-92-1	Lead	6.8	mg/kg	0.32	J	
AS-R3-27	6/22/2001	soil	VOCs	75-09-2	Methylene Chloride	4.1	µg/kg	5.4	J	
AS-R3-27	6/22/2001	soil	GAMMA	15092-94-1	Pb-212	2.08	pCi/g	0.26		0.42
AS-R3-27	6/22/2001	soil	GAMMA	15067-28-4	Pb-214	1.33	pCi/g	0.32		0.31
AS-R3-27	6/22/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.131	pCi/g	0.011	J	0.039
AS-R3-27	6/22/2001	soil	GAMMA	14913-50-9	Tl-208	0.54	pCi/g	0.15		0.15
AS-R3-C	6/22/2001	soil	GAMMA	14331-83-0	Ac-228	1.85	pCi/g	0.65		0.58
AS-R3-C	6/22/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4	mg/kg	1.1		
AS-R3-C	6/22/2001	soil	RCRAMETALS	7440-39-3	Barium	220	mg/kg	11		
AS-R3-C	6/22/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.5	mg/kg	1.1		
AS-R3-C	6/22/2001	soil	GAMMA	10045-97-3	Cs-137	112	pCi/g	0.35		19
AS-R3-C	6/22/2001	soil	DRO	68334-30-5	Diesel-Range Organics	4.6	mg/kg	5.3	J	
AS-R3-C	6/22/2001	soil	GAMMA	13966-00-2	K-40	32	pCi/g	2.1		6.9
AS-R3-C	6/22/2001	soil	RCRAMETALS	7439-92-1	Lead	16	mg/kg	0.32	J	
AS-R3-C	6/22/2001	soil	GAMMA	15092-94-1	Pb-212	1.36	pCi/g	0.68		0.51
AS-R3-C	6/22/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.101	pCi/g	0.028		0.038
AS-R3-C	6/22/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.51	pCi/g	0.026	J	0.1
AS-R3-C	6/22/2001	soil	STRONTIUM	10098-97-2	Sr-90	5.7	pCi/g	0.33		1.1
AS-R4-02	6/21/2001	soil	VOCs	67-64-1	Acetone	130	µg/kg	20	J	
AS-R4-02	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	65	mg/kg	1		
AS-R4-02	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	170	mg/kg	10		
AS-R4-02	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	1.47	pCi/g	0.42		0.44
AS-R4-02	6/21/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.89	mg/kg	1	B	
AS-R4-02	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	6.7	mg/kg	1		
AS-R4-02	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	0.79	pCi/g	0.22		0.25
AS-R4-02	6/21/2001	soil	DRO	68334-30-5	Diesel-Range Organics	15	mg/kg	5		
AS-R4-02	6/21/2001	soil	GAMMA	13966-00-2	K-40	17.9	pCi/g	3.1		4.8
AS-R4-02	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	16	mg/kg	0.6	J	
AS-R4-02	6/21/2001	soil	METALS	7439-97-6	Mercury	0.1	mg/kg	0.1		
AS-R4-02	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	24	µg/kg	5		
AS-R4-02	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	1.1	pCi/g	0.4		0.36
AS-R4-02	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	1.63	pCi/g	0.36		0.4

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AS-R4-02	6/21/2001	soil	VOCs	99-87-6	P-Isopropyltoluene	20	µg/kg	5	J	
AS-R4-02	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	1.54	pCi/g	0.011	J	0.24
AS-R4-02	6/21/2001	soil	RCRAMETALS	7782-49-2	Selenium	2.2	mg/kg	1		
AS-R4-02	6/21/2001	soil	VOCs	108-88-3	Toluene	2.4	µg/kg	5	J	
AS-R5-02	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	0.9	pCi/g	0.31		0.25
AS-R5-02	6/21/2001	soil	VOCs	67-64-1	Acetone	35	µg/kg	20	J	
AS-R5-02	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	60	mg/kg	1		
AS-R5-02	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	120	mg/kg	10		
AS-R5-02	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	1.13	pCi/g	0.25		0.27
AS-R5-02	6/21/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.23	mg/kg	1	B	
AS-R5-02	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	5	mg/kg	1		
AS-R5-02	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	0.54	pCi/g	0.12		0.14
AS-R5-02	6/21/2001	soil	GAMMA	13966-00-2	K-40	21.4	pCi/g	1.2		4.1
AS-R5-02	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.6	J	
AS-R5-02	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	22	µg/kg	5		
AS-R5-02	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	0.84	pCi/g	0.17		0.2
AS-R5-02	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	1.34	pCi/g	0.24		0.29
AS-R5-02	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.36	pCi/g	0.015	J	0.077
AS-R5-02	6/21/2001	soil	RCRAMETALS	7782-49-2	Selenium	2.3	mg/kg	1		
AS-R5-02	6/21/2001	soil	GAMMA	14913-50-9	Tl-208	0.35	pCi/g	0.093		0.1
AS-R5-02	6/21/2001	soil	VOCs	108-88-3	Toluene	2.1	µg/kg	5	J	
AS-R6-02	6/21/2001	soil	VOCs	67-64-1	Acetone	34	µg/kg	20	J	
AS-R6-02	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	14	mg/kg	1		
AS-R6-02	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	190	mg/kg	10		
AS-R6-02	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	0.87	pCi/g	0.37		0.36
AS-R6-02	6/21/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.25	mg/kg	1	B	
AS-R6-02	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	27	mg/kg	1		
AS-R6-02	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	0.7	pCi/g	0.23		0.25
AS-R6-02	6/21/2001	soil	GAMMA	13966-00-2	K-40	13.4	pCi/g	3.3		4.3
AS-R6-02	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	17	mg/kg	0.61	J	
AS-R6-02	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	25	µg/kg	5.1	J	
AS-R6-02	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	1.46	pCi/g	0.42		0.42
AS-R6-02	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	1.23	pCi/g	0.46		0.38
AS-R6-02	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.55	pCi/g	0.017	J	0.1
AS-R6-02	6/21/2001	soil	RCRAMETALS	7782-49-2	Selenium	2.7	mg/kg	1		
AS-R8-02	6/21/2001	soil	VOCs	78-93-3	2-Butanone	23	µg/kg	20	J	
AS-R8-02	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	1.17	pCi/g	0.44		0.32
AS-R8-02	6/21/2001	soil	VOCs	67-64-1	Acetone	250	µg/kg	20	J	

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AS-R8-02	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	18	mg/kg	1		
AS-R8-02	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	100	mg/kg	10		
AS-R8-02	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	1.53	pCi/g	0.27		0.35
AS-R8-02	6/21/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.26	mg/kg	1	B	
AS-R8-02	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	20	mg/kg	1		
AS-R8-02	6/21/2001	soil	GAMMA	10045-97-3	Cs-137	0.75	pCi/g	0.13		0.18
AS-R8-02	6/21/2001	soil	GAMMA	13966-00-2	K-40	15.2	pCi/g	1.5		3.2
AS-R8-02	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	15	mg/kg	0.61	J	
AS-R8-02	6/21/2001	soil	METALS	7439-97-6	Mercury	0.098	mg/kg	0.1	B	
AS-R8-02	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	61	µg/kg	5.1	J	
AS-R8-02	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	1.84	pCi/g	0.25		0.38
AS-R8-02	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	1.65	pCi/g	0.26		0.35
AS-R8-02	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.315	pCi/g	0.014	J	0.067
AS-R8-02	6/21/2001	soil	RCRAMETALS	7782-49-2	Selenium	2.9	mg/kg	1		
AS-R8-02	6/21/2001	soil	GAMMA	14913-50-9	Tl-208	0.51	pCi/g	0.13		0.14
AS-R8-02	6/21/2001	soil	VOCs	108-88-3	Toluene	2.9	µg/kg	5.1	J	
AS-R8-02	6/21/2001	soil	VOCs	75-69-4	Trichlorofluoromethane	2.2	µg/kg	5.1	J	
AS-R9-02	6/21/2001	soil	GAMMA	14331-83-0	Ac-228	1	pCi/g	0.4		0.28
AS-R9-02	6/21/2001	soil	RCRAMETALS	7440-38-2	Arsenic	13	mg/kg	1		
AS-R9-02	6/21/2001	soil	RCRAMETALS	7440-39-3	Barium	170	mg/kg	10		
AS-R9-02	6/21/2001	soil	GAMMA	14733-03-0	Bi-214	1.39	pCi/g	0.21		0.31
AS-R9-02	6/21/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.24	mg/kg	0.51	B	
AS-R9-02	6/21/2001	soil	RCRAMETALS	7440-47-3	Chromium	4.7	mg/kg	1		
AS-R9-02	6/21/2001	soil	GAMMA	13966-00-2	K-40	24.9	pCi/g	1.4		4.7
AS-R9-02	6/21/2001	soil	RCRAMETALS	7439-92-1	Lead	19	mg/kg	0.3	J	
AS-R9-02	6/21/2001	soil	METALS	7439-97-6	Mercury	0.06	mg/kg	0.1	B	
AS-R9-02	6/21/2001	soil	VOCs	75-09-2	Methylene Chloride	28	µg/kg	5.1		
AS-R9-02	6/21/2001	soil	GAMMA	15092-94-1	Pb-212	1.45	pCi/g	0.19		0.3
AS-R9-02	6/21/2001	soil	GAMMA	15067-28-4	Pb-214	1.59	pCi/g	0.23		0.33
AS-R9-02	6/21/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.061	pCi/g	0.011	J	0.025
AS-R9-02	6/21/2001	soil	RCRAMETALS	7782-49-2	Selenium	2.4	mg/kg	0.51		
AS-R9-02	6/21/2001	soil	GAMMA	14913-50-9	Tl-208	0.43	pCi/g	0.1		0.12
AS-S1-1	6/16/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.1	mg/kg	1.2		
AS-S1-1	6/16/2001	soil	RCRAMETALS	7440-39-3	Barium	270	mg/kg	12		
AS-S1-1	6/16/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.47	mg/kg	1.2	J	
AS-S1-1	6/16/2001	soil	GAMMA	10198-40-0	Co-60	0.77	pCi/g	0.26		0.26
AS-S1-1	6/16/2001	soil	GAMMA	10045-97-3	Cs-137	1320	pCi/g	4.1		220
AS-S1-1	6/16/2001	soil	GAMMA	13966-00-2	K-40	32.5	pCi/g	4.1		7.9

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-S1-1	6/16/2001	soil	RCRAMETALS	7439-92-1	Lead	32	mg/kg	0.36		
AS-S1-1	6/16/2001	soil	METALS	7439-97-6	Mercury	0.055	mg/kg	0.12	B	
AS-S1-1	6/16/2001	soil	VOCs	75-09-2	Methylene Chloride	18	µg/kg	6		
AS-S1-1	6/16/2001	soil	PLUTONIUM	13981-16-3	Pu-238	2.95	pCi/g	0.021		0.4
AS-S1-1	6/16/2001	soil	PLUTONIUM	15117-48-3	Pu-239	13.9	pCi/g	0.017		1.8
AS-S1-1	6/16/2001	soil	STRONTIUM	10098-97-2	Sr-90	117	pCi/g	0.34		21
AS-S2-1	6/16/2001	soil	GAMMA	14331-83-0	Ac-228	1.42	pCi/g	0.54		0.41
AS-S2-1	6/16/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4.2	mg/kg	1.2		
AS-S2-1	6/16/2001	soil	RCRAMETALS	7440-39-3	Barium	1000	mg/kg	12		
AS-S2-1	6/16/2001	soil	RCRAMETALS	7440-47-3	Chromium	2	mg/kg	1.2	J	
AS-S2-1	6/16/2001	soil	GAMMA	10045-97-3	Cs-137	39.3	pCi/g	0.19		6.5
AS-S2-1	6/16/2001	soil	GAMMA	13966-00-2	K-40	32.3	pCi/g	2		6.1
AS-S2-1	6/16/2001	soil	RCRAMETALS	7439-92-1	Lead	6	mg/kg	0.35		
AS-S2-1	6/16/2001	soil	GAMMA	15092-94-1	Pb-212	1.55	pCi/g	0.45		0.41
AS-S2-1	6/16/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.122	pCi/g	0.011		0.037
AS-S2-1	6/16/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.444	pCi/g	0.016		0.085
AS-S2-1	6/16/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.33	mg/kg	0.58	B	
AS-S2-1	6/16/2001	soil	STRONTIUM	10098-97-2	Sr-90	3.26	pCi/g	0.33		0.66
AS-S2-1	6/16/2001	soil	GAMMA	14913-50-9	Tl-208	0.54	pCi/g	0.21		0.18
AS-S3-1	6/16/2001	soil	GAMMA	14331-83-0	Ac-228	1.56	pCi/g	0.7		0.56
AS-S3-1	6/16/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.4	mg/kg	1.1		
AS-S3-1	6/16/2001	soil	RCRAMETALS	7440-39-3	Barium	92	mg/kg	11		
AS-S3-1	6/16/2001	soil	GAMMA	10045-97-3	Cs-137	124	pCi/g	0.4		21
AS-S3-1	6/16/2001	soil	GAMMA	13966-00-2	K-40	33	pCi/g	1.7		7
AS-S3-1	6/16/2001	soil	RCRAMETALS	7439-92-1	Lead	7.3	mg/kg	0.34		
AS-S3-1	6/16/2001	soil	GAMMA	15092-94-1	Pb-212	2.28	pCi/g	0.92		0.73
AS-S3-1	6/16/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.268	pCi/g	0.011		0.059
AS-S3-1	6/16/2001	soil	PLUTONIUM	15117-48-3	Pu-239	1.26	pCi/g	0.0042		0.19
AS-S3-1	6/16/2001	soil	STRONTIUM	10098-97-2	Sr-90	2.3	pCi/g	0.36		0.51
AS-S4-0.5	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	2.21	pCi/g	0.53		0.63
AS-S4-0.5	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.8	mg/kg	1.1		
AS-S4-0.5	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	240	mg/kg	11		
AS-S4-0.5	6/19/2001	soil	SVOCs	56-55-3	Benzo(a)anthracene	39	µg/kg	350	J	
AS-S4-0.5	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.5	mg/kg	1.1		
AS-S4-0.5	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	101	pCi/g	0.39		17
AS-S4-0.5	6/19/2001	soil	GAMMA	13966-00-2	K-40	32.2	pCi/g	1.4		6.9
AS-S4-0.5	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	14	mg/kg	0.32		
AS-S4-0.5	6/19/2001	soil	METALS	7439-97-6	Mercury	0.08	mg/kg	0.11	B	

)4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
AS-S4-0.5	6/19/2001	soil	VOCs	75-09-2	Methylene Chloride	41	µg/kg	5.3		
AS-S4-0.5	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	1.91	pCi/g	0.56		0.53
AS-S4-0.5	6/19/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.395	pCi/g	0.014		0.079
AS-S4-0.5	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	2.09	pCi/g	0.011		0.31
AS-S4-0.5	6/19/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.27	mg/kg	0.53	J	
AS-S4-0.5	6/19/2001	soil	STRONTIUM	10098-97-2	Sr-90	3.6	pCi/g	0.4		0.74
AS-S4-0.5	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.82	pCi/g	0.39		0.31
AS-S4-01	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	1.87	pCi/g	0.89		0.8
AS-S4-01	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.2	mg/kg	1.1		
AS-S4-01	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	180	mg/kg	11		
AS-S4-01	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.4	mg/kg	1.1		
AS-S4-01	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	319	pCi/g	1.2		53
AS-S4-01	6/19/2001	soil	GAMMA	13966-00-2	K-40	34.3	pCi/g	2		7.6
AS-S4-01	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	14	mg/kg	0.33		
AS-S4-01	6/19/2001	soil	METALS	7439-97-6	Mercury	0.052	mg/kg	0.11	B	
AS-S4-01	6/19/2001	soil	VOCs	75-09-2	Methylene Chloride	21	µg/kg	5.4		
AS-S4-01	6/19/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.95	pCi/g	0.029		0.16
AS-S4-01	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	5.79	pCi/g	0.013		0.82
AS-S4-01	6/19/2001	soil	STRONTIUM	10098-97-2	Sr-90	11.1	pCi/g	0.38		2.1
AS-S5-1	6/14/2001	soil	GAMMA	14331-83-0	Ac-228	1.96	pCi/g	0.69		0.6
AS-S5-1	6/14/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.8	mg/kg	1.1		
AS-S5-1	6/14/2001	soil	RCRAMETALS	7440-39-3	Barium	34	mg/kg	11		
AS-S5-1	6/14/2001	soil	GAMMA	14733-03-0	Bi-214	1.02	pCi/g	0.42		0.39
AS-S5-1	6/14/2001	soil	RCRAMETALS	7440-47-3	Chromium	0.75	mg/kg	1.1	J	
AS-S5-1	6/14/2001	soil	GAMMA	10045-97-3	Cs-137	0.79	pCi/g	0.24		0.26
AS-S5-1	6/14/2001	soil	GAMMA	13966-00-2	K-40	34.4	pCi/g	1.9		7.4
AS-S5-1	6/14/2001	soil	RCRAMETALS	7439-92-1	Lead	6.4	mg/kg	0.34		
AS-S5-1	6/14/2001	soil	METALS	7439-97-6	Mercury	0.052	mg/kg	0.11	B	
AS-S5-1	6/14/2001	soil	GAMMA	15092-94-1	Pb-212	2.24	pCi/g	0.42		0.54
AS-S5-1	6/14/2001	soil	GAMMA	15067-28-4	Pb-214	0.88	pCi/g	0.38		0.29
AS-S5-1	6/14/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.28	mg/kg	0.56	B	
AS-S5-1	6/14/2001	soil	GAMMA	14913-50-9	Tl-208	0.76	pCi/g	0.21		0.24
AS-S6-1	6/16/2001	soil	GAMMA	14331-83-0	Ac-228	1.65	pCi/g	0.74		0.74
AS-S6-1	6/16/2001	soil	GAMMA	14596-10-2	AM-241	1.48	pCi/g	0.56		0.48
AS-S6-1	6/16/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.1	mg/kg	1.1		
AS-S6-1	6/16/2001	soil	RCRAMETALS	7440-39-3	Barium	110	mg/kg	11		
AS-S6-1	6/16/2001	soil	SVOCs	205-99-2	Benzo(b)fluoranthene	41	µg/kg	380	J	
AS-S6-1	6/16/2001	soil	RCRAMETALS	7440-43-9	Cadmium	0.29	mg/kg	0.57	B	

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AS-S6-1	6/16/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.4	mg/kg	1.1	J	
AS-S6-1	6/16/2001	soil	GAMMA	10045-97-3	Cs-137	87	pCi/g	0.42		15
AS-S6-1	6/16/2001	soil	DRO	68334-30-5	Diesel-Range Organics	82	mg/kg	5.7		
AS-S6-1	6/16/2001	soil	GAMMA	13966-00-2	K-40	31.2	pCi/g	2.6		7.4
AS-S6-1	6/16/2001	soil	RCRAMETALS	7439-92-1	Lead	12	mg/kg	0.34		
AS-S6-1	6/16/2001	soil	METALS	7439-97-6	Mercury	0.053	mg/kg	0.11	B	
AS-S6-1	6/16/2001	soil	VOCs	75-09-2	Methylene Chloride	13	µg/kg	5.7		
AS-S6-1	6/16/2001	soil	GAMMA	15092-94-1	Pb-212	2.19	pCi/g	0.73		0.64
AS-S6-1	6/16/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.543	pCi/g	0.016		0.096
AS-S6-1	6/16/2001	soil	PLUTONIUM	15117-48-3	Pu-239	5.29	pCi/g	0.011		0.69
AS-S6-1	6/16/2001	soil	STRONTIUM	10098-97-2	Sr-90	3.46	pCi/g	0.36		0.71
AS-S6-1	6/16/2001	soil	GAMMA	14913-50-9	Tl-208	0.86	pCi/g	0.38		0.33
ATR-07	6/8/2001	water	VOCs	67-64-1	Acetone	19	µg/L	20	J	
ATR-07	6/8/2001	water	VOCs	100-42-5	Styrene	1.4	µg/L	5	J	
ATR-11	6/12/2001	water	VOCs	67-64-1	Acetone	14	µg/L	20	J	
ATR-11	6/12/2001	water	VOCs	100-42-5	Styrene	1.1	µg/L	5	J	
ATR-17	6/18/2001	water	VOCs	75-09-2	Methylene Chloride	42	µg/L	5		
ATR-18	6/19/2001	water	VOCs	75-09-2	Methylene Chloride	43	µg/L	5	J	
ATR-19	6/19/2001	water	VOCs	75-09-2	Methylene Chloride	37	µg/L	5	J	
ATR-25	7/10/2001	water	VOCs	75-09-2	Methylene Chloride	4.8	µg/L	5	J	
ATR-26	7/10/2001	water	VOCs	75-09-2	Methylene Chloride	0.78	µg/L	5	J	
AW-01	5/2/2001	water	RCRAMETALS	7440-39-3	Barium	0.13	mg/L	0.1		
AW-02	6/6/2001	water	RCRAMETALS	7440-38-2	Arsenic	0.0016	mg/L	0.01	B	
AW-02	6/6/2001	water	RCRAMETALS	7440-39-3	Barium	0.11	mg/L	0.1		
AW-02	6/6/2001	water	VOCs	75-25-2	Bromoform	0.53	µg/L	5	J	
AW-02	6/6/2001	water	RCRAMETALS	7440-47-3	Chromium	0.0067	mg/L	0.01	B	
AW-03	6/6/2001	water	VOCs	67-64-1	Acetone	14	µg/L	20	J	
AW-03	6/6/2001	water	VOCs	75-27-4	Bromodichloromethane	1	µg/L	5	J	
AW-03	6/6/2001	water	VOCs	67-66-3	Chloroform	3.2	µg/L	5	J	
AW-04	6/6/2001	water	VOCs	67-64-1	Acetone	17	µg/L	20	J	
AW-04	6/6/2001	water	VOCs	75-27-4	Bromodichloromethane	1.4	µg/L	5	J	
AW-04	6/6/2001	water	VOCs	75-15-0	Carbon Disulfide	12	µg/L	5		
AW-04	6/6/2001	water	VOCs	67-66-3	Chloroform	4.5	µg/L	5	J	
AW-04	6/6/2001	water	VOCs	74-87-3	Chloromethane	0.68	µg/L	10	J	
AW-05	6/10/2001	water	VOCs	67-64-1	Acetone	110	µg/L	20		
AW-05	6/10/2001	water	RCRAMETALS	7440-38-2	Arsenic	0.0054	mg/L	0.01	B	
AW-05	6/10/2001	water	RCRAMETALS	7440-39-3	Barium	0.04	mg/L	0.1	B	
AW-06	6/13/2001	water	VOCs	67-64-1	Acetone	8.7	µg/L	20	J	

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AW-06	6/13/2001	water	SVOCs	117-81-7	Bis(2-ethylhexyl)phthalate	5.6	µg/L	10	J	
AW-06	6/13/2001	water	VOCs	75-27-4	Bromodichloromethane	1.1	µg/L	5	J	
AW-06	6/13/2001	water	VOCs	67-66-3	Chloroform	3.6	µg/L	5	J	
AW-07	6/13/2001	water	VOCs	67-64-1	Acetone	23	µg/L	20	J	
AW-07	6/13/2001	water	VOCs	75-27-4	Bromodichloromethane	0.96	µg/L	5	J	
AW-07	6/13/2001	water	VOCs	67-66-3	Chloroform	2.5	µg/L	5	J	
AW-08	6/18/2001	water	VOCs	67-64-1	Acetone	12	µg/L	20	J	
AW-08	6/18/2001	water	VOCs	67-66-3	Chloroform	2	µg/L	5	J	
AW-08	6/18/2001	water	VOCs	75-09-2	Methylene Chloride	34	µg/L	5		
AW-09	6/18/2001	water	VOCs	67-64-1	Acetone	11	µg/L	20	J	
AW-09	6/18/2001	water	SVOCs	100-51-6	Benzyl Alcohol	4.3	µg/L	9.5	J	
AW-09	6/18/2001	water	VOCs	75-27-4	Bromodichloromethane	1.1	µg/L	5	J	
AW-09	6/18/2001	water	VOCs	67-66-3	Chloroform	3.2	µg/L	5	J	
AW-09	6/18/2001	water	VOCs	75-09-2	Methylene Chloride	41	µg/L	5		
AW-10	6/28/2001	water	VOCs	67-64-1	Acetone	9	µg/L	20	J	
AW-10	6/28/2001	water	VOCs	75-27-4	Bromodichloromethane	0.9	µg/L	5	J	
AW-10	6/28/2001	water	VOCs	67-66-3	Chloroform	2.9	µg/L	5	J	
AW-11	6/28/2001	water	RCRAMETALS	7440-39-3	Barium	0.0055	mg/L	0.1	B	
AW-11	6/28/2001	water	VOCs	67-66-3	Chloroform	1.6	µg/L	5	J	
QAS-01-2	6/13/2001	soil	GAMMA	14331-83-0	Ac-228	1.77	pCi/g	0.27		0.35
QAS-01-2	6/13/2001	soil	VOCs	67-64-1	Acetone	50	µg/kg	22	J	
QAS-01-2	6/13/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.5	mg/kg	1.1		
QAS-01-2	6/13/2001	soil	RCRAMETALS	7440-39-3	Barium	160	mg/kg	11		
QAS-01-2	6/13/2001	soil	GAMMA	14913-49-6	BI-212	1.71	pCi/g	0.92		0.71
QAS-01-2	6/13/2001	soil	GAMMA	14733-03-0	Bi-214	0.85	pCi/g	0.17		0.2
QAS-01-2	6/13/2001	soil	RCRAMETALS	7440-47-3	Chromium	2.9	mg/kg	1.1		
QAS-01-2	6/13/2001	soil	GAMMA	10045-97-3	Cs-137	0.91	pCi/g	0.077		0.18
QAS-01-2	6/13/2001	soil	DRO	68334-30-5	Diesel-Range Organics	36	mg/kg	5.4		
QAS-01-2	6/13/2001	soil	GAMMA	13966-00-2	K-40	28.2	pCi/g	0.95		5
QAS-01-2	6/13/2001	soil	RCRAMETALS	7439-92-1	Lead	19	mg/kg	0.32		
QAS-01-2	6/13/2001	soil	VOCs	75-09-2	Methylene Chloride	2.6	µg/kg	5.4	J	
QAS-01-2	6/13/2001	soil	GAMMA	15092-94-1	Pb-212	1.97	pCi/g	0.14		0.36
QAS-01-2	6/13/2001	soil	GAMMA	15067-28-4	Pb-214	0.95	pCi/g	0.19		0.2
QAS-01-2	6/13/2001	soil	VOCs	99-87-6	P-Isopropyltoluene	17	µg/kg	5.4		
QAS-01-2	6/13/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.25	mg/kg	0.54	B	
QAS-01-2	6/13/2001	soil	GAMMA	15065-10-8	TH-234	3.4	pCi/g	1.9	J	1.3
QAS-01-2	6/13/2001	soil	GAMMA	14913-50-9	Tl-208	0.63	pCi/g	0.08		0.13
QAS-08	6/28/2001	soil	GAMMA	14331-83-0	Ac-228	1.88	pCi/g	0.46		0.63

4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
QAS-08	6/28/2001	soil	RCRAMETALS	7440-38-2	Arsenic	3.4	mg/kg	1.1		
QAS-08	6/28/2001	soil	RCRAMETALS	7440-39-3	Barium	840	mg/kg	11	J	
QAS-08	6/28/2001	soil	RCRAMETALS	7440-47-3	Chromium	1.7	mg/kg	1.1		
QAS-08	6/28/2001	soil	GAMMA	10045-97-3	Cs-137	46.7	pCi/g	0.35		7.8
QAS-08	6/28/2001	soil	DRO	68334-30-5	Diesel-Range Organics	1.5	mg/kg	5.3	J	
QAS-08	6/28/2001	soil	GAMMA	13966-00-2	K-40	32.4	pCi/g	1.9		7
QAS-08	6/28/2001	soil	RCRAMETALS	7439-92-1	Lead	7.4	mg/kg	0.32	J	
QAS-08	6/28/2001	soil	GAMMA	15092-94-1	Pb-212	1.86	pCi/g	0.72		0.59
QAS-08	6/28/2001	soil	PLUTONIUM	13981-16-3	Pu-238	0.08	pCi/g	0.011		0.029
QAS-08	6/28/2001	soil	PLUTONIUM	15117-48-3	Pu-239	0.435	pCi/g	0.014		0.084
QAS-08	6/28/2001	soil	STRONTIUM	10098-97-2	Sr-90	1.12	pCi/g	0.32		0.3
QAS-09-1.5	6/7/2001	soil	GAMMA	14331-83-0	Ac-228	0.85	pCi/g	0.4		0.28
QAS-09-1.5	6/7/2001	soil	RCRAMETALS	7440-38-2	Arsenic	4	mg/kg	1.1	J	
QAS-09-1.5	6/7/2001	soil	RCRAMETALS	7440-39-3	Barium	180	mg/kg	11	J	
QAS-09-1.5	6/7/2001	soil	GAMMA	14733-03-0	Bi-214	0.87	pCi/g	0.24		0.25
QAS-09-1.5	6/7/2001	soil	RCRAMETALS	7440-47-3	Chromium	4.1	mg/kg	1.1	J	
QAS-09-1.5	6/7/2001	soil	GAMMA	10045-97-3	Cs-137	0.46	pCi/g	0.13		0.14
QAS-09-1.5	6/7/2001	soil	DRO	68334-30-5	Diesel-Range Organics	1.6	mg/kg	5.4	J	
QAS-09-1.5	6/7/2001	soil	GAMMA	13966-00-2	K-40	23.3	pCi/g	1.7		4.9
QAS-09-1.5	6/7/2001	soil	RCRAMETALS	7439-92-1	Lead	9.1	mg/kg	0.32	J	
QAS-09-1.5	6/7/2001	soil	GAMMA	15092-94-1	Pb-212	1.38	pCi/g	0.22		0.31
QAS-09-1.5	6/7/2001	soil	GAMMA	15067-28-4	Pb-214	0.87	pCi/g	0.22		0.22
QAS-09-1.5	6/7/2001	soil	RCRAMETALS	7782-49-2	Selenium	0.59	mg/kg	0.54	J	
QAS-09-1.5	6/7/2001	soil	GAMMA	14913-50-9	Tl-208	0.42	pCi/g	0.11		0.13
QAS-S4-0.5	6/19/2001	soil	GAMMA	14331-83-0	Ac-228	1.54	pCi/g	0.67		0.6
QAS-S4-0.5	6/19/2001	soil	VOCs	67-64-1	Acetone	25	µg/kg	21	J	
QAS-S4-0.5	6/19/2001	soil	RCRAMETALS	7440-38-2	Arsenic	2.9	mg/kg	1.1		
QAS-S4-0.5	6/19/2001	soil	RCRAMETALS	7440-39-3	Barium	210	mg/kg	11		
QAS-S4-0.5	6/19/2001	soil	RCRAMETALS	7440-47-3	Chromium	2	mg/kg	1.1		
QAS-S4-0.5	6/19/2001	soil	GAMMA	10045-97-3	Cs-137	97	pCi/g	0.37		16
QAS-S4-0.5	6/19/2001	soil	GAMMA	13966-00-2	K-40	27.5	pCi/g	2.5		6.4
QAS-S4-0.5	6/19/2001	soil	RCRAMETALS	7439-92-1	Lead	13	mg/kg	0.32		
QAS-S4-0.5	6/19/2001	soil	METALS	7439-97-6	Mercury	0.068	mg/kg	0.11	B	
QAS-S4-0.5	6/19/2001	soil	VOCs	75-09-2	Methylene Chloride	12	µg/kg	5.3		
QAS-S4-0.5	6/19/2001	soil	GAMMA	15092-94-1	Pb-212	1.78	pCi/g	0.68		0.56
QAS-S4-0.5	6/19/2001	soil	VOCs	99-87-6	P-Isopropyltoluene	3.9	µg/kg	5.3	J	
QAS-S4-0.5	6/19/2001	soil	PLUTONIUM	13981-16-3	Pu-238	4.47	pCi/g	0.015		0.63
QAS-S4-0.5	6/19/2001	soil	PLUTONIUM	15117-48-3	Pu-239	26.5	pCi/g	0.012		3.6

I4 Analytical	DATE	MATRIX	USER_TEST_PANEL	CASNO	PARM	RESULT	UNITS	DET_LIM	Q	ERROR
QAS-S4-0.5	6/19/2001	soil	STRONTIUM	10098-97-2	Sr-90	4.12	pCi/g	0.39		0.83
QAS-S4-0.5	6/19/2001	soil	GAMMA	14913-50-9	Tl-208	0.66	pCi/g	0.37		0.28

Appendix B

Data Quality Objective Process for CAU 504, 16a-Tunnel Muckpile

B.1.0 Introduction

The 16a-Tunnel Muckpile is located in Area 16 of the NTS and is identified under FFACO classification as CAU 504.

B.1.1 Problem Statement

The purpose of the investigation is to determine whether hazardous or radioactive contamination exists in concentrations that exceed regulatory levels within the boundaries or in the underlying soils of CAU 504. The investigation will focus on collection of data sufficient to support corrective action recommendations for closure of CAU 504.

There are four CASs identified in CAU 504 16a-Tunnel Muckpile. These CASs are:

- 16-06-01, Muckpile
- 16-23-01, Contaminated Burial Pit
- 16-23-02, Contaminated Area
- 16-99-01, Concrete Construction Waste

According to historical information, six nuclear tests were conducted between 1962 and 1971 in the Shoshone Mountain Tunnel complex (REECo, 1993). Subsequent to each test, additional horizontal mining for tunnel re-entry resulted in the generation of rock debris and construction wastes including wood, cabling, scrap metal, and cementitious mixtures. Contamination from these wastes, potentially containing low levels of radioactive and/or hazardous constituents, may be present in the four CASs listed above. Existing information about the nature and extent of contamination is insufficient to evaluate and select corrective actions for the CAU.

In addition to the nuclear tests, high explosive testing was also conducted within the tunnel complex. Waste determinations done at the time of the high explosive detonations confirm that no hazardous waste was deposited in the Muckpile. Wastes from this testing were sent to the U10C landfill.

B.1.2 Project Kickoff Meeting

The use of the DQO process to ensure that environmental data used in decision making are appropriate is part of the technical strategy found in Part VI of the FFACO. The DQO meeting with DTRA, NDEP, and the NTS environmental contractor was held on September 28, 2000.

B.2.0 Conceptual Model

The following assumptions were made regarding the CAU:

- Records of waste quantities deposited in the Muckpile or onto other CASs are not available.
- The wastes listed in the historical descriptions are in solid form. It is not likely that liquid wastes were generated or dumped onto the Muckpile or other CASs.
- Photographs and topographic representations of the area can be analyzed for potential of contaminant runoff as part of the characterization.
- Limited process knowledge and insufficient analytical data are available to adequately estimate the variability for COPCs.

A summary of historical information of the CASs is presented in Table B.2-1.

B.2.1 Primary Model

The primary model describes the most probable scenario for current conditions at the U16a-Tunnel Muckpile. Proposed characterization methods are based upon the following assumptions:

- No leaching of the solid contaminants has impacted soil directly below (surrounding) the Muckpile or other disposal areas.
- Minor lateral migration may have occurred due to erosion of the Muckpile sides. Lateral migration of trinity glass into the ravine downgradient is thought to be the source of the elevated readings within CAS 16-23-02.
- Groundwater contamination is highly unlikely because environmental conditions at the site, such as an arid climate and low permeabilities, are not conducive to downward migration.
- System dynamics are such that there are no driving forces other than the limited precipitation.

Table B.2-1
Summary of Historical Information CAU 504

Corrective Action Site	Historical Information	Source
Muckpile (16-06-01)	Muckpile 1,000 feet 60 degrees northeast of portal, large Muckpile 400 by 800 feet containing drums and other unknown materials	REECo, 1991
	Contaminated waste rock, debris, and perhaps equipment is believed to be buried within the Muckpile; volume is likely to exceed 3,000 cubic yards; releases of radioactive gases detected in three of six tests conducted; wastes believed to have been buried beneath at least 10 feet of clean material; potential for ponding of water on the Muckpile top	DRI, 1988
	U-16a Muckpile and canyon 180,000 square feet signed as RAD-9 Caution Buried Radioactive Materials – Digging Prohibited	REECo, 1992
	Activity of greater intensity attributed to a vent line from event U-16a, lying on the surface of the ground 1/2 meter in diameter and 30 meters long (from 3.2 to 6.6 picocuries per gram of cesium-137 in soil)	EG&G, 1986
Contaminated Burial Pit (16-23-01)	Starting about 110 yards north of the portal is a burial pit that extends northeastward about 40 to 50 yards	REECo, 1991
Contaminated Area (16-23-02)	U-16a ravine 1,200 feet 110 degrees southeast of U16A Muckpile; large ravine with a berm across it; ravine runs from Muckpile southeasterly; has old radex signs on both sides of ravine; water runoff from the Muckpile is contained in the ravine behind the dam (berm); there may be both radiation and hazardous chemical contamination	REECo, 1991
Concrete Construction Waste (16-99-01)	In the area of the 16a-Tunnel portal, over the edge of the pad southeast of the ventilation pump shack, spill running down the side of the pad and spreading out at the bottom of the gully	REECo, 1991

B.2.2 Alternate Models

Assumed conditions under the alternate model are considered less likely than assumed conditions under the primary model. Under the following conditions, the alternate model accounts for COPC migration beyond the immediate vicinity:

- Seasonal precipitation events have breached the clean fill and moved contamination from the CAS boundaries.
- Precipitation events have caused the mobilization of contaminants downward to the native soils beneath the Muckpile or other CASs.

B.3.0 Potential Contaminants

The list of potential contaminants is based, in part, on the assumption that the six tests associated with the U16A Tunnel complex and the subsequent drillback operations were conducted in a manner similar to sites previously investigated. The six tests are Marshmallow (06/28/62), Gum Drop (04/21/65), Double Play (06/15/66), Ming Vase (11/20/68), Diamond Dust (05/12/70), and Diamond Mine (07/01/71) (DOE/NV, 2000). The following is the list of COPCs for surface and subsurface soils and the related CASs:

- VOCs - CASs 16-23-01, 16-06-01, 16-99-01
- SVOCs - CASs 16-23-01, 16-06-01, 16-99-01
- Radionuclides - All CASs
- Metals - CASs 16-23-01, 16-06-01, 16-99-01
- TPH-DRO - CASs 16-23-01, 16-06-01, 16-99-01

B.4.0 Decisions and Inputs

The following describes the decisions and strategies to resolve identified data gaps for CAU 504.

B.4.1 Decisions

Decisions to be resolved by the investigation include:

- Determine the types and concentrations of contaminants at the site.
- Determine whether contaminant concentrations exceed regulatory standards and/or standards for the protection of human health and the environment.
- Determine the extent of contamination with enough certainty to develop and evaluate a range of potential corrective actions for the site, including closure in place and clean closure.

B.4.2 Inputs and Strategy

A list of information inputs, existing data, identified data gaps, and brief strategies are discussed in Table B.4-1.

Table B.4-1
Inputs and Strategies CAU 504
(Page 1 of 2)

Decision	Input	Existing Data	Data Gap	Strategy
Are COPCs present at the site?	COPC identification	Historical knowledge	Exact knowledge of presence of COPCs	Collect representative samples from CAS 16-06-01 (Muckpile), CAS 16-23-01 (Contaminated Burial Pit), and CAS 16-99-01 (Concrete Construction Waste) in and immediately below affected areas; CAS 16-23-02 (Contaminated Area) from the surface soils of the ravine
Do COPCs exceed regulatory levels?	COPC concentrations	No sampling data available	Exact concentrations of COPCs	Compare analytical results to preliminary action levels identified in Section 3.3 of the CAIP (DTRA, 2001)

Table B.4-1
Inputs and Strategies CAU 504
(Page 2 of 2)

Decision	Input	Existing Data	Data Gap	Strategy
Is there a potential for migration of COPCs?	Stability, geotechnical and drainage evaluations	Some geotechnical data available	Engineer evaluations of NAC 444.6891-6897 (NAC, 1999a)	Assess existing data for usability, collect remaining geotechnical samples for analysis
Data sufficient to support closure options?	Closure in place	Potential for COPC within the CAU boundary	Presence, concentration and extent of COPCs Potential for migration of contaminants	Evaluate corrective action decisions, prepare CADD
	Clean closure			Prepare CADD/CR

B.5.0 Investigation Strategy

In general, investigate the soils at the surface and subsurface of the CASs to determine the presence of contamination. Select sampling points within the Muckpile, at the Contaminated Burial Pit, at the Contaminated Area, and beneath the Concrete Construction Waste.

Collect biased surface soil (up to 5 ft below ground surface [bgs]) for analysis for COPCs using sonic-drilling methods or hand tools. Locate and target soil surrounding visually impacted areas or where historic knowledge of operations might indicate contamination.

Conduct two-stage subsurface sampling during the field investigation to confirm or refute the conceptual model for the site, to assess the migration of the COPCs, and to determine whether COPCs are present in concentrations exceeding the PALs for the site. Sonic drilling methods will be used to obtain subsurface media (from 5 ft bgs to native interface) for field screening and laboratory analysis. Employ sonic drilling to 5 ft below the native soil interface, in areas that soils with potential contamination were deposited above grade to determine whether migration of COPCs has occurred.

In addition, collect samples in order to obtain site-specific geotechnical information applicable to the evaluation of remediation and/or closure options. Table C.1-1 in Appendix C of the CAIP (DTRA, 2001) presents the analytical methods for the COPCs identified during the DQO.

B.6.0 Decision Rules

The following decision rules are applicable to this CAU 504 investigation and will be used to guide the investigation and subsequent data evaluation:

- If laboratory results for soil samples indicate the presence of COPCs above the PALs, a CADD will be prepared.
- If COPCs are not identified in the soil above the PALs, a CADD/CR may be prepared.

B.7.0 Decision Error

A two-stage sampling approach will be implemented for the subsurface materials of CAS 16-06-01 (Muckpile) and CAS 16-23-01 (Contaminated Burial Pit). A biased approach will be used for the surface areas of CAS 16-06-01 (Muckpile), CAS 16-23-01 (Burial Pit), and areas of CAS 16-23-02 (Contaminated Area) and CAS 16-99-01 (Concrete Construction Waste) that have field-screening elevations or indications of visual impaction. To reduce the possibility of false positives, two-stage sampling will be conducted with sampling as close to selected locations as possible, yielding the highest confidence that any existing contamination has been found. Strictly random sampling is not appropriate for this type of investigation. In lieu of a quantitative determination of sampling error, the false-positive error will be minimized by the following actions.

Preliminary action levels for the site will be determined based on NAC 445A requirements (NAC, 1999b), or as applicable 40 *Code of Federal Regulations* 261.24 (CFR, 1999). Instead of directly measuring samples using the toxicity characteristic leaching procedures, values may be calculated by dividing the total analytical result by 20. Additional information to support development of preliminary action levels is available in the Integrated Risk Information System, in the U.S. Environmental Protection Agency (EPA) Region IX PRGs (EPA, 1999) for industrial sites. The PRGs for radionuclides will be established in accordance with DOE Order 5400.5 (DOE, 1993). Preliminary action levels for radionuclides are concentrations reflecting the average activity of 20 background surface samples plus two times the standard deviation of the average activity. Subsurface soils will be collected from unimpacted areas to establish the background levels. The average, plus two standard deviations, will be used to evaluate site data.

Collection of samples sufficient to achieve a confidence level of 90 percent is expected.

B.8.0 References

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DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

DRI, see Desert Research Institute.

DTRA, see Defense Threat Reduction Agency.

Defense Threat Reduction Agency. 2001. *Corrective Action Investigation Plan for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site*, Rev. 0. Las Vegas, NV.

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EPA, see U.S. Environmental Protection Agency.

NAC, see *Nevada Administrative Code.*

Nevada Administrative Code. 1999a. NAC 444.6891-6897, "Sanitation." Carson City, NV.

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Appendix C

Data Assessment

C.1.0 Data Assessment

The DQA process is the scientific evaluation of the investigation results to determine whether the DQO criteria established in the CAU 504 CAIP were met and whether the DQO decisions can be supported at the desired level of confidence. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of the decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that the DQO decisions are sound and defensible, and that the 90 percent level of confidence agreed to in the CAIP was achieved.

The DQA involves five steps that begin with a review of the DQOs and end with an answer to the DQO decisions. The five steps are briefly summarized below.

Step 1: Review the DQOs and Sampling Design – Review the DQO process to provide context for analyzing the data. State the primary statistical hypotheses; confirm the limits on the decision errors for committing false rejection (Type I) or false acceptance (Type II) decision errors; and review any special features, potential problems, or deviations to the sampling design.

Step 2: Conduct a Preliminary Data Review – The preliminary data review involves reviewing QA reports and inspecting the data both numerically and graphically, validating and verifying the data to ensure that the measurement systems performed in accordance with the criteria specified, and using the validated data to determine whether the quality of the data is satisfactory.

Step 3: Select the Test – Select the test based on the population of interest, population parameter, and the hypotheses. Identify the key underlying assumptions that could cause a change in one of the DQO decisions.

Step 4: Verify the Assumptions – Perform tests of assumptions. If data are missing or are censored, determine the impact on the DQO decision error.

Step 5: Draw Conclusions from the Data – Perform the calculations required for the test.

C.1.1 Review the DQOs and Sampling Design

This section contains a review of the DQO process presented in the CAU 504 CAIP (DTRA, 2001) and Appendix B of this document. The DQO decisions are presented with the

DQO provisions for limiting false negative or false positive decision errors. Special features, potential problems, or any deviations from the sampling design are also presented.

C.1.1.1 Review DQOs

The CAU 504 investigation was one of the early projects and the DQO process had not evolved to the level that was present in the later investigations. The decision statement as presented in the CAU 504 CAIP is: "Determine if hazardous or radioactive contamination exists in concentrations that exceed regulatory levels within the boundaries or in the underlying soils of CAU 504."

DQO Provisions To Limit False Negative Decision Error

A false negative decision error (where consequences are more severe) was controlled by meeting the following criteria:

1. Having a high degree of confidence that the combination of random and biased sampling strategies will identify COCs if present in the CASs.
2. Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.
3. Having a high degree of confidence that the data are of sufficient quality and completeness.

Criterion 1:

The following methods (stipulated in the CAU 504 DQOs [DTRA, 2001] and agreed to by NDEP) were used in selecting the sample locations:

- Random locations to collect soil samples from the Muckpile and channel.
- Biased locations based on professional judgment and site knowledge to collect soil samples from the Muckpile, Concrete Construction Waste, Contamination Area, and channel.

This provides a high degree of confidence that sampling will detect any COCs that may be present.

Criterion 2:

All samples were analyzed using the analytical methods listed in Table 3-1 of the CAIP. Table C.1-1 provides a reconciliation of environmental samples analyzed to the planned analytical program. Samples were analyzed for all of the analytical methods specified in the CAIP (DTRA, 2001).

Table C.1-1
CAU 504 Number of Soil Samples Submitted per Analyte

	Analytes						
	VOCs	SVOCs	TPH-DRO	Metals	Gamma Spectroscopy	Isotopic Plutonium	Strontium-90
Muck	27	27	27	27	27	27	27
Native Soil	17	17	17	17	17	17	17
Concrete	9	11	11	11	11	11	11
Channel Soil	16	21	21	21	21	21	21
Background	0	0	0	3	3	3	3

DRO = Diesel-range organics
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

Sample results were assessed against the DQI of sensitivity as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The sensitivity acceptance criteria defined in the CAIP is that analytical detection limits will be less than the corresponding action level. This goal was not achieved for the radiological analytes listed in Table C.1-2. All chemical analytes met the sensitivity goal. Results not meeting the sensitivity goal were not used in making DQO decisions and will therefore be considered as rejected data.

Table C.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 504
(Page 1 of 2)

Sample Number	Parameter	Result (pCi/g)	Detection Limit (pCi/g)	PAL (pCi/g)
AS-S1-1	Americium-241	ND	15	12.7
AS-13-12	Americium-241	ND	18	12.7

Table C.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 504
(Page 2 of 2)

Sample Number	Parameter	Result (pCi/g)	Detection Limit (pCi/g)	PAL (pCi/g)
AS-11-41	Americium-241	ND	22	12.7
AS-06-0.5	Bismuth-212	ND	5	5
AS-13-12	Bismuth-212	ND	7	5
AS-10-28.5	Bismuth-212	ND	7.9	5
AS-11-41	Bismuth-212	ND	10	5
AS-11-41	Bismuth-214	ND	5.2	5
AS-11-41	Lead-212	ND	6.4	5
AS-13-13	Lead-214	ND	5	5
AS-13-12	Lead-214	ND	5.9	5
AS-11-41	Lead-214	ND	8.2	5
AS-12-62.5	Thorium-227	ND	18	17.6
QAS-01-2	Thorium-227	ND	18	17.6
AS-D18-01	Thorium-227	ND	20	17.6
AS-01-7.5	Thorium-227	ND	21	17.6
AS-08-11.5	Thorium-227	ND	21	17.6
AS-13-57.5	Thorium-227	ND	22	17.6
AS-15-27.5	Thorium-227	ND	22	17.6
AS-R15-06	Thorium-227	ND	22	17.6
AS-08-8.5	Thorium-227	ND	23	17.6
AS-07-4	Thorium-227	ND	24	17.6
AS-11-41	Thorium-227	ND	25	17.6
AS-06-4	Thorium-227	ND	28	17.6
AS-11-55	Thorium-227	ND	33	17.6
AS-05-5.5	Thorium-227	ND	57	17.6
AS-11-41	Uranium-235	ND	19	17.6

ND = Nondetect
PAL = Preliminary action level
pCi/g = Picocuries per gram

Criterion 3:

To satisfy the third criterion, the entire dataset, as well as individual sample results, were assessed against the acceptance criteria for the DQIs of precision, accuracy, comparability,

completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The DQI acceptance criteria for precision and accuracy are defined in Table C.1-1 of the CAIP (DTRA, 2001). The acceptance criteria for comparability, completeness, and representativeness are not specified in the CAIP. As presented in the following sections, these goals were met for each DQI except as noted.

Precision

Duplicate precision is evaluated using the relative percent difference (RPD) or normalized difference. For the purpose of determining the data precision of chemical analyses, the RPD between duplicate analyses was calculated. For radionuclides, the RPD was not calculated unless both the sample and its duplicate had a concentration of the target radionuclide exceeding five times their minimum detectable concentration. Otherwise, radionuclide duplicate results were evaluated using the normalized difference. Table C.1-3 provides the results for all constituents that were qualified for precision.

Table C.1-3
Precision Measurements

Parameter	CAS Number	User Test Panel	Number of Analyses Qualified	Number of Measurements Performed	Percent within Criteria
Barium	7440-39-3	RCRA Metals	7	83	91.6
Plutonium-238	13981-16-3	Plutonium	7	85	91.8
Lead	7439-92-1	RCRA Metals	20	83	75.9

CAS = Chemical Abstracts Service
RCRA = *Resource Conservation and Recovery Act*

As shown in Table C.1-3, the precision rate for barium and Pu-238 met the acceptance criterion of 80 percent; however, the precision rate for lead did not meet the 80 percent criterion. Lead was often used for testing in the form of lead shot so it is possible that lead contamination at a location where there was testing is inhomogeneous in soil samples. Because the contaminant is in small pellets in the soil matrix, mixing will not produce homogeneity. Measurement of duplicate soil aliquots from a container may result in unacceptable precision because the aliquots contain different amounts of the lead shot. This does not mean the precision of the measurement is poor but that the concentration of the contaminant is variable. Because all of the other constituents exceed the acceptance criteria for precision, the dataset is determined to be acceptable for the DQI of precision.

Accuracy

For the purpose of determining data accuracy of sample analyses, environmental soil samples were evaluated and incorporated into the accuracy calculation. Table C.1-4 provides the evaluation results for the constituents qualified for accuracy.

Table C.1-4
Accuracy Measurements

Parameter	CAS Number	User Test Panel	Number of Analyses Qualified	Number of Measurements Performed	Percent within Criteria
2-Butanone	78-93-3	VOCs	1	72	98.6
Toluene	108-88-3	VOCs	1	72	98.6
Trichlorofluoromethane	75-69-4	VOCs	1	72	98.6
Acetone	67-64-1	VOCs	2	72	97.2
Methylene Chloride	75-09-2	VOCs	2	72	97.2

CAS = Chemical Abstracts Service
VOC = Volatile organic compound

As the accuracy rate for all of the constituents exceeds the acceptance criteria, the dataset is determined to be acceptable for the DQI of accuracy.

Representativeness

The DQO process as identified in Section 3.0 of the CAU 504 CAIP (DTRA, 2001) was used to address sampling and analytical requirements for CAU 504. During this process, appropriate locations were selected that enabled the samples collected to be representative of the population parameters identified in the DQO (random locations and biased locations that were most likely to encounter contamination). The sampling locations identified in the Criterion 1 discussion meet these criteria. Therefore, the analytical data acquired during the CAU 504 CAI are considered to be representative of the population parameters.

Comparability

Field sampling, as described in the CAU 504 CAIP (DTRA, 2001), was performed and documented in accordance with approved procedures that are comparable to standard industry practices. Approved analytical methods and procedures were used to analyze, report, and validate the data. These are comparable to other methods used not only in industry and government practices, but most importantly are comparable to other investigations conducted at the NTS. Therefore, project datasets are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting the DQO requirements.

Also, standard, approved field and analytical methods ensure that data were appropriate for comparison to the investigation action levels specified in the CAU 504 CAIP (DTRA, 2001).

Completeness

The CAU 504 CAIP did not define criteria for completeness; therefore, the criteria of 80 percent of CAS-specific non-critical analytes identified in the CAIP having valid results and 100 percent of critical analytes having valid results will be used for the CAU 504 evaluation. Also, the dataset must be sufficiently complete to be able to support the DQO decisions. Critical analytes for CAU 504 were not defined, so the COCs identified from other investigated NTS Muckpiles and channels (arsenic, lead, TPH-DRO, Pu-239, Cs-137, and Co-60) have been defined as the critical analytes for CAU 504.

Rejected data (either qualified as rejected or data that failed the criterion of sensitivity) were not used in the resolution of DQO decisions. The completeness for all critical chemical and radiological analytes was 100 percent. The completeness for all non-critical chemical and radiological analytes exceeded 80 percent except for acetone, which had a completeness of only 45.8 percent. Although acetone did not meet the completeness criteria, it will not have any effect on the DQO decisions because the highest result for samples that were not rejected was 0.25 milligrams per kilogram (mg/kg), the PAL is 54,000 mg/kg, and acetone is a common laboratory artifact. Therefore, the dataset is considered complete for purposes of supporting the DQO decisions.

DQO Provisions To Limit False Positive Decision Error

The false positive decision error was controlled by assessing the potential for false positive analytical results. Quality assurance (QA)/quality control (QC) samples such as field blanks, trip blanks, laboratory control samples, and method blanks were used to determine whether a false positive analytical result may have occurred. Of the 41 QA/QC samples submitted, no false positive analytical results were detected.

Proper decontamination of sampling equipment and the use of certified clean sampling equipment and containers minimized the potential for cross contamination that could lead to a false positive analytical result.

C.1.1.2 Sampling Design

The CAIP (DTRA, 2001) made the following commitments for sampling:

1. Random sampling will be conducted on the Muckpile.

   Result: The 15 random locations identified were drilled. Fifteen muck and 15 native soil samples were collected from the borings.

2. Biased locations will be identified and drilled on the Muckpile to investigate areas with elevated radiological readings found in the radiological drive-over survey.

   Result: Six biased locations were identified and sampled to investigate the areas with elevated radiological readings on the Muckpile. Six muck samples were collected. In addition, five biased muck samples and two biased native soil samples were collected from the random borings based on elevated radiological field screening results.

3. Random sampling will be conducted in the channel downgradient of the Contamination Area.

   Result: Nine random locations were identified and sampled. Nine soil samples were collected.

4. Biased samples will be collected in the Contamination Area and downgradient to investigate areas with elevated radiological readings found in the radiological walk-over survey.

   Result: Three biased locations were identified in the Contamination Area, and three were identified downgradient of the Contamination Area. All six locations were sampled to investigate the areas with elevated radiological readings. Twelve soil samples were collected.

5. Biased samples will be collected under the Concrete Construction Waste.

   Result: Seven biased locations were identified under the Concrete Construction Waste and sampled. Eleven soil samples were collected.

C.1.2 Conduct a Preliminary Data Review

A preliminary data review was conducted by reviewing QA reports and inspecting the data. The contract analytical laboratories generate a QA non-conformance report when data quality does

not meet contractual requirements. All data received from the analytical laboratories met contractual requirements, and no QA non-conformance reports were generated. Data were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified. The validated dataset quality was found to be satisfactory.

C.1.3 Select the Test

The CAIP (DTRA, 2001) only committed to collecting enough samples to achieve a 90 percent confidence level with no specifications on how that would be tested. Therefore, the procedure described in Chapter 9 of the EPA SW-846 Method (EPA, 1999) will be used to answer the question: "Were enough samples collected to ensure a 90 percent confidence level in the mean COPC concentration?" In addition the procedure in SW-846 will also be used to answer the question: "Does the mean concentration exceed the regulatory threshold?" This will be consistent to the process that was used in subsequent CADD/CRs prepared for muckpile characterizations.

Because of the change in closure strategy agreed to by NDEP, DTRA, and NNSA/NSO, the regulatory threshold is now the risk-based FAL instead of the PALs discussed in the CAIP. Comparing the average concentration of the most prevalent contaminants to their PAL and, if they exceed the PAL, comparing them to their respective FALs will also be used to help answer the questions.

C.1.4 SW-846 Evaluation

To answer the first question, equation (8) of Table 9-1 in SW-846 was used. To answer the second question, equation (6) of Table 9-1 in SW-846 was used (EPA, 1999). Only results from random samples were used for this evaluation. These questions were answered for the critical analytes arsenic, Cs-137, Pu-238, and Pu-239.

Question 1: "Were enough samples collected?" is answered by solving equation (8) of Table 9-1 in SW-846 for each analyte.

$$n = t_{.20}^2 \times s^2 / (RT - \bar{x})^2 \qquad (\textit{Equation 1})$$

where:

n = minimum number of samples to ensure a 90 percent confidence level

$t_{.20}^2$ = the square of the "$t_{.20}$" value in Table 9-2, SW-846, for a one-tailed 90 percent confidence interval

s^2 = variance in the concentration measured in the samples collected during characterization

RT = regulatory threshold and is set to the limiting PRG established by the EPA for the COPC for the industrial land use. For TPH, the RT is 100 mg/kg. For radionuclides, it is the U.S. Nuclear Regulatory Commission and National Council on Radiation Protection and Measurements screening levels

$\bar{x}$ = the mean concentration of the COPC in the collected samples.

Question 2: "Does the mean concentration exceed the regulatory threshold?" is answered by solving equation (6) of Table 9-1 in SW-846 for each analyte.

$$CI = \bar{x} +/- (t_{.20} \times (\frac{s}{\sqrt{n}})) \qquad (\textit{Equation 2})$$

where:

CI = confidence interval

$\bar{x}$ = the mean concentration of the COPC in the collected samples

n = number of samples collected

$t_{.20}$ = the "t" value in Table 9-2, SW-846 for a one-tailed 90 percent confidence interval and the appropriate degrees of freedom

s = standard deviation of the sample

The values used for the calculations and the results are presented in Table C.1-5.

Table C.1-5
SW-846 Evaluation of the Number of Samples and Comparison of 90 Percent Confidence Level with the PAL

Variable	Arsenic		Cs-137		Pu-238		Pu-239	
	Muckpile	Channel	Muckpile	Channel	Muckpile	Channel	Muckpile	Channel
$T_{.20}$	1.345	1.397	1.345	1.397	1.345	1.397	1.345	1.397
$T_{.20}^2$	1.809	1.952	1.809	1.952	1.809	1.952	1.809	1.952
S^2	3.063	544.659	37,277.662	0.106	0.58	0.00002	18.31	0.21
RT	242 mg/kg[a]	242 mg/kg[a]	266 pCi/g[b]	266 pCi/g[b]	3.04 pCi/g[b]	3.04 pCi/g[b]	18.3 pCi/g[b]	18.3 pCi/g[b]
$\bar{x}$	3.78 mg/kg	21.99 mg/kg	84.521 pCi/g	0.36 pCi/g	0.29 pCi/g	0.01 pCi/g	1.62 pCi/g	0.41 pCi/g
n collected	15	9	15	9	15	9	15	9
n needed	<1	<1	3	<1	<1	<1	<1	<1
Upper Confidence Interval	4.39 mg/kg	32.85 mg/kg	151.57 pCi/g	0.512 pCi/g	0.55 pCi/g	0.012 pCi/g	3.11 pCi/g	0.61 pCi/g
Upper Confidence>RT	No	No	No	No	No	No	No	No

[a]Final action level from the Risk Assessment Information System

[b]Final action level calculated using RESRAD

Cs = Cesium
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram
Pu = Plutonium
RESRAD = Residual Radioactive
RT =Regulatory threshold

Based on the results of the calculations, an adequate number of samples were collected to meet the 90 percent confidence level for characterization of the Muckpile and channel for all four tested analytes. In comparing the 90 percent confidence level to the RT, the upper confidence interval is below the RT for all four analytes in the Muckpile and channel.

C.1.5 Verify the Assumptions

The results of the investigation support the assumptions identified in the CAU 504 DQOs and in Table C.1-6.

Table C.1-6
Key Assumptions

Exposure Scenario	Exposure to contaminants is limited to industrial site workers, construction/remediation workers, and military personnel conducting training. Exposure could occur through ingestion, inhalation, external exposure, or dermal contact.
	The investigation did not reveal any potential exposures that were not identified in the conceptual site model (CSM).
Affected Media	Surface and subsurface soils in and below the Muckpile and channel. Contamination of perched, deep, and regional groundwater is not a concern.
	The investigation results did not identify any affected media that were not identified in the CSM.
Location of Contamination Release Points	The Muckpile may contain small volumes of *Resource Conservation and Recovery Act* (RCRA)-regulated constituents in addition to radiological constituents.
	The investigation results confirmed this by not finding any RCRA-regulated constituents.
Transport Mechanisms	Contamination may migrate through the Muckpile into the native material as a result of rainwater infiltration, and significant rain events could transport contamination down the channel below the Muckpile.
	A low level of cesium (Cs)-137 was found in one native soil sample from beneath the Muckpile, indicating infiltration is a very minor transport mechanism. Man-made radionuclides were found in the channel below the Contamination Area in trinitite glass, proving that transport of the contaminants in storm water runoff is occurring.
Preferential Pathways	Percolation of precipitation through the soils of the Muckpile.
	A low level of Cs-137 was found in one native soil sample from beneath the Muckpile, indicating that if rainwater is acting as a transport mechanism, it is very minor.
Lateral and Vertical Extent of Contamination	Contamination could be locally significant, but vertical infiltration of contaminants is probably limited to less than 5 feet.
	The biased sampling confirmed that the contamination was locally significant and all of the sampling showed that vertical infiltration was not significant. Man-made radionuclides were identified in the channel below the Contamination Area showing that lateral migration was occurring in storm water runoff.
Groundwater Impacts	There are no groundwater impacts.
Future Land Use	Nonresidential, zoned for nuclear and high explosives tests.
	The investigation results did not reveal any future land uses other than those identified in the CSM.

C.1.6 Results

This section resolves the DQO decision for CAU 504.

C.1.6.1 Decision Rules for CAU 504

Original Decision Rule: If laboratory results for the soil samples indicate the presence of COPCs above the PALs, then a CADD will be prepared.

Result: Representatives from DTRA and NDEP came to an agreement that a risk-based approach would be used for characterizing the 16a-Tunnel Muckpile. Using the risk-based approach for limited access occasional use scenario, the 90 percent upper confidence level did not exceed the FALs for any of the CASs. However, two biased muckpile samples had concentrations of Cs-137, Pu-238 and/or Pu-239 that exceeded their RESRAD calculated FALs; another four biased and one random muckpile soil samples had concentrations of Cs-137 that exceeded the FAL; and one biased channel sample had a Pu-239 concentration that exceeded the FAL. Therefore, the Muckpile and channel are considered to be contaminated with radionuclides and will be closed accordingly.

Original Decision Rule: If laboratory results for the soil samples do not indicate the presence of COPCs above the PALs, then a CADD or CADD/CR will be prepared.

Result: The PALS were exceeded; however, due to the nature of the contamination and the impracticality of remediating the radionuclides, it was determined that the best closure alternative is to close the radionuclides in place by applying use restrictions. Therefore, a CADD/CR will be prepared that will propose use restrictions for controlling access to the site.

C.2.0 References

DTRA, see Defense Threat Reduction Agency.

Defense Threat Reduction Agency. 2001. *Corrective Action Investigation Plan for Corrective Action Unit 504: 16a-Tunnel Muckpile, Nevada Test Site*, Rev. 0. Las Vegas, NV.

EPA, see U.S. Environmental Protection Agency.

NNSA/NV, see U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office.

U.S. Department of Energy, National Nuclear Security Administration, Nevada Operations Office. 2002. *Industrial Sites Quality Assurance Project Plan*, *Nevada Test Site, Nevada,* DOE/NV--372, Rev. 3. Las Vegas, NV.

U.S. Environmental Protection Agency. 1999. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846. 3rd Edition. Washington, DC.

Appendix D

Risk Assessment for CAU 504

D.1.0 Risk-Based Corrective Action Process

This section contains documentation of the ASTM Method E 1739-95 (ASTM, 1995) risk-based corrective action process as applied to CAU 504. The ASTM Method E 1739-95 defines three tiers or levels in evaluating DQO decisions involving increasingly more sophisticated analyses.

- Tier 1 – Sample results from source areas (highest concentrations) compared to the PALs based on generic (non-site-specific) conditions.
- Tier 2 – Sample results from exposure points compared to SSTLs calculated using site-specific inputs and Tier I formulas (from the ASTM procedure).
- Tier 3 – Sample results from exposure points compared to SSTLs and points of compliance calculated using chemical fate/transport and probabilistic modeling.

The risk based corrective action decision process stipulated in ASTM Method E 1739-95 is summarized in Figure D.1-1.

D.1.1 Scenario

Corrective Action Unit 504 (16a-Tunnel Muckpile) consists of four CASs:

- 16-06-01, Muckpile
- 16-23-01, Contaminated Burial Pit
- 16-23-02, Contaminated Area
- 16-99-01, Concrete Construction Waste

In addition to these CASs, the channel from the Contaminated Area to Mid Valley Road was investigated.

The Muckpile and associated CASs are part of 16a-Tunnel, which was operated intermittently between 1962 and 1971 for nuclear weapons effects and Vela Uniform tests, and from 1975 to 1999 for high explosives tests. The 16a-Tunnel was mined into the tuffs on the east slope of Shoshone Mesa. The Muckpile was constructed in an easterly direction from the tunnel portal, becoming wider and thicker away from the portal, terminating approximately 650 ft east of the portal. The muckpile contains approximately 175,000 yd^3 of mining and re-entry debris. Less than 1 percent of this material is thought to be re-entry debris.

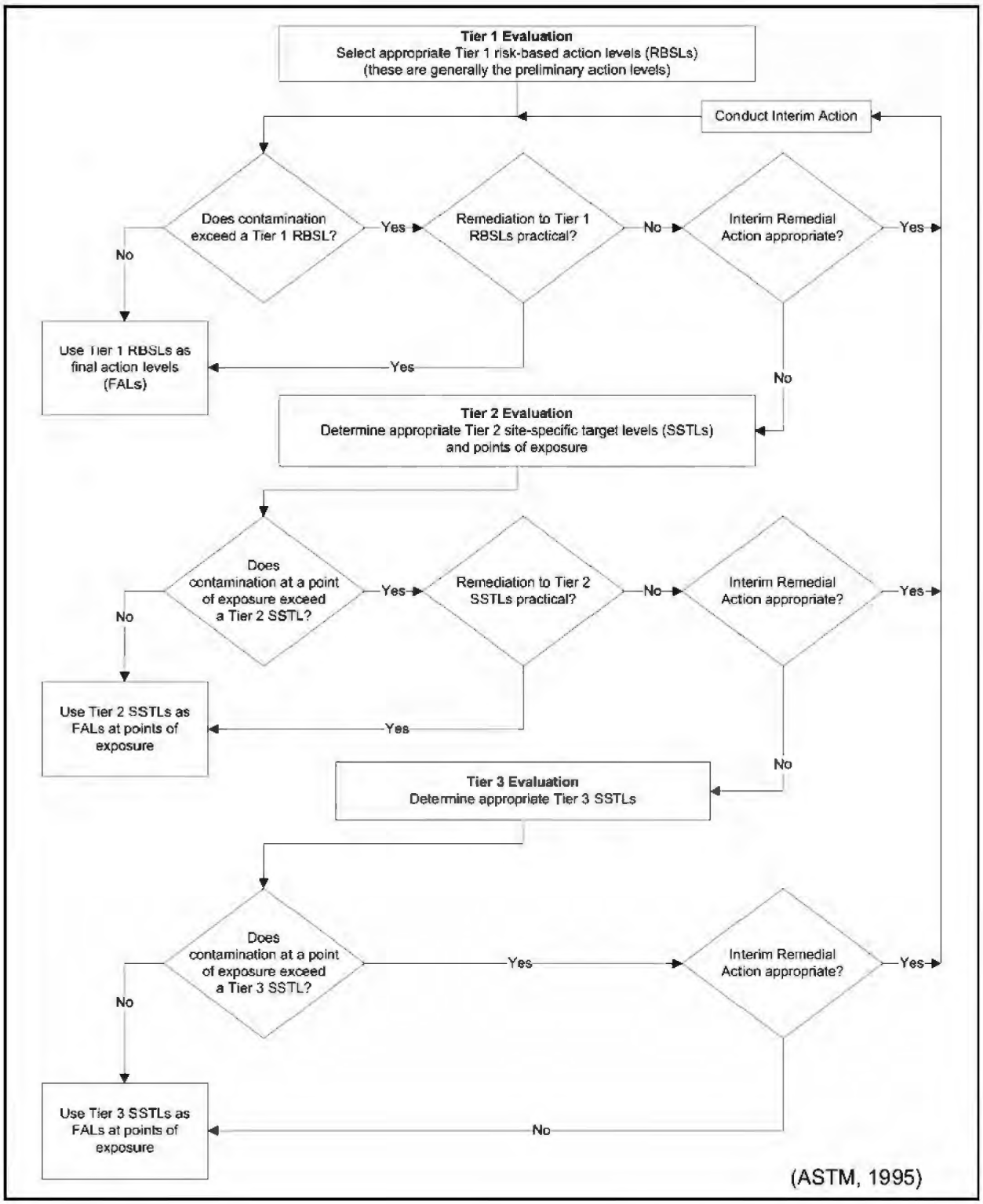

Figure D.1-1
ASTM Method E 1739-95 Risk-Based Corrective Action Decision Process

D.1.2 Site Assessment

The CAI at CAU 504 involved soil sampling using rotosonic drilling techniques and hand tools. The investigation results identified arsenic and radiological COCs that exceeded the PALs as defined in the CAIP (DTRA, 2001). The maximum concentration of the COCs identified and their corresponding PALs (Tier 1 comparison) are presented in Tables D.1-1 (chemical results) and D.1-2 (radiological results).

Table D.1-1
Maximum Reported Chemical Values for Tier 1 Comparison

Contaminant	CAS Number	Sample No.	Result (mg/kg)	PAL (mg/kg)
2-Butanone	78-93-3	AS-R8-02	0.023	110,000[a]
Acetone	67-64-1	AS-R8-02	0.25	54,000[a]
Arsenic	7440-38-2	AS-R14-C	**77**	23[b]
Barium	7440-39-3	AS-05-5.5	4,300	67,000[a]
Benzo(a)Anthracene	56-55-3	AS-S4-0.5	0.039	2.1[a]
Benzo(b)Fluoranthene	205-99-2	AS-S6-1	0.041	2.1[a]
Bis(2-ethylhexyl)phthalate	117-81-7	AS-14-2	0.12	120[a]
Cadmium	7440-43-9	AS-R4-02	0.89	450[a]
Chromium	7440-47-3	AS-03-23	210	450[a]
Diesel-Range Organics	68334-30-5	AS-S6-1	82	100[c]
Lead	7439-92-1	AS-01-7.5	44	800[a]
Mercury	7439-97-6	AS-R12-04	0.2	310[a]
Methylene Chloride	75-09-2	AS-12-62.5	0.071	21[a]
Phenol	108-95-2	AS-03-23	0.055	100,000[a]
P-Isopropyltoluene	99-87-6	AS-R4-02	0.02	2,000
Selenium	7782-49-2	AS-R12-04	5.1	5,100[a]
Silver	7440-22-4	AS-03-23	530	5,100[a]
Toluene	108-88-3	AS-R8-02	0.0029	520[a]
Trichlorofluoromethane	75-69-4	AS-R12-04	0.0025	2,000

[a]Final action level based on *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).
[b]Nevada Test Site background plus two standard deviations.
[c]*Nevada Administrative Code* 445A.2272 (NAC, 2003b)

Bold indicates value exceeds the PAL.

CAS = Chemical Abstracts Service
mg/kg = Milligrams per kilogram
PAL = Preliminary action level

Table D.1-2
Maximum Reported Radiological Values for Tier 1 Comparison

Parameter	CAS Number	Sample No.	Result (pCi/g)	PAL (pCi/g)
Actinium-228	14331-83-0	AS-C2-B	2.64	5[a]
Americium-241	14596-10-2	AS-S6-1	1.48	12.7[a]
Bismuth-212	14913-49-6	QAS-01-2	1.71	5[a]
Bismuth-214	14733-03-0	AS-R8-02	1.53	5[a]
Cobalt-60	10198-40-0	AS-11-41	**5.3**	2.7[a]
Cesium-137	10045-97-3	AS-11-41	**1,770**	12.2[a]
Lead-212	15092-94-1	AS-R10-02	2.78	5[a]
Lead-214	15067-28-4	AS-R8-02	1.65	5[a]
Plutonium-238	13981-16-3	AS-11-41	**20.2**	13[a]
Plutonium-239	15117-48-3	AS-11-41	**122**	12.7[a]
Strontium-90	10098-97-2	AS-S1-1	117	838[a]
Thallium-208	14913-50-9	AS-15-27.5	0.93	5[a]
Thorium-234	15065-10-8	QAS-01-2	3.4	105[a]

[a]PALs used as action levels. The PALs for radiological contaminants are based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

Bold indicates value exceeds the PAL.

CAS = Chemical Abstracts Service
PAL = Preliminary action level
pCi/g = Picocuries per gram

D.1.3 Site Classification and Initial Response Action

The four major site classifications listed in Table 3 of the ASTM standard are: (1) immediate threat to human health, safety, and/or the environment; (2) short-term (0 to 2 years) threat to human health, safety, and/or the environment; (3) long-term (greater than 2 years) threat to human health, safety, and/or the environment; (4) no demonstrated long-term threats.

Based on the CAI, CAU 504 and associated channel do not present an immediate threat to human health, safety, and\or the environment; therefore, no interim response actions are necessary at this CAU. The CAI demonstrated that the contamination present at CASs 16-06-01 (Muckpile), 16-23-01 (Contaminated Burial Pit), and 16-99-01 (Concrete Construction Waste) is limited to the points of release, however, the radiological contamination at CAS 16-23-02 (Contamination Area) has migrated down the channel to the east in surface runoff. The results

further showed that there has been no migration of contaminants into the native material under the Muckpile. A detailed discussion of the nature and extent of contamination is presented in Appendix A of this report. Based on this information, this CAU is determined to be Classification 3 as defined by ASTM Method E 1739-95 (ASTM, 1995). At all of the CASs, radionuclide COCs were identified that may pose long-term threats to human health or the environment.

D.1.4 Development of Tier 1 Lookup Table of Risk-Based Screening Level Selection

Tier 1 action levels have been defined as the PALs established during the DQO process. The PALs are a tabulation of chemical-specific (but not site-specific) screening levels based on the type of media (soil) and potential exposure scenarios (industrial). These are conservative estimates of risk, are preliminary in nature, and are used as action levels for site screening purposes. Although the PALs are not intended to be used as FALs, a FAL may be defined as the Tier 1 action level if individual constituent analytical results are below the corresponding Tier 1 action level. The FAL may also be established as the Tier I action level if individual constituent analytical results exceed the corresponding Tier 1 action level value and implementation of a corrective action based on the FAL is practical. The PALs are defined as:

- The EPA Region 9 Risk-Based PRGs for Industrial Soils (EPA, 2004).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered to be the mean plus two times the standard deviation of the mean based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- Concentrations for TPH-DRO above 100 mg/kg per NAC 445A.2272 (NAC, 2003b).
- The PALs for radioactive contaminants are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenarios (NCRP, 1999) scaled to 25-mrem/yr dose constraint (Appenzeller-Wing, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

The PALs were developed based on an industrial scenario. Because CAU 504 in Area 16 is not assigned any work stations and is considered to be in a remote or occasional use area, the use of industrial land use based PALs is conservative. The Tier 1 lookup table is defined as the PAL concentrations or activities defined in the CAIP (DTRA, 2001).

D.1.5 Exposure Pathway Evaluation

The DQOs stated that site workers would only be exposed to COCs through oral ingestion, inhalation, or dermal contact (absorption) due to exposure to potentially contaminated media (i.e., soil) at the CASs. The results of the CAI showed that all COCs identified in CAU 504 are localized near the release points and have not significantly migrated laterally or vertically in the subsurface. There has been some lateral migration of the trinitite down the drainage; however, this has been minor and is identified as small, isolated areas with elevated radiological activity identified by the walk-over radiological surveys. Because the contaminants were identified in the muck and channel soils, the primary potential exposure pathway would be through worker contact with the contaminated soil. The lack of migration into the subsurface demonstrated by the analytical results, elapsed time since the suspected release, the surface migration through storm water runoff, and the depth to groundwater supports the selection and evaluation of only the surface and shallow subsurface contact as the complete exposure pathway. Groundwater is not considered to be an exposure or migration pathway.

D.1.6 Comparison of Site Conditions with Tier 1 Risk-Based Screening Levels

All analytical results for CAU 504 were less than corresponding Tier 1 action levels (i.e., PALs) except for those listed in Table D.1-3.

Table D.1-3
COPCs Detected Above Preliminary Action Levels

	Arsenic	Co-60	Cs-137	Pu-238	Pu-239
CAS 16-06-01, Muckpile, and CAS 16-23-01, Contaminated Burial Pit		**X**	X	X	X
CAS 16-99-01, Concrete Construction Waste			X		
CAS 16-23-02, Contamination Area			X		
Channel Below CAS 16-23-02	X		X		X

Co = Cobalt
COPC = Contaminant of potential concern
Cs = Cesium
Pu = Plutonium

D.1.7 Evaluation of Tier 1 Results

For all constituents at CAU 504 not listed in Section D.1.6, the FALs were established as the Tier 1 risk-based screening levels. It was determined that no further action is required for these constituents at CAU 504.

It was determined by DTRA that remediation of the remaining constituents listed in Table D.1-3 is not practical. Therefore, Tier 2 SSTLs were calculated for those constituents.

D.1.8 Tier 1 Remedial Action Evaluation

Chemical Evaluation

Actions to remediate arsenic to Tier 1 action levels would be difficult and expensive while potentially not providing a significant risk reduction. Therefore, this chemical was moved to a Tier 2 evaluation before establishing a FAL or implementing a corrective action.

Radionuclide Evaluation

Actions to remediate Co-60, Cs-137, Pu-238, and Pu-239 to the Tier 1 action levels would be difficult and expensive while potentially not providing a significant risk reduction. Therefore, these radionuclides were moved to a Tier 2 evaluation before establishing FALs or implementing a corrective action.

D.1.9 Tier 2 Evaluation

No additional data were needed to complete a Tier 2 evaluation.

D.1.10 Development of Tier 2 Table of SSTLs

Evaluation of Chemical SSTLs

The only chemical that exceeded its PAL is arsenic. The Tier 2 evaluation consisted of calculating a Tier 2 SSTL using site-specific inputs to standard risk equations for chemical contaminants. The SSTL was calculated using equations which are compliant with the RAGS Part B procedures and were extracted from the RAIS (ORNL, 2004) located online at: http://risk.lsd.ornl.gov/cgi-bin/prg/PRG_search. This website provides an online menu-driven environmental risk assessment system that, among other things, will calculate PRGs based on site-specific parameters. The calculated SSTL, the maximum reported level for arsenic, and the average concentration of all samples with positive detects of arsenic are presented in Table D.1-4. Only four samples from the channel below CAS 16-23-02 (Contamination Area) had arsenic concentrations that exceeded the PAL, so only the results from the channel samples are included in the average.

Table D.1-4
Tier 2 SSTLs and CAU 504 Results for Chemical Constituents

CAS Number	Common Name	16-23-02		
		SSTL (mg/kg)	Maximum Result (mg/kg)	Average[a] (mg/kg)
7440-38-2	Arsenic	242	77	21

[a]This is an average of both random and biased samples

CAS = Chemical Abstracts Service
mg/kg = Milligrams per kilogram
SSTL = Site-specific target level

Evaluation of Radiological Constituent SSTLs

The Tier 2 evaluation consisted of evaluating the mixture of all radionuclides detected at the CAS to develop Tier 2 action levels for the radionuclides that exceeded Tier 1 levels. The CAS specific Tier 2 action levels were calculated using the RESRAD code (Yu et al., 2001) and site-specific parameters. The RESRAD calculations were based on continued use of the site under the Occasional Use Area scenario, assuming that a site worker will be on site for 10 days per year, 8 hours a day for 5 years. A more detailed discussion of the RESRAD code, site-specific parameters used, and the printed RESRAD outputs are provided in Attachment A of this appendix. These SSTLs, the maximum reported level, and the average level for each radiological constituent are presented in Table D.1-5.

Table D.1-5
Tier 2 SSTLs and CAU 504 Results for Radiological Constituents

CAS Number	Common Name	SSTL (pCi/g)	Maximum Result (pCi/g)	Average[a] (pCi/g)
16-06-01 (Muckpile) and 16-23-01 (Contaminated Burial Pit)				
10198-40-0	Cobalt-60	0.8	5.3	0.7
10045-97-3	Cesium-137	266	1770	265.8
13981-16-3	Plutonium-238	3	20.2	1.3
15117-48-3	Plutonium-239	18	122	7.7
16-99-01 (Concrete Construction Waste)				
10045-97-3	Cesium-137	266	49	12.6
16-23-02 (Contaminated Area and Channel)				
10045-97-3	Cesium-137	266	112	19.1
15117-48-3	Plutonium-239	18	20.5	1.4

[a]This is an average of both random and biased samples

CAS = Chemical Abstracts Service
pCi/g = Picocuries per gram
SSTL = Site-specific target level

Although all detected radionuclides at the CAS were used in the sum-of-fractions calculation, and a unique Tier 2 action level was developed for all radionuclides, only the radionuclides that initially exceeded Tier 1 levels have a Tier 2 based FAL. The CAS specific FALs established for these radionuclides are the SSTLs listed in Table D.1-5.

D.1.11 Comparison of Site Conditions with Tier 2 FALs

The Tier 2 action levels are typically compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Points of exposure are defined as those locations or areas at which an individual or population may come in contact with a COC originating from a CAS. For CAU 504, the Tier 2 action levels were compared to maximum constituent concentrations from each sample location and to the average concentration for the site.

A comparison between the maximum concentration of the radionuclides identified above Tier 1 action levels (Co-60, Cs-137, Pu-238 and Pu-239) was conducted against the CAS-specific Tier 2-based FALs (the Mixture Radionuclide Guidelines) listed in Attachment A of this appendix. For CAS 16-06-01 (Muckpile) and 16-23-01 (Contaminated Burial Pit), the maximum concentration exceeded the CAU-specific FALs for all four radionuclides, but the average activity of each radionuclide is below their CAU-specific FALs. For CAS 16-99-01 (Concrete Construction Waste), the only radionuclide that exceeded the PAL did not exceed the CAU-specific FAL. For CAS 16-23-02 (Contaminated Area) and the associated channel, Cs-137 did not exceed the CAU-specific FAL but Pu-239 did; however, the average activity of Pu-239 is below their CAU-specific FAL.

D.1.12 Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation of the chemical and radiological constituents, CAU 504 is not contaminated with organic or inorganic constituents under the Occasional Use Area scenario, it is; however, contaminated with radiological constituents at concentrations that would pose a risk to the occasional use worker. The radiological constituents Co-60, Cs-137, Pu-238, and Pu-239 were identified at concentrations that would pose a risk to the industrial worker; therefore, the site will be closed with a use restriction.

As all contaminant FALs were established as Tier 1 or Tier 2 action levels, a Tier 3 evaluation was considered unnecessary.

D.2.0 Regulatory Basis

The FFACO Part III, Section III.3 (FFACO, 1996; as amended August 2006) stipulates conformance with Chapter 445 of the NAC (NAC, 2003a). Section NAC 445A.227 lists the factors to be considered in determining whether a corrective action is required.

Section NAC 445A.227 states:

1. Except as otherwise provided in NAC 445A.22715, the Director may require an owner or operator to take corrective action if the release of a hazardous substance, hazardous waste, or a regulated substance contaminates soil and the level of contamination exceeds the action level established for the soil pursuant to NAC 445A.2272.
2. In determining whether corrective action is required, the Director shall consider:
   (a) The depth of any groundwater.
   (b) The distance to irrigation wells or wells for drinking water.
   (c) The type of soil that is contaminated.
   (d) The annual precipitation.
   (e) The type of waste or substance that was released.
   (f) The extent of the contamination.
   (g) The present and potential use for the land.
   (h) The preferred routes of migration.
   (i) The location of structures or impediments.
   (j) The potential for a hazard related to fire, vapor, or explosion.
   (k) Any other information specifically related to the site that the director determines is appropriate.

For a site where it is determined that corrective action is required (the corrective action process applies to all FFACO sites), Section NAC 445A.22705 (NAC, 2003c) stipulates a process to determine the necessary remediation standards (or FALs) based on an evaluation of the risk the site poses to public health and the environment.

Section NAC 445A.22705 states:

1. Except as otherwise provided in NAC 445A.22715, if an owner or operator is required to take corrective action pursuant to NAC 445A.227, the owner or operator may conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary. Such an evaluation must be conducted using Method E 1739-95, adopted by the ASTM, as it exists on October 3, 1996, or an equivalent method approved by the Division.

2. The Division shall determine whether an evaluation complies with the requirements of Method E 1739-95, or an equivalent method of testing approved by the Division. The Division may reject, require revisions be made to, or withdraw its concurrence with the evaluation at any time after the completion of the evaluation for the following reasons:

    (a) The evaluation does not comply with the applicable requirements for conducting the evaluation.

    (b) Conditions at the site have changed.

    (c) New information or previously unidentified information that would alter the results of the evaluation becomes available and demonstrates that the release may have a detrimental impact on public health or the environment.

Therefore, in compliance with Section NAC 445A.22705, DTRA conducted "an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary" using ASTM Method E 1739-95.

D.3.0 Recommendations

Organic, inorganic, and radiological constituents detected in environmental samples during the CAI were evaluated against FALs to determine the nature and extent of COCs for CAU 504. Assessment of the data generated from the investigation activities indicates that the radionuclides Co-60, Cs-137, Pu-238, and Pu-239 exceeded their FALs in the Muckpile, and Pu-239 exceeded its FAL in one channel sample. None of the other FALs for chemical or radiological constituents were exceeded, and Co-60, Cs-137, Pu-238, and Pu-239 are identified as the only COCs present.

As COCs were identified above corresponding FALs, it was determined that closure in place with a use restriction is the best option for closing CAU 504. This is based on the fact that even though the FALs were exceeded, this remote, controlled access site poses only limited risk overall to public health and the environment. Given the limited number of COCs, the negligible lateral and vertical migration and the lack of potential impact to groundwater, it would create a greater hazard to worker safety, public health, and the environment to remove the contamination, transport it, and bury it at another location.

No corrective action beyond the initiation of a use restriction is necessary.

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Attachment A

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 504, 16a-Tunnel Muckpile, Nevada Test Site, Nevada

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 504, 16a-Tunnel Muckpile, Nevada Test Site, Nevada

July 2007

Prepared by:
Stoller-Navarro Joint Venture,
7710 W. Cheyenne, Las Vegas, Nevada 89129

Work sponsored by United States Department of Energy,
National Nuclear Security Administration Nevada Site Office,
Environmental Restoration Division,
Las Vegas, Nevada

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 504, 16a-Tunnel Muckpile, Nevada Test Site, Nevada

1.0 Introduction

The U.S. Department of Energy (DOE), the U.S. Department of Defense (DoD) (through the Defense Threat Reduction Agency [DTRA]), and the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Environmental Restoration Division have numerous sites impacted from the development and testing of nuclear weapons. These impacts can take the form of chemical and/or radiological contaminants. Similar to its approach for chemical contamination, DoD and NNSA/NSO are committed to properly evaluating, radiologically characterizing, and where appropriate, remediating these sites to ensure the doses to radiation workers and members of the public are maintained as-low-as-reasonably achievable (ALARA), at a minimum, below the primary dose limits as stated in DOE Order 5400.5 (DOE, 1993).

To accomplish this, the potential for residual radioactive contamination in soils must be evaluated to determine the status of compliance with the requirements of DOE Order 5400.5 (DOE, 1993). The DOE Order 5400.5 requires that: "The Authorized Limits shall be established to (1) provide that, at a minimum, the basic dose limits … will not be exceeded, or (2) be consistent with applicable generic guidelines."

Because generic guidelines have not been established for volumetric residual radioactivity for the radionuclides of concern at Corrective Action Unit (CAU) 504, Authorized Limits or final action levels (FALs) were derived using the Residual Radioactive (RESRAD) model and computer code (Yu et al., 2001). The goal of this effort was to produce Authorized Limits, in units of picocuries per gram (pCi/g) in soil above background, for CAU 504 that would result in radiation doses less than 25 mrem per year (mrem/yr) to an industrial worker at the site.

To develop the FALs, a "realistic" yet conservative radiation dose analysis was conducted using approved exposure scenarios and site-specific data to determine the translation between surface soil concentrations and individual radiation doses. For this analysis, site-specific data included soil sampling results obtained during corrective action investigation (CAI) activities at CAU 504, and meteorological data obtained from the Air Resources Laboratory/Special Operations and Research Division (ARL, 2007). This report provides the radiation dose modeling analysis supporting the technical derivation of the Authorized Limits for CAU 504, 16a-Tunnel Muckpile, Nevada Test Site (NTS), Nevada. This report also defines the radionuclides considered and approved exposure scenarios for the NTS, identifies the applicable exposure pathways and key input data or assumptions, presents the radiation doses for unit concentrations of radionuclides in soil, and establishes the FALs for CAU 504. Figure 1-1 shows the location of CAU 504 at the NTS.

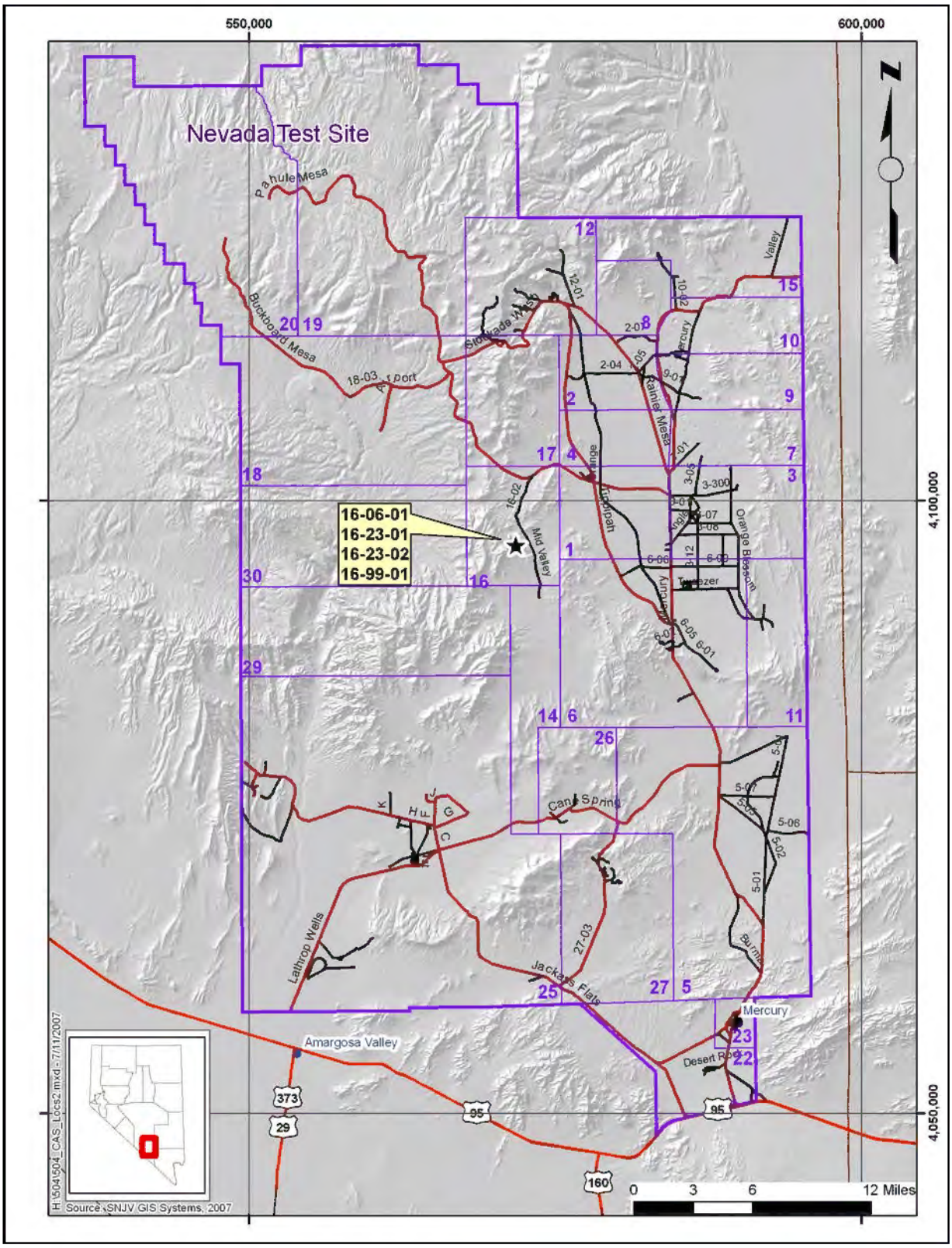

Figure 1-1
Nevada Test Site Map Showing CAU 504 Location

2.0 Facility Description

Corrective Action Unit 504, 16a-Tunnel Muckpile, is identified under *Federal Facility Agreement and Consent Order* (FFACO) classification and consists of four corrective action sites (CASs): CAS 16-06-01, Muckpile; CAS 16-23-01, Contaminated Burial Pit; CAS 16-23-02, Contaminated Area; and CAS 16-99-01, Concrete Construction Waste. There is limited information available about the Muckpile and the associated CASs. Specifics concerning potential wastes buried within or released from the Muckpile have not been documented. General background information pertaining to typical tunnel operations, Muckpile materials, and waste management procedures and operations were obtained from the *N-Tunnel Muckpile Sampling and Analysis Plan* (DNA, 1992); the Corrective Action Investigation Plans (CAIPs) for CAU 476, Area 12 T-Tunnel Muckpile (DTRA, 2000) and CAU 477, Area 12 N-Tunnel Muckpile (DTRA, 1999); and *Waste Management Planning Document for DNA Activities at the Nevada Test Site* (DNA, 1990).

The 16a-Tunnel, constructed on the east slope of the Shoshone Mesa, was mined into bedded and non-bedded tuffs approximately 855 to 1,050 feet (ft) below the mesa surface (USGS, 1962). The surface elevation of the tunnel portal is about 5,410 ft above mean sea level (USGS, 1962). The 16a-Tunnel was excavated in a westerly direction into the Shoshone Mesa on the side of the canyon. The Muckpile was built out in an easterly direction from the tunnel portal. In general, the Muckpile widens and thickens away from the tunnel, terminating approximately 650 ft east of the tunnel. The Muckpile is approximately 650 ft across at its widest point, with a maximum height of approximately 85 ft.

2.1 Operational History

The 16a-Tunnel was used for both nuclear weapons effects tests and high explosives testing. It operated intermittenly between 1962 and 1971 for weapons effects and Vela Uniform tests. Subsequent to each of these tests, tunnel re-entry involved additional horizontal mining and the generation of rock debris and construction wastes such as cabling, scrap metal, and cementitious mixtures which could have contained low levels of radioactivity. The materials excavated during re-entry were generally hauled outside the tunnel to the edge of the existing Muckpile. During the initial years of nuclear testing, re-entry waste of various types were probably disposed into the Muckpile.

High explosive tests have also been conducted in the 16a-Tunnel. Debris from these tests was disposed of within the boundaries of the CAU. Soils blown into the 16a-Tunnel during a high explosive test were sampled for detonation products. Based on this sampling, the soils were determined to be non-hazardous (Dubiskas, 1995).

2.2 Release and Waste Information

There have been no known or suspected releases from CAU 504. The 16a-Tunnel Muckpile contains approximately 175,000 cubic yards of material consisting primarily of mining debris (rock) generated during the excavation phase of tunnel construction. Some non-geologic materials were disposed of in the Muckpile during tunnel construction including construction

waste such as steel, wood, cables, grout, and concrete including the concrete dumped over the eastern edge of the Muckpile (CAS 16-99-01). Originally, CAS 16-99-01 was incorrectly described as a part of CAU 473 but was identified during the investigation of that site as construction waste from tunnel operations and reclassified (DTRA, 1998). Less than 1 percent of the Muckpile is expected to be composed of debris generated from re-entry operations (DNA, 1990). In cases where radioactive debris was placed in the Muckpile, the debris was typically capped with 10 ft of clean cover material (Dubiskas, 1997).

3.0 Site Investigation Activities

From June 4 to July 11, 2001, CAI activities were performed at the 16a-Tunnel Muckpile as set forth in the CAU 504 CAIP (DTRA, 2001). The purpose of the CAI was to determine whether or not the 16a-Tunnel Muckpile and/or the underlying native soils have been impacted by contaminants of potential concern (COPCs) at concentrations that exceed regulatory limits, and to provide sufficient information and data to develop appropriate corrective action strategies for the Muckpile.

3.1 Site Investigation Plans

Corrective action investigation activities were performed as set forth in the CAU 504 CAIP (DTRA, 2001). The objective of the CAU 504 CAI was to meet the objectives specified in the project-specific Data Quality Objectives (DQOs) by:

- Characterizing the muck from the surface to native material interface.
- Characterizing the native materials underlying the Muckpile (from 2 to 5 ft below the Muckpile/native soil interface or until drill refusal) for COPCs.
- Establishing background levels of radioactivity and meals in the native soils surrounding the ponds.

The DQO process is a seven-step strategic planning approach based upon the scientific method used to plan data collection activities for CAU 504, 16a-Tunnel Muckpile. The DQOs are designed to ensure that data collected will provide sufficient and reliable information to identify, evaluate and technically defend the recommended corrective actions (i.e., no further action, closure in place, or clean closure).

The primary objective of the investigation was to provide sufficient information and data to develop appropriate corrective action alternatives for CAU 504. This objective was achieved by identifying the nature and extent, both horizontal and vertical of contaminants of concern (COCs) (i.e., COPCs at concentrations above action levels).

The investigation strategy was developed by representatives of NDEP and DTRA, in accordance with U.S. Environmental Protection Agency (EPA) *Guidance for the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 1994). The CAU 504 CAIP contains a description of the investigation strategy and the DQO process.

3.2 Summary of Specific Site Investigation Activities

This section provides a brief description of work activities conducted to support the investigation of radioactive contamination at CAU 504.

As outlined in the CAIP (DTRA, 2001), the following tasks were performed:

- Drive-over and walk-over radiological survey – Before commencing drilling and sampling, drive-over and walk-over radiological surveys were conducted to identify surface and sub-surface areas with elevated readings. The drive-over survey was conducted on the Muckpile, and the walk-over surveys were conducted in the ravine on the south side and east of the Muckpile.

- Background sampling – Three locations were identified and excavated by hand to a depth of approximately 3 inches to collect background native soil samples. Samples were field screened and submitted for radionuclide and inorganic constituent analysis.

- Subsurface sampling (CAS 16-06-01 and CAS 16-23-01) – Fifteen boreholes were drilled to characterize the Muckpile and the underlying native material. At each borehole, a continuous core was extracted and field screened. One sample was collected from a randomly selected depth in each borehole, and one sample of the native material was collected from the bottom of the hole. If the field screening identified sections of core with elevated readings, additional biased samples were collected.

- Surface/shallow subsurface sampling (CAS 16-06-01 and CAS 16-23-01) – Five boreholes were drilled and one location was hand-excavated to characterize the surface/shallow subsurface of the Muckpile (less than 5 ft). At the five drilled boreholes, a continuous core was extracted from each borehole. Each core was field screened for volatile organic compounds and elevated radiological readings and the portion of the core with the highest field screening results was collected for laboratory analysis. If no portion of the core exhibited elevated field-screening results, the interval between 0.5 and 1.5 ft sent for analysis. One location was too close to the edge of the Muckpile to drill, so a sample was obtained by digging to a depth of 1.5 ft using hand tools. Seven samples were collected and submitted for analysis.

- Surface soil sampling using hand tools (CAS 16-23-02 and the drainage east of CAS 16-23-02) – Twenty-one environmental samples were collected from 16 locations to characterize these areas. The sample locations were identified using a combination of biased and random selection techniques.

- Surface soil sampling using hand tools (CAS 16-99-01) – Eleven environmental soil samples were collected from eight locations under and around the Concrete Construction Waste. The sample locations were all biased to fall under the concrete or in areas with elevated radiological screening results. The samples were collected in 2-inch lifts starting at the ground surface or the base of the concrete. Sampling continued until a sample collected did not exceed the radiological field screening level. That sample was sent for laboratory analysis. Then all samples collected above this point were mix together as a composite sample and submitted for laboratory analysis.

4.0 Site Investigation Sample Results

Radionuclides were found in the Muckpile and channel samples. The RESRAD calculations are based on validated analytical sample results obtained during site investigation activities and other applicable information specified in the CAIP (DTRA, 2001). Because the lack of specific discharge information and potential impact from venting of I, J, and K Tunnels, RESRAD calculations are based upon the value of the maximum radionuclide concentration found in the samples. The RESRAD calculations of the area were performed for the COCs present in the CAU 504 16a-Tunnel Muckpile using the maximum radionuclide concentrations obtained from the CAI sample results. Appendix A of this document contains a detailed description of the sample results, analytical parameters, and laboratory methods used to analyze the soil samples.

The maximum principal radionuclide concentrations (including background) detected at CAU 504 are listed in Table 4-1.

Table 4-1
Maximum Results for Principal Radionuclides Found in CAU 504 Soil Samples

Sample Number	Radionuclide	Concentration (pCi/g)	Sample media
AS-S1-1	Uranium-235	2.7	Muckpile
AS-S1-1	Strontium-90	117	Muckpile
AS-13-12	Antimony-125	3.3	Muckpile
AS-13-13	Ruthernium-106	6	Muckpile
AS-11-41	Plutonium-239	122	Muckpile
AS-11-41	Plutonium-238	20.2	Muckpile
AS-C2-0.5	Niobium-94	0.133	Construction concrete
AS-11-41	Sodium-22	0.34	Muckpile
AS-S6-1	Manganese-54	0.14	Muckpile
AS-S4-01	Europium-155	0.7	Muckpile
AS-10-28.5	Europium-154	1.8	Muckpile
AS-11-41	Europium-152	2.2	Muckpile
AS-11-41	Cesium-137	1,770	Muckpile
AS-13-13	Cesium-134	0.64	Muckpile
AS-11-41	Cobalt-60	5.3	Muckpile
AS-11-41	Cobalt-57	1.2	Muckpile
AS-13-12	Cerium-144	6.7	Muckpile
AS-S1-1	Cadmium-109	20	Muckpile
AS-11-41	Americium-241	28	Muckpile
AS-C2-B	Aluminum-26	0.097	Construction concrete
AS-13-13	Silver-110m	1.4	Muckpile

pCi/g = Picocuries per gram

5.0 Initial Concentrations for Principal Radionuclides

Principal radionuclides are defined as radionuclides with a half-life greater than six months. The decay products of any principal radionuclide down to, but not including, the next principal radionuclide in its decay chain are defined as associated radionuclides. The RESRAD assumes that a principal radionuclide is in secular equilibrium with its associated radionuclides at the point of exposure. Therefore, associated radionuclides and radionuclides with half-lives less than six months are not input into the RESRAD calculations.

5.1 Authorized Values for Initial Concentrations of Principal Radionuclides

The authorized exposure scenarios specify that value of the arithmetic mean plus the 95 percent upper confidence limit (UCL) obtained from site-specific sampling results be entered as the principal radionuclide concentrations for RESRAD calculates. The sample results for all samples with radionuclide concentrations above the minimum detectable concentration within the land parcels are entered into the EPA software application ProUCL version 3.0. The ProUCL software is used to calculate the 95 percent UCL for principal radionuclide concentrations based on the distribution of the unknown mean.

If the ProUCL software determined that there were not enough data to calculate the 95 percent UCL for a specific radionuclide, the maximum concentration from the sample dataset was used as the initial concentration for that radionuclide.

5.2 Authorized Values Initial Concentrations of Principal Radionuclides for Area Averaging/Location-Specific Scenarios

The DOE Order 5400.5 (DOE, 1993) states: "Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2" (5400.5, IV, 4.a.). The DOE Order 5400.5 also states: "If the average concentration of any surface or below-surface area less than or equal to 25 m^2, exceeds the limit or guideline by a factor of $(100/A)^{0.5}$, [where A is the area (in square meters) of the region in which concentrations are elevated], limits for "hot-spots" shall also be developed and applied" (5400.5, IV, 4.a.(1)). The DOE Order 5400.5, IV, 4.a.(1) indicates that criterion for these location-specific analysis is discussed in DOE G 441.1-XX (DOE 2002), Section 5.2.2.

The purpose of the location-specific analysis criterion is to ensure that applying the homogeneous criteria, in which the concentrations of residual radioactive material are averaged over a 100-square meter (m^2) area, does not result in the release of small areas that, because of averaging, contain unacceptably high concentrations of residual radioactive material. The location-specific criterion is used to supplement Authorized Limits for larger areas and is intended to prevent excessive exposures from a small, contaminated area that is within a larger area that meets the basic Authorized Limits. Thus, it is intended for use in areas where the residual radioactive material concentrations are not uniform. Also, the above criterion was derived conservatively, assuming the Authorized Limits were based on a dose constraint of 25 mrem/yr and selected to ensure unlikely exposure conditions would not cause the primary dose limit (100 mrem/yr) to be exceeded. The authorized exposure scenarios specify that the value of the maximum concentration of principal radionuclides obtained from site-specific

sampling results be entered as the principal radionuclide concentrations for RESRAD location-specific calculations. The authorized area parameters for RESRAD location-specific calculations are 1 m^2, 10 m^2, and 100 m^2 contamination areas.

5.3 Inhomogeneous Contamination and Initial Radionuclide Concentrations

A contaminated zone is inhomogeneous if it contains a contaminated region within which the concentration of a radionuclide exceeds three times the average for the contaminated zone. RESRAD uses a mathematical construct that assumes uniform distribution of radionuclides within a volume. However, RESRAD recognizes that radiological contamination is inhomogeneous in nature and provides detailed guidance for applying inhomogeneous criteria (e.g., location-specific criteria, sum of fractions rule). The RESRAD User's Manual states that the inhomogeneous release criteria are generally more realistic and hence less restrictive than the homogeneous release criteria (Yu et al., 2001). This shows that the approved initial radionuclide concentration values (i.e., arithmetic mean plus 95 percent UCL or the maximum radionuclide concentration from the sample dataset) will result in more restrictive release criteria. The arithmetic mean plus the 95 percent UCL are used for the initial concentrations of principal radionuclides when the sample results are obtained using a random sampling method. The maximum radionuclide concentration values are used for the initial concentrations of principal radionuclides when the sample results are obtained using a non-random (e.g., bias or judgmental sampling) sampling method.

The RESRAD states that a statistical approach should always be considered as a first priority regarding the estimation of soil concentrations, as cited in the *Data Collection Handbook To Support Modeling Impacts of Radioactive Material in Soil* (Yu et al., 1993). The 95 percent UCL represents a value that has a 5 percent chance that the actual mean of the dataset would exceed it. The 95 percent UCL is computed using the EPA code ProUCL. The code calculates the 95 percent UCL based on the distribution of the dataset (e.g., normal, log-normal, gamma, non-parametric).

The ProUCL software has been developed to compute an appropriate 95 percent UCL of the unknown population mean to support exposure assessment and cleanup decisions for EPA projects. A 95 percent UCL of the unknown population arithmetic mean is often used to:

- Estimate the exposure point concentration term
- Determine the attainment of cleanup standards
- Estimate background level mean contaminant concentrations or
- Compare the soil concentrations with site-specific soil screening levels.

It is important to compute a reliable, conservative, and stable 95 percent UCL of the population mean using the available data. The 95 percent UCL should approximately provide the 95 percent coverage for the unknown population mean.

The EPA has recommended that the maximum value of the dataset be used for the initial EPC term when the 95 percent UCL exceeds the maximum (EPA, 1992). However, if the maximum value of the dataset is used, then most of the statistical data associated with the distribution of the dataset are ignored (except for the maximum). Therefore, by using the mean plus the 95 percent

UCL the statistical data associated with the dataset are retained, and the value approaches or exceeds the maximum value of the dataset as recommended by EPA.

5.4 Initial Concentrations of Principal Radionuclide for CAU 504

The initial radionuclide concentrations used for the RESRAD calculations are those listed in Table 4-1. The analytical results showed that radionuclides are present in all CAS locations. Samples from the Muckpile (which include the Contaminated Burial Pit), Concrete Construction Waste soil, and the Contaminated Area and drainage channel soil contain radionuclides with concentrations exceeding preliminary action level (PAL). Because no specific information was available for the origin of these radionuclides, all four CASs are considered as one whole unit for RESRAD analysis. The maximum radionuclide concentration values found were used to perform the RESRAD calculations to demonstrate conservatism.

6.0 Authorized RESRAD Exposure Pathways and Scenarios

This section describes the input parameters, exposures scenarios, and guidance for calculating site-specific radiological remediation levels for projects using the RESRAD computer code (Yu et al., 2001), as agreed to by NNSA/NSO, Stoller-Navarro Joint Venture (SNJV), the NTS Management and Operating (M&O) Contractor, and NDEP.

6.1 Guidance for RESRAD Calculations

The guidance in this section was developed by NNSA/NSO, SNJV, the M&O Contractor, and NDEP and is only applicable to soils containing residual radioactive material. This guidance does not apply to structures, facilities, equipment, and building materials containing contaminated surfaces or volume contamination. The primary dose limit for any member of the public is 100-millirem (mrem) total effective dose equivalent (TEDE) in a year. This limit applies to the sum of internal and external doses resulting from all modes of exposure to all radiation sources other than background radiation and doses received as a patient from medical sources as required by DOE 5400.5, II.1.a.(3)(a) (DOE, 1993). The dose constraint is defined as one quarter of the dose limit (i.e., 25-mrem) and will be applied to ensure that in a 1,000-year period the maximally exposed individual does not exceed the dose constraint in any single year. The requirements of Chapter IV of DOE 5400.5 Chapter IV will not specifically apply if NNSA/NSO chooses to continue to own and actively control access or use of the site. However, the radiation protection requirements in the other sections of DOE 5400.5 will apply to NNSA/NSO owned and maintained sites.

Due to the large spatial variability in background amongst sites, the "above background criterion" will be defined as the concentration of a specific radionuclide in soil that equals or exceeds its corresponding PAL. The source data for these radionuclide-specific PALs are taken directly from National Council on Radiation Protection and Measurements Report No. 129 Table 2.1, Construction, Commercial, Industrial land-use scenario column for a 25-mrem dose constraint (NCRP, 1999). The generic guidelines for residual concentrations of radium (Ra)-226, Ra-228, thorium (Th)-230, and Th-232 are found in Chapter IV of DOE Order 5400.5, Change 2, *Radiation Protection of the Public and Environment* (DOE, 1993).

Background radiation refers to the local area and includes:

- Concentration of naturally occurring radionuclides.
- Cosmic radiation.
- Radionuclides of anthropogenic origin that have been globally dispersed and are present at low concentrations such as fallout from nuclear weapons. (Note: This is not the case at the NTS because the historical aspects of the NTS [e.g., aboveground and belowground testing, and other operations resulted in dispersion of radionuclides locally].)

Due to the impracticality of determining "true" background, a dose constraint with no background subtraction will be used (i.e., a dose constraint not in excess of background). The

use of the dose constraint with no background subtraction is a far more conservative and sensitive approach because it does not deal with the uncertainty of natural background.

6.2 Description of Approved Scenarios

Based on the future land use as identified in the *Nevada Test Site Resource Management Plan* (DOE/NV, 1998), the following two exposure scenarios have been identified as "actual" and "likely" use scenarios. Stoller-Navarro Joint Venture has approval to use two scenarios (Scenario A and Scenario B) for use with the RESRAD code (NDEP, 2004). Both scenarios consider radiation exposures to the critical population group via the following pathways:

- Direct exposure to external radiation from the contaminated soil
- Internal dose from inhalation of airborne radionuclides
- Internal dose from ingestion of contaminated soil

The two scenarios vary the parameters associated with the future land use of the site but use the same dose constraint parameter of 25 mrem/yr. Scenario A is approved for sites in Mercury or within 500 ft of an active building. Scenario B is approved for all other sites. Scenarios A and B are briefly described below.

For Scenario A, the future land use assumes continued industrial use of the site. This scenario addresses long-term exposure received by industrial workers exposed daily to residual levels of radionuclides in soil during an average workday outdoors on site (EPA, 1991). Scenario A parameters are based on the following:

- A worker will be outdoors at the site for a total of 2,000 hours per year (hr/yr) (250 days per year, 8 hours per day) for a duration of 25 years.

- Indoor fraction time is zero, which means that the worker is outside being exposed for the entire workday.

- The outdoor time fraction is 0.228 and is calculated by dividing the total work hours at the site per year (2,000 hr/yr) by the total number of hours in a year (8,760 hr/yr).

- Worker exposures are limited to working hours and do not include contributions from ingestion of drinking water, plant foods, meat, or fish taken from the immediate area.

For Scenario B, the future land use assumes land use restrictions with a low occupancy factor and lighter work activities at the site. The assumptions for Scenario B include the following:

- A worker will be at the site and outdoors for a total of 335 hr/yr for a duration of 25 years.

- The indoor fraction time is zero

- The outdoor time fraction is 0.038, which is calculated by dividing the total work hours at the site per year (335 hr/yr) by the total number of hours in a year (8,760 hr/yr).

- The worker exposures are limited to working hours and do not include contributions from ingestion of drinking water, plant foods, meat, or fish taken from the immediate area.

When Scenario B is selected, a Use Restriction will be included at closure that will state the use scenario and the requirement for an occupant agency or entity to re-evaluate the closure if site use changes to fit the parameters of Scenario A.

Table 6-1 lists the pathways considered for Scenarios A and B.

Table 6-1
Summary of Pathways Considered for Scenarios A and B

Pathway	Scenario A	Scenario B
External exposure	Yes	Yes
Particulate inhalation	Yes	Yes
Radon inhalation	No	No
Ingestion of soil	Yes	Yes
Ingestion of produce from on-site garden	No	No
Ingestion of meat from on-site livestock	No	No
Ingestion of milk from on-site livestock	No	No
Ingestion of fish from on-site pond	No	No
Ingestion of water from on-site well	No	No

6.3 RESRAD Parameters

The RESRAD User's Manual states that: "The RESRAD default parameter values were carefully selected and are realistic, although conservative, parameter values. (In most cases, use of these values will not result in underestimation of the dose or risk.) Site-specific parameters should be used whenever possible. Therefore, use of default values that significantly overestimate the dose or risk for a particular site is discouraged" (Yu et al., 2001).

Table 6-2 lists all of the RESRAD default values along with the site-specific RESRAD parameters approved for use with Scenarios A and B. A reference or reason is provided for parameters that require site-specific input.

Table 6-2
Approved RESRAD Parameters
(Page 1 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Dose Conversion Factors					Use FGR 13 Morbidity
R02 Exposure Pathways					
Pathway 1- External Gamma		Active	Active		
Pathway 2- Inhalation		Active	Active		
Pathway 3- Plant Ingestion		Suppressed	Suppressed		
Pathway 4- Meat Ingestion		Suppressed	Suppressed		
Pathway 5- Milk Ingestion		Suppressed	Suppressed		
Pathway 6- Aquatic Foods		Suppressed	Suppressed		
Pathway 7- Drinking Water		Suppressed	Suppressed		
Pathway 8- Soil Ingestion		Active	Active		
Pathway 9- Radon		Suppressed	Suppressed		
R011 Contaminated Zone (CZ)					
Area of CZ	m^2	Site Specific	Site Specific	1.000E+04	Maximum area of contamination out to two successive sample intervals below PALs. (~ 15 ft intervals laterally)
Thickness of CZ	m	Site Specific	Site Specific	2.000E+00	Maximum identified depth plus two successive intervals below PALs as identified during the site characterization. (~ 5 ft intervals vertically)
Length Parallel to Aquifer Flow	m	Not Used	Not Used	1.000E+02	Not used with the above pathway selection
Radiation Dose Limit	mrem/yr	25	25	2.5E+001	RESRAD Default (DOE, 1993)
Elapsed Time Since Placement of Material	yr	0.0	0.0	0.0	RESRAD Default
R012 Initial Principal Radionuclide					
Site-Specific Parent Radionuclide with half-life greater than 180 days, does not include naturally occurring and primordial radionuclides	pCi/g	Site Specific	Site Specific	0.0	The arithmetic mean plus the 95% UCL for the site.

Table 6-2
Approved RESRAD Parameters
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Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
R013 Cover and Contaminated Zone Hydrological Data					
Cover Depth	m	Site Specific	Site Specific	0.0	The minimum depth as identified during the site characterization
Density of Cover Material	g/cm^3	1.5	1.5	1.5	RESRAD Default unless site data significantly different
Cover Depth Erosion Rate	m/yr	1.000E-03	1.000E-03	1.000E-03	RESRAD Default unless site data significantly different
Density of Contaminated Zone	g/cm^3	1.5	1.5	0.5	RESRAD Default unless site data significantly different
Contamination Zone Erosion Rate	m/yr	1.000E-03	1.000E-03	1.000E-03	RESRAD Default unless site data significantly different
Contaminated Zone Total Porosity	-	4.000E-01	4.000E-01	4.000E-01	RESRAD Default unless site data significantly different
Contaminated Zone Field Capacity	-	2.000E-01	2.000E-01	2.000E-01	RESRAD Default unless site data significantly different
Contaminated Zone Hydraulic Conductivity	m/yr	1.000E+01	1.000E+01	1.000E+01	RESRAD Default unless site data significantly different
Contaminated Zone b Parameter	-	5.300E+00	5.300E+00	5.300E+00	RESRAD Default unless site data significantly different
Average Annual Wind Speed	m/sec	Site Specific	Site Specific	2.000E+00	Data from Air Resources Laboratory (ARL, 2007) http://www.sord.nv.doe.gov/arlsord-1.htm
Humidity in Air	g/m^3	Not Used	Not Used	8.000E+00	Not used with the above pathway selection
Evapotranspiration Coefficient	-	5.000E-01	5.000E-01	5.000E-01	RESRAD Default not significant due to lack of groundwater pathway
Precipitation	m/yr	Site Specific	Site Specific	1.000E+00	Data from Air Resources Laboratory (ARL, 2007) http://www.sord.nv.doe.gov/arlsord-1.htm
Irrigation	m/yr	0	0	2.000E-01	Assumes no artificial supply of water to soil
Irrigation Mode	-	Overhead	Overhead	Overhead	RESRAD Default
Runoff Coefficient	-	4.000E-01	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu et al., 1993)
Watershed Area for Nearby Stream or Pond	m^2	Not Used	Not Used	1.000E+06	Not used with the above pathway selection
Accuracy for Water/Soil Computations	-	Not Used	Not Used	1.000E-03	Not used with the above pathway selection

Table 6-2
Approved RESRAD Parameters
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Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
R014 Saturated Zone Hydrological Data					
Density of Saturated Zone	g/cm^3	Not Used	Not Used	1.500E+00	Not used with the above pathway selection
Saturated Zone Total Porosity	-	Not Used	Not Used	4.000E-01	Not used with the above pathway selection
Saturated Zone Effective Porosity	-	Not Used	Not Used	2.000E-01	Not used with the above pathway selection
Saturated Zone Field Capacity	-	Not Used	Not Used	2.000E-01	Not used with the above pathway selection
Saturated Zone Hydraulic Conductivity	m/yr	Not Used	Not Used	1.000E+02	Not used with the above pathway selection
Saturated Zone Hydraulic Gradient	-	Not Used	Not Used	2.000E-02	Not used with the above pathway selection
Saturated Zone b Parameter	-	Not Used	Not Used	5.300E+00	Not used with the above pathway selection
Water Table Drop Rate	m/yr	Not Used	Not Used	1.000E-03	Not used with the above pathway selection
Well Pump Intake Depth	m	Not Used	Not Used	1.000E+01	Not used with the above pathway selection
Model: Nondispersion or Mass-Balance	-	ND	ND	ND	RESRAD Default
Well Pumping Rate	m^3/yr	Not Used	Not Used	2.500E+02	Not used with the above pathway selection
R015 Uncontaminated and Unsaturated Strata Hydrological Data					
Number of Unsaturated Zone Strata	-	Not Used	Not Used	1	Not used with the above pathway selection
Thickness	m	Not Used	Not Used	4.000E+00	Not used with the above pathway selection
Soil Density	g/cm^3	Not Used	Not Used	1.500E+00	Not used with the above pathway selection
Total Porosity	-	Not Used	Not Used	4.000E-01	Not used with the above pathway selection
Effective Porosity	-	Not Used	Not Used	2.000E-01	Not used with the above pathway selection
Field Capacity	-	Not Used	Not Used	2.000E-01	Not used with the above pathway selection
Soil-specific b Parameter	-	Not Used	Not Used	5.300E+00	Not used with the above pathway selection
Hydraulic Conductivity	m/yr	Not Used	Not Used	1.000E+01	Not used with the above pathway selection

Table 6-2
Approved RESRAD Parameters
(Page 4 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
R016 Distribution Coefficients and Leach Rates					
Contaminated Zone K_d (All Zones)	cm^3/g				RESRAD Defaults
Saturated Leach Rate	/yr	0.0	0.0	0.0	Not used
Solubility Constant	-	0.0	0.0	0.0	Not used
R017 Inhalation and External Gamma					
Inhalation Rate	m^3/yr	8.400E+03	1.230E+04	8.400E+03	RESRAD Default and for an individual performing outdoor activities, a typical activity mix can consist of 37% at a moderate activity level, 28% at both resting and light activity levels, and 7% at a heavy activity level, which results in a 1.4 m^3/h (12,300 m^3/yr) inhalation rate. (Yu et al., 1993)
Mass Loading for Inhalation	g/m^3	6.00E-04	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu et al., 1993)
Exposure Duration	yr	25	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1	1	0.4	Assumes no indoor time fraction.
Shielding Factor External Gamma	-	1	1	0.7	Assumes no indoor time fraction.
Fraction of Time Spent Indoors	-	0.0	0.0	0.5	Assumes no indoor time fraction.
Fraction of Time Spent Outdoors	-	0.228	0.038	0.25	Based on Industrial/Commercial use scenarios for standard occupancy and low occupancy.
Shape Factor	-	1.0	1.0	1.0	RESRAD Default

Table 6-2
Approved RESRAD Parameters
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Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
R018 Ingestion Pathway Data, Dietary Parameters					
Fruits, Vegetables, and Grain Consumption	kg/yr	Not Used	Not Used	1.600E+02	Not used with the above pathway selection
Leafy Vegetable Consumption	kg/yr	Not Used	Not Used	1.400E+01	Not used with the above pathway selection
Milk Consumption	L/yr	Not Used	Not Used	9.200E+01	Not used with the above pathway selection
Meat and Poultry Consumption	kg/yr	Not Used	Not Used	6.300E+01	Not used with the above pathway selection
Fish Consumption	kg/yr	Not Used	Not Used	5.400E+00	Not used with the above pathway selection
Other Seafood Consumption	kg/yr	Not Used	Not Used	9.000E-01	Not used with the above pathway selection
Soil Ingestion Rate	g/yr	1.752E+02	1.752E+02	36.5	480 mg/day (EPA, 1991)
Drinking Water Intake	L/yr	Not Used	Not Used	5.100E+02	Not used with the above pathway selection
Drinking Water Contaminated Fraction	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
Household Water Contaminated Fraction	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
Livestock Water Contaminated Fraction	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
Irrigation Water Contaminated Fraction	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
Aquatic Food Contamination Fraction	-	Not Used	Not Used	5.000E-01	Not used with the above pathway selection
Plant Food Contamination Fraction	-	Not Used	Not Used	-1	Not used with the above pathway selection
Meat Contamination Fraction	-	Not Used	Not Used	-1	Not used with the above pathway selection
Milk Contamination Fraction	-	Not Used	Not Used	-1	Not used with the above pathway selection
R019 Ingestion Pathway Data, Nondietary					
Livestock Fodder Intake for Meat	kg/day	Not Used	Not Used	6.800E+01	Not used with the above pathway selection
Livestock Fodder Intake for Milk	kg/day	Not Used	Not Used	5.500E+01	Not used with the above pathway selection
Livestock Water Intake for Meat	L/day	Not Used	Not Used	5.000E+01	Not used with the above pathway selection
Livestock Water Intake for Milk	L/day	Not Used	Not Used	1.600E+02	Not used with the above pathway selection

Table 6-2
Approved RESRAD Parameters
(Page 6 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Livestock Soil Intake	kg/day	Not Used	Not Used	5.000E-01	Not used with the above pathway selection
Mass Loading for Foliar Deposition	g/m^3	Not Used	Not Used	1.000E-04	Not used with the above pathway selection
Depth of Soil Mixing Layer	m	Not Used	Not Used	1.500E-01	Not used with the above pathway selection
Depth of Roots	m	Not Used	Not Used	9.000E-01	Not used with the above pathway selection
Drinking Water Fraction from Groundwater	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
Household Water Fraction from Groundwater	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
Livestock Water Fraction from Groundwater	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
Irrigation Fraction from Groundwater	-	Not Used	Not Used	1.000E+00	Not used with the above pathway selection
R021 Radon					
Radon Parameters Not Used					Not used with the above pathway selection

FGR = Federal Guidance Report
ft = foot
g/cm^3 = Grams per cubic centimeter
g/m^3 = Grams per cubic meter
g/yr = Grams per year
kg/day = Kilograms per day
kg/yr = Kilograms per year
L/day = Liters per day
L/yr = Liters per year
m = Meter
m/sec = Meters per second
m/yr = Meters per year
m^2 = Square meter
m^3/h = Cubic meters per hour
m^3/yr = Cubic meters per year
mg/day = Milligrams per day
mrem/yr = Millirem per year
ND = Nondetect
PAL = Preliminary action level
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive
UCL = Upper confidence limit
yr = Year
/yr = Per year

6.4 Residual Radioactive Material Guideline

The residual radioactive material guideline represents the concentration of residual radioactive material that can remain in place and still allow use of that area without radiological restrictions. Using site-specific parameters and sample analysis results, the radioactive material guideline, G, can be calculated for a given dose limit of H_{EL} for an individual as follows;

$$G = H_{EL} / DSR ,$$

where DSR is the total dose/source concentration ratio. The dose limit H_{EL}, used to derive the residual radioactive material guideline is 25 mrem/yr.

Single radionuclide guidelines are calculated for individual radionuclides such that the annual dose to industrial/construction workers at the site should not exceed an annual dose limitation of 25 mrem/yr. Sites contaminated with two or more radionuclides (i.e., a mixture of radionuclides) require further evaluation to ensure that collective exposures from individual radionuclides do not exceed the 25 mrem/yr annual dose constraint. This evaluation is performed using a sum of the fractions method. The initial soil concentration of each radionuclide is divided by the single radionuclide guideline for that radionuclide to produce a ratio. These ratios are then summed. If the sum is less than or equal to unity, then the collective annual dose from all radionuclides at the site should not exceed the 25 mrem/yr annual dose constraint. If the sum does exceed unity, the annual dose to industrial/construction workers could exceed the 25 mrem/yr dose constraint, even if the concentrations of residual radionuclides at the site are below the single radionuclide guideline values. For sites where the sum of the ratios exceeds unity, residual radioactive material guidelines for mixtures of radionuclides are calculated such that the following equation is satisfied:

$$\overline{M} = \sum_i \overline{S}_i(t_o) / G_i(t_m) \leq 1$$

Where:

	$\overline{M}$	=	average mixture sum (dimensionless)
	$\overline{S}_i(t_o)$	=	initial concentration of the *i*th principal radionuclide averaged over an area determined by scenario activities
	$G_i(t_m)$	=	single radionuclide soil concentration guideline for the *i*th principal radionuclide at time t maximum.

For a site where the sum of the ratios does not exceed unity, the residual radioactive guidelines for single radionuclides are the radionuclide concentrations to be used as the FAL. For sites where the sum of the ratios exceeds unity, the residual radioactive guidelines for mixtures of radionuclides are mathematically adjusted so that the above equation is satisfied. Those adjusted values are then used as the FAL.

7.0 RESRAD Calculations for CAU 504, 16a-Tunnel Muckpile

This section discuses the RESRAD calculations and results for CAU 504.

7.1 Selection of RESRAD Exposure Scenario

Scenario B was selected as the exposure scenario for the CAU 504 because of the remote location of the site. Because Scenario B parameters will be used for these calculations, a Use Restriction will be implemented at closure that will state the use scenario and the requirement for an occupant agency or entity to re-evaluate the closure if site use changes to fit the parameters of Scenario A.

7.2 User Input Parameters

The RESRAD default parameters that were modified for the calculations performed for CAU 504 in this report and the site-specific values entered are presented in Table 7-1. A complete list of the RESRAD default parameters and the site-specific parameters used for CAU 504 is provided in Table A-1 of Attachment A. The initial radionuclide concentrations used for analyses are those listed in Table 4-1.

Because the uncertainty of any specific radionuclide origin and the positive analytical results for samples from all CAS locations (including the background samples), CAU 504 is treated as one unit for RESRAD analysis.

7.3 Radionuclide Concentrations and Dose Estimates

The maximum dose results from RESRAD calculations for the CAU 504 is 166.2 mrem/yr occurring at year zero (current year) and the dose will not decrease to zero until year 150. The detailed RESRAD results for this CAS are provided in Exhibit 1, RESRAD Summary Report: CAU 504.

Uncertainty in the derivation of dose estimates and dose/source contribution ratios comes from the distribution of possible input parameter values, as well as uncertainty in the conceptual model used to represent the site. The pathway contributing to the total annual dose at the time of maximum dose occurs are almost all (98.97 percent) for external exposure, 0.75 percent for inhalation, and 0.28 percent for soil ingestion pathways. Therefore, uncertainties in the following parameters: Erosion rates, thickness of contaminated zone, occupancy factors, and wind speed have the greatest significance on the model predictions.

The maximum dose contributions and total dose/source concentration ratios for the Muckpile under Scenario B parameters have been predicted to occur at year zero. The calculated maximum dose contributions for all considered pathways are presented in Table 7-2. Figure 7-1 shows that the TEDE to remote worker for the considered pathway decreases to below the 25 mrem/yr dose constraint at year 68. The dose from cesium-137, the dominating contributing radionuclide, at year zero is 160.8 mrem/yr and doses from all radionuclides decreases to 24.98 rem/yr for year 68.

Because the radionuclide concentrations found at this site pose a dose level above the 25 mrem/yr constraint under the current site conditions considered for the site, the site should be use restricted and radiologically posted in accordance with applicable regulation and procedures.

7.4 Residual Radioactive Material Guidelines for CAU 504

The sum of the ratios for CAU 504 exceeds unity. Table 7-3 presents the calculations results for deriving guidelines for radionuclides for this CAU. The FALs for the CAU 504 scenario are the residual radioactive material guideline values for mixture radionuclides.

Table 7-1
RESRAD Parameters Input Values for CAU 504
(Page 1 of 2)

Parameter	Units	CAU 504	Defaults	Reference/Rationale
Area of CZ	m^2	1.000E+02	1.000E+04	Estimated using the site boundary
Thickness of CZ	m	1.500E-01	2.000E+00	Top layer of the contamination soil
Principal radionuclides	pCi/g	See Table 4-1	0.0	Initial concentrations are the maximum concentrations from sample results: maximum for biased sample or average for random sample.
Average Annual Wind Speed	m/sec	3.8	2.000E+00	Data from Air Resource Laboratory (ARL, 2007)
Precipitation	m/yr	2.1950E-01	1.000E+00	Data from Air Resources Laboratory (ARL, 2007)
Runoff Coefficient	-	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu et al., 1993)
Inhalation Rate	m^3/yr	1.230E+04	8.400E+03	RESRAD Default and for an individual performing outdoor activities, a typical activity mix can consist of 37% at a moderate activity level, 28% at both resting and light activity levels, and 7% at a heavy activity level, which results in a 1.4 m^3/h (12,300 m^3/yr) inhalation rate. (Yu et al., 1993)
Mass Loading for Inhalation	g/m^3	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu et al., 1993)
Exposure Duration	yr	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1.0	0.4	Assumes no indoor time fraction
Shielding Factor External Gamma	-	1.0	0.7	Assumes no indoor time fraction
Fraction of Time Spent Indoors	-	0.0	0.5	Assumes no indoor time fraction
Fraction of Time Spent Outdoors	-	0.038	0.25	Scenario specific based on Industrial/Commercial Use Scenarios for standard occupancy and low occupancy.
Soil Ingestion Rate	g/yr	1.752E+02	36.5	EPA, 1991; 480 mg/day

Table 7-1
RESRAD Parameters Input Values for CAU 504
(Page 2 of 2)

Parameter	Units	CAU 504	Defaults	Reference/Rationale

CZ = Contaminated Zone
g/m^3 = Grams per cubic meter
g/yr = Grams per year
m = Meter
m^2 = Square meter
m/sec = Meters per second
m/yr = Meters per year
m^3/h = Cubic meters per hour
m^3/yr = Cubic meters per year
mg/day = Milligrams per day
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive
yr = Year

Table 7-2
Maximum Dose Contributions for CAU 504
Using Scenario B (dose as mrem/yr)

Radionuclide	Ground		Inhalation		Soil		Total	
	Annual Dose	Fraction	Annual Dose	Fraction	Annual Dose	Fraction	Annual Dose	Fraction
Silver-110m	2.225E-01	0.0013	6.811E-07	0.0000	3.576E-06	0.0000	2.225E-01	0.0013
Aluminum-26	2.101E-02	0.0001	6.582E-08	0.0000	4.713E-07	0.0000	2.101E-02	0.0001
Americium-241	3.839E-02	0.0002	2.096E-01	0.0013	6.709E-02	0.0004	3.151E-01	0.0019
Cadmium-109	3.884E-03	0.0000	1.603E-05	0.0000	7.192E-05	0.0000	3.972E-03	0.0000
Cerium-144	3.810E-02	0.0002	2.821E-05	0.0000	6.218E-05	0.0000	3.819E-02	0.0002
Cobalt-57	1.204E-02	0.0001	1.202E-07	0.0000	6.107E-07	0.0000	1.204E-02	0.0001
Cobalt-60	2.027E+00	0.0122	1.848E-05	0.0000	8.864E-05	0.0000	2.027E+00	0.0122
Cesium-134	1.379E-01	0.0008	4.269E-07	0.0000	2.644E-05	0.0000	1.379E-01	0.0008
Cesium-137	1.607E+02	0.9674	9.487E-04	0.0000	5.805E-02	0.0003	1.608E+02	0.9678
Europium-152	3.907E-01	0.0024	8.052E-06	0.0000	9.216E-06	0.0000	3.907E-01	0.0024
Europium-154	3.430E-01	0.0021	8.413E-06	0.0000	1.097E-05	0.0000	3.430E-01	0.0021
Europium-155	3.715E-03	0.0000	4.597E-07	0.0000	6.632E-07	0.0000	3.716E-03	0.0000
Manganese-54	1.306E-02	0.0001	1.092E-08	0.0000	1.763E-07	0.0000	1.306E-02	0.0001
Sodium-22	1.056E-01	0.0006	3.834E-08	0.0000	2.247E-06	0.0000	1.056E-01	0.0006
Niobium-94	1.717E-02	0.0001	4.693E-07	0.0000	3.160E-07	0.0000	1.717E+02	0.0001
Plutonium-238	1.046E-04	0.0000	1.340E-01	0.0008	4.272E-02	0.0003	1.769E-01	0.0011
Plutonium-239	1.096E-03	0.0000	8.895E-01	0.0054	2.865E-01	0.0017	1.177E-00	0.0071
Ruthenium-106	8.274E-02	0.0005	1.920E-05	0.0000	4.307E-05	0.0000	8.281E-02	0.0005
Antimony-125	2.013E-01	0.0006	3.560E-07	0.0000	3.657E-06	0.0000	1.013E-01	0.0006
Strontium-90	8.040E-02	0.0005	2.559E-03	0.0000	1.167E-02	0.0001	9.463E-02	0.0006
Uranium-235	6.132E-02	0.0004	5.629E-03	0.0000	4.778E-04	0.0000	6.743E-02	0.0004
Total	1.644E+02	0.9897	1.242E+00	0.0075	4.669E-01	0.0028	1.662E+02	1.0000

mrem/yr = Millirem per year

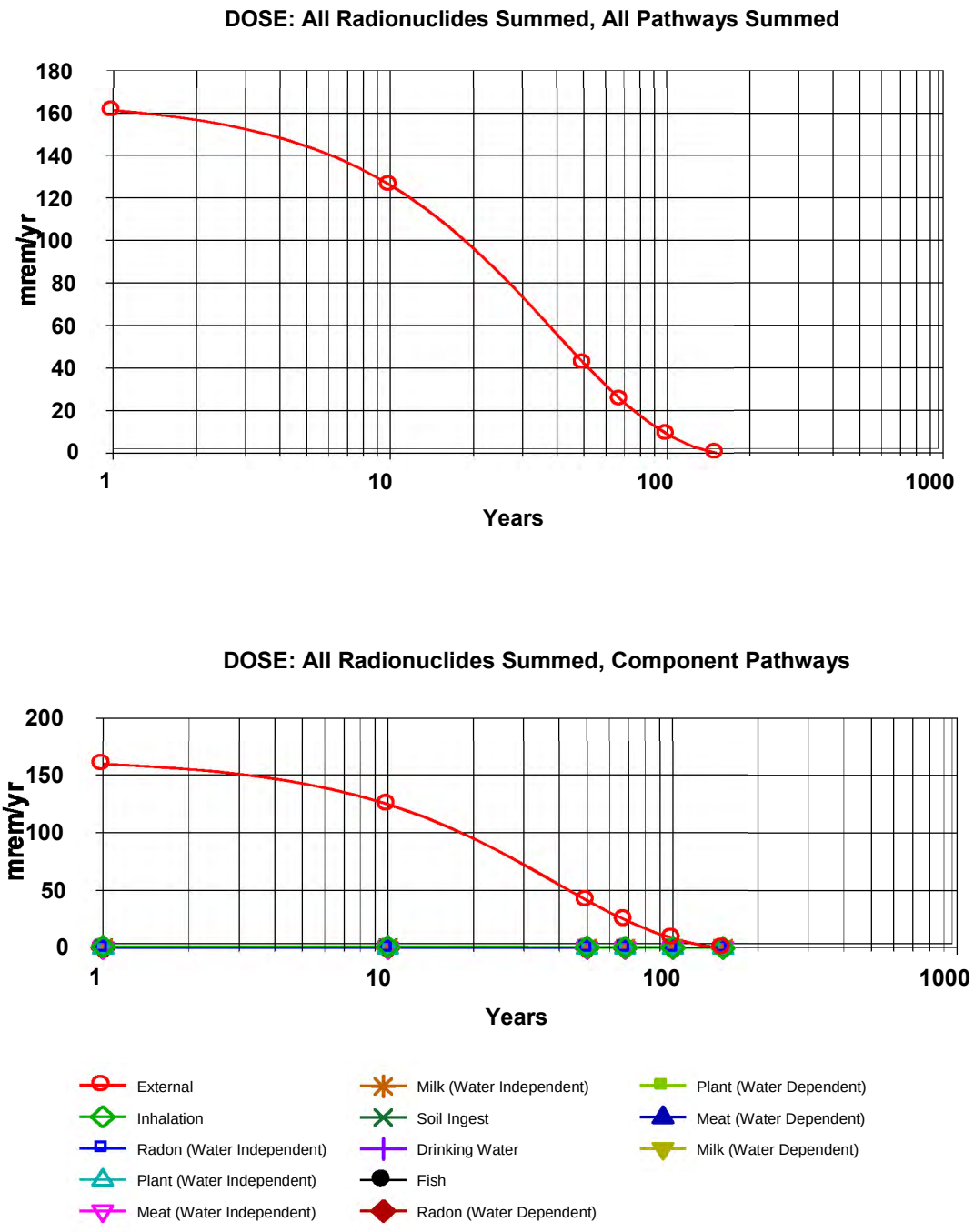

Figure 7-1
CAU 504 Dose Rate Per Year All Radionuclides Summed, All Pathways Summed and Component Pathways

Table 7-3
CAU 504 Sum of Fractions and Proportional Scaling and Final Action Level Determination

Radionuclide	Initial Radionuclide Concentration (pCi/g)	Contribution %	Single Radionuclide Guidelines (pCi/g)	Ratio for Single Radionuclide Guidelines	Mixture Radionuclides Guidelines[a] (pCi/g) (FAL)	Ratio for Mixture Radionuclide Guidelines
Uranium-235	2.7	1.2797E-03	1.0010E+03	2.6973E-03	4.0614E-01	4.0573E-04
Strontium-90	117	5.5454E-02	3.0910E+04	3.7852E-03	1.7599E+01	5.6937E-04
Antimony-125	3.3	1.5641E-03	8.1430E+02	4.0526E-03	4.9639E-01	6.0959E-04
Ruthernium-106	6	2.8438E-03	1.8110E+03	3.3131E-03	9.0253E-01	4.9836E-04
Plutonium-239	122	5.7824E-02	2.5910E+03	4.7086E-02	1.8351E+01	7.0827E-03
Plutonium-238	20.2	9.5741E-03	2.8550E+03	7.0753E-03	3.0385E+00	1.0643E-03
Niobium-94	0.133	6.3038E-05	1.9360E+02	6.8698E-04	2.0006E-02	1.0334E-04
Sodium-22	0.34	1.6115E-04	80.460E+01	4.2257E-03	5.1143E-02	6.3564E-04
Manganese-54	0.14	6.6355E-05	2.6800E+02	5.2239E-04	2.1059E-02	7.8578E-05
Europium-155	0.7	3.3178E-04	4.7090E+03	1.4865E-04	1.0529E-01	2.2360E-05
Europium-154	1.8	8.5314E-04	1.3120E+02	1.3720E-02	2.7076E-01	2.0637E-03
Europium-152	2.2	1.0427E-03	1.4080E+02	1.5625E-02	3.3093E-01	2.3503E-03
Cesium-137	1,770	8.3892E-01	2.7520E+02	6.4317E+00	2.6625E+02	9.6746E-01
Cesium-134	0.64	3.0334E-04	1.1600E+02	5.5172E-03	9.6270E-02	8.2991E-04
Cobalt-60	5.3	2.5120E-03	6.5360E+01	8.1089E-02	7.9723E-01	1.2198E-02
Cobalt-57	1.2	5.6876E-04	2.4920E+03	4.8154E-04	1.8051E-01	7.2434E-05
Cerium-144	6.7	3.1756E-03	4.3860E+03	1.5276E-03	1.0078E+00	2.2978E-04
Cadmium-109	20	9.4793E-03	1.2590E+05	1.5886E-04	3.0084E+00	2.3895E-05
Americium-241	28	1.3271E-02	2.2220E+03	1.2601E-02	4.2118E+00	1.8955E-03
Aluminum-26	0.097	4.5975E-05	1.1540E+02	8.4055E-04	1.4591E-02	1.2644E-04
Total	2,109.9	1.0000E+00	N/A	6.6457E+00[b]	N/A	9.9966E-01

[a]Single radionuclide guidelines apply to areas uniformly contaminated with a single radionuclide. The mixture radionuclide guidelines apply to areas uniformly contaminated with a mixture of radionuclides. The FALs for CAU 504 are the radionuclide guidelines for mixture radionuclides (i.e., Mixture Radionuclide Guidelines column).
[b]Unity > 1

FAL = Final action level
N/A = Not applicable
pCi/g = Picocuries per gram

8.0 References

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Attachment A

RESRAD Parameters Used for Analysis of CAU 504 Site

The parametric values used in the RESRAD code for the analysis of the CAU 504 site are listed in Table A-1. Some parameters are site specific, while other values are default RESRAD values. The dose conversion factors used for inhalation and ingestion were the default Federal Guidance Report 13 morbidity values and correspond to the guidance and recommendations per the August 9, 2002, memorandum from A. Lawrence, Office of Environmental Policy & Guidance, to Distribution, titled "Radiation Risk Estimation from Total Effective Dose Equivalents (TEDEs)" (EH-412-2002-1) (Lawrence, 2002).

Table A-1
RESRAD Parameters
(Page 1 of 6)

Parameter	Units	CAU 504	Defaults	Reference/Rationale
R011 Contaminated Zone (CZ)				
Area of CZ	m^2	1.00E+02	1.000E+04	10x10 m specific location area
Thickness of CZ	m	1.200E+00	2.000E+00	Maximum depth from contaminated samples
Length Parallel to Aquifer Flow	m	Not Used	1.000E+02	Not Used
Radiation Dose Limit	mrem/yr	2.5E+001	2.5E+001	RESRAD Default (Yu et al., 1993)
Elapsed Time Since Placement of Material	yr	0.0	0.0	RESRAD Default
R012 Initial Principal Radionuclide				
Principal radionuclides	pCi/g	See Table 7.2	0.0	Site Specific
R013 Cover and Contaminated Zone Hydrological Data				
Cover Depth	m	0.0	0.0	No Cover Assumed
Density of Cover Material	g/cm^3	Not Used	1.5	No Cover Assumed
Cover Depth Erosion Rate	m/yr	Not Used	1.000E-03	No Cover Assumed
Density of Contaminated Zone	g/cm^3	1.5	1.5	RESRAD Default
Contamination Zone Erosion Rate	m/yr	1.000E-03	1.000E-03	RESRAD Default
Contaminated Zone Total Porosity	-	4.000E-01	4.000E-01	RESRAD Default
Contaminated Zone Field Capacity	-	2.000E-01	2.000E-01	RESRAD Default
Contaminated Zone Hydraulic Conductivity	m/yr	1.000E+01	1.000E+01	RESRAD Default
Contaminated Zone b Parameter	-	5.300E+00	5.300E+00	RESRAD Default
Average Annual Wind Speed	m/sec	3.4	2.000E+00	Data from Air Resource Laboratory (2007)
Humidity in Air	g/m^3	Not Used	8.000E+00	Not Used
Evapotranspiration Coefficient	-	5.000E-01	5.000E-01	RESRAD Default

Table A-1
RESRAD Parameters
(Page 2 of 6)

Parameter	Units	CAU 504	Defaults	Reference/Rationale
Precipitation	m/yr	3.260E-01	1.000E+00	Data from Air Resources Laboratory
Irrigation	m/yr	2.000E-01	2.000E-01	RESRAD Default
Irrigation Mode	-	Overhead	Overhead	RESRAD Default
Runoff Coefficient	-	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu et al., 1993)
Watershed Area for Nearby Stream or Pond	m^2	Not Used	1.000E+06	Not Used
Accuracy for Water/Soil Computations	-	Not Used	1.000E-03	Not Used
R014 Saturated Zone Hydrological Data				
Density of Saturated Zone	g/cm^3	Not Used	1.500E+00	Not Used
Saturated Zone Total Porosity	-	Not Used	4.000E-01	Not Used
Saturated Zone Effective Porosity	-	Not Used	2.000E-01	Not Used
Saturated Zone Field Capacity	-	Not Used	2.000E-01	Not Used
Saturated Zone Hydraulic Conductivity	m/yr	Not Used	1.000E+02	Not Used
Saturated Zone Hydraulic Gradient	-	Not Used	2.000E-02	Not Used
Saturated Zone b Parameter	-	Not Used	5.300E+00	Not Used
Water Table Drop Rate	m/yr	Not Used	1.000E-03	Not Used
Well Pump Intake Depth	m	Not Used	1.000E+01	Not Used
Model: Nondispersion or Mass-Balance	-	Not Used	ND	Not Used
Well Pumping Rate	m^3/yr	Not Used	2.500E+02	Not Used
R015 Uncontaminated and Unsaturated Strata Hydrological Data				
Number of Unsaturated Zone Strata	-	Not Used	1	Not Used
Thickness	m	Not Used	4.000E+00	Not Used
Soil Density	g/cm^3	Not Used	1.500E+00	Not Used

Table A-1
RESRAD Parameters
(Page 3 of 6)

Parameter	Units	CAU 504	Defaults	Reference/Rationale
Total Porosity	-	Not Used	4.000E-01	Not Used
Effective Porosity	-	Not Used	2.000E-01	Not Used
Field Capacity	-	Not Used	2.000E-01	Not Used
Soil-specific b Parameter	-	Not Used	5.300E+00	Not Used
Hydraulic Conductivity	m/yr	Not Used	1.000E+01	Not Used
R016 Distribution Coefficients and Leach Rates				
Contaminated Zone K_d (all Zones)	cm^3/g			RESRAD Default
Saturated Leach Rate	/yr	0.0	0.0	Not Used
Solubility Constant	-	0.0	0.0	Not Used
R017 Inhalation and External Gamma				
Inhalation Rate	m^3/yr	1.230E+04	8.400E+03	RESRAD Default and for an individual performing outdoor activities, a typical activity mix can consist of 37% at a moderate activity level, 28% at both resting and light activity levels, and 7% at a heavy activity level, which results in a 1.4 m^3/h (12,300 m^3/yr) inhalation rate. (Yu et al., 1993)
Mass Loading for Inhalation	g/m^3	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu et al., 1993)
Exposure Duration	yr	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1.0	0.4	Assumes no indoor time fraction
Shielding Factor External Gamma	-	1.0	0.7	Assumes no indoor time fraction
Fraction of Time Spent Indoors	-	0.0	0.5	Assumes no indoor time fraction
Fraction of Time Spent Outdoors	-	0.038	0.25	Scenario specific based on Industrial/ Commercial Use Scenarios for standard occupancy and low occupancy.
Shape Factor	-	1.0	1.0	RESRAD Default

Table A-1
RESRAD Parameters
(Page 5 of 6)

Parameter	Units	CAU 504	Defaults	Reference/Rationale
R018 Ingestion Pathway Data, Dietary Parameters				
Fruits, Vegetables, and Grain Consumption	kg/yr	Not Used	1.600E+02	Not Used
Leafy Vegetable Consumption	kg/yr	Not Used	1.400E+01	Not Used
Milk Consumption	L/yr	Not Used	9.200E+01	Not Used
Meat and Poultry Consumption	kg/yr	Not Used	6.300E+01	Not Used
Fish Consumption	kg/yr	Not Used	5.400E+00	Not Used
Other Seafood Consumption	kg/yr	Not Used	9.000E-01	Not Used
Soil Ingestion Rate	g/yr	1.752E+02	36.5	EPA, 1991; 480 mg/day
Drinking Water Intake	L/yr	Not Used	5.100E+02	Not Used
Drinking Water Contaminated Fraction	-	Not Used	1.000E+00	Not Used
Household Water Contaminated Fraction	-	Not Used	1.000E+00	Not Used
Livestock Water Contaminated Fraction	-	Not Used	1.000E+00	Not Used
Irrigation Water Contaminated Fraction	-	Not Used	1.000E+00	Not Used
Aquatic Food Contamination Fraction	-	Not Used	5.000E-01	Not Used
Plant Food Contamination Fraction	-	Not Used	-1	Not Used
Meat Contamination Fraction	-	Not Used	-1	Not Used
Milk Contamination Fraction	-	Not Used	-1	Not Used
R019 Ingestion Pathway Data, Nondietary				
Livestock Fodder Intake for Meat	kg/day	Not Used	6.800E+01	Not Used
Livestock Fodder Intake for Milk	kg/day	Not Used	5.500E+01	Not Used
Livestock Water Intake for Meat	L/day	Not Used	5.000E+01	Not Used
Livestock Water Intake for Milk	L/day	Not Used	1.600E+02	Not Used

Table A-1
RESRAD Parameters
(Page 6 of 6)

Parameter	Units	CAU 504	Defaults	Reference/Rationale
Livestock Soil Intake	kg/day	Not Used	5.000E-01	Not Used
Mass Loading for Foliar Deposition	g/m^3	Not Used	1.000E-04	Not Used
Depth of Soil Mixing Layer	m	1.500E-01	1.500E-01	RESRAD Default
Depth of Roots	m	Not Used	9.000E-01	Not Used
Drinking Water Fraction from Groundwater	-	Not Used	1.000E+00	Not Used
Household Water Fraction from Groundwater	-	Not Used	1.000E+00	Not Used
Livestock Water Fraction from Groundwater	-	Not Used	1.000E+00	Not Used
Irrigation Fraction from Groundwater	-	Not Used	1.000E+00	Not Used
R021 Radon				
Radon Parameters Not Used				Not Used

cm^3/g = Cubic centimeters per gram
g/cm^3 = Grams per cubic centimeter
g/m^3 = Grams per cubic meter
g/yr = Grams per year
kg/day = Kilograms per day
kg/yr = Kilograms per year
L/day = Liters per day
L/yr = Liters per year
m = Meter
m^2 = Square meter
m/sec = Meters per second
m/yr = Meters per year
m^3/h = Cubic meters per hour
m^3/yr = Cubic meters per year
mg/day = Milligrams per day
mrem/yr = Millirem per year
ND = Nondetect
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive
yr = Year
/yr = Per year

Exhibit 1

RESRAD Summary Report:
CAU 504

(39 Pages)

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.724E+00	6.700E+00	DCF2(1)
B-1	Ag-110m+D	8.030E-05	8.030E-05	DCF2(2)
B-1	Al-26	7.960E-05	7.960E-05	DCF2(3)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(4)
B-1	Cd-109	1.140E-04	1.140E-04	DCF2(5)
B-1	Ce-144+D	3.740E-04	3.740E-04	DCF2(6)
B-1	Co-57	9.070E-06	9.070E-06	DCF2(7)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(8)
B-1	Cs-134	4.620E-05	4.620E-05	DCF2(9)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(10)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(11)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(13)
B-1	Eu-155	4.140E-05	4.140E-05	DCF2(14)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(15)
B-1	Mn-54	6.700E-06	6.700E-06	DCF2(16)
B-1	Na-22	7.660E-06	7.660E-06	DCF2(17)
B-1	Nb-94	4.140E-04	4.140E-04	DCF2(18)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(19)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(20)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(21)
B-1	Pu-238	3.920E-01	3.920E-01	DCF2(22)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(24)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(25)
B-1	Ru-106+D	4.770E-04	4.770E-04	DCF2(26)
B-1	Sb-125+D	1.386E-05	1.220E-05	DCF2(27)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(28)
B-1	Th-229+D	2.169E+00	2.150E+00	DCF2(29)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(30)
B-1	U-233	1.350E-01	1.350E-01	DCF2(31)
B-1	U-234	1.320E-01	1.320E-01	DCF2(32)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(33)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.410E-02	DCF3(1)
D-1	Ag-110m+D	1.080E-05	1.080E-05	DCF3(2)
D-1	Al-26	1.460E-05	1.460E-05	DCF3(3)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(4)
D-1	Cd-109	1.310E-05	1.310E-05	DCF3(5)
D-1	Ce-144+D	2.112E-05	2.100E-05	DCF3(6)
D-1	Co-57	1.180E-06	1.180E-06	DCF3(7)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(8)
D-1	Cs-134	7.330E-05	7.330E-05	DCF3(9)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(10)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(11)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(13)
D-1	Eu-155	1.530E-06	1.530E-06	DCF3(14)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(15)
D-1	Mn-54	2.770E-06	2.770E-06	DCF3(16)
D-1	Na-22	1.150E-05	1.150E-05	DCF3(17)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
D-1	Nb-94	7.140E-06	7.140E-06	DCF3(18)
D-1	Np-237+D	4.444E-03	4.440E-03	DCF3(19)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(20)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(21)
D-1	Pu-238	3.200E-03	3.200E-03	DCF3(22)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(24)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(25)
D-1	Ru-106+D	2.740E-05	2.740E-05	DCF3(26)
D-1	Sb-125+D	3.647E-06	2.810E-06	DCF3(27)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(28)
D-1	Th-229+D	4.027E-03	3.530E-03	DCF3(29)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(30)
D-1	U-233	2.890E-04	2.890E-04	DCF3(31)
D-1	U-234	2.830E-04	2.830E-04	DCF3(32)
D-1	U-235+D	2.673E-04	2.660E-04	DCF3(33)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Ag-110m+D , plant/soil concentration ratio, dimensionless	1.500E-01	1.500E-01	RTF(2,1)
D-34	Ag-110m+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-03	3.000E-03	RTF(2,2)
D-34	Ag-110m+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.500E-02	2.500E-02	RTF(2,3)
D-34				
D-34	Al-26 , plant/soil concentration ratio, dimensionless	4.000E-03	4.000E-03	RTF(3,1)
D-34	Al-26 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-04	5.000E-04	RTF(3,2)
D-34	Al-26 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-04	2.000E-04	RTF(3,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(4,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(4,3)
D-34				
D-34	Cd-109 , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(5,1)
D-34	Cd-109 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	4.000E-04	4.000E-04	RTF(5,2)
D-34	Cd-109 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Ce-144+D , plant/soil concentration ratio, dimensionless	2.000E-03	2.000E-03	RTF(6,1)
D-34	Ce-144+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,2)
D-34	Ce-144+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(6,3)
D-34				
D-34	Co-57 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(7,1)
D-34	Co-57 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(7,2)
D-34	Co-57 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(8,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(8,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(8,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
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Menu	Parameter	Current Value	Base Case*	Parameter Name
D-34	Cs-134 , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(9,1)
D-34	Cs-134 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(9,2)
D-34	Cs-134 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(9,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(10,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(10,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(10,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(11,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(13,3)
D-34				
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(14,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(14,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(14,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(15,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(15,3)
D-34				
D-34	Mn-54 , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(16,1)
D-34	Mn-54 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-04	5.000E-04	RTF(16,2)
D-34	Mn-54 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(16,3)
D-34				
D-34	Na-22 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(17,1)
D-34	Na-22 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-02	8.000E-02	RTF(17,2)
D-34	Na-22 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	4.000E-02	4.000E-02	RTF(17,3)
D-34				
D-34	Nb-94 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(18,1)
D-34	Nb-94 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-07	3.000E-07	RTF(18,2)
D-34	Nb-94 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(18,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(19,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(19,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(19,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(20,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(20,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(20,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(21,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(21,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(21,3)
D-34				
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(22,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(22,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(22,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
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Menu	Parameter	Current Value	Base Case*	Parameter Name
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(24,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(24,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(24,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(25,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(25,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(25,3)
D-34				
D-34	Ru-106+D , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(26,1)
D-34	Ru-106+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(26,2)
D-34	Ru-106+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.300E-06	3.300E-06	RTF(26,3)
D-34				
D-34	Sb-125+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(27,1)
D-34	Sb-125+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(27,2)
D-34	Sb-125+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-04	1.000E-04	RTF(27,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(28,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(28,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(28,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(29,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(29,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(29,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(30,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(30,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(30,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(31,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(31,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(31,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(32,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(32,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(32,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(33,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(33,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(33,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Ag-110m+D , fish	5.000E+00	5.000E+00	BIOFAC(2,1)
D-5	Ag-110m+D , crustacea and mollusks	7.700E+02	7.700E+02	BIOFAC(2,2)
D-5				
D-5	Al-26 , fish	5.000E+02	5.000E+02	BIOFAC(3,1)
D-5	Al-26 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(3,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
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Menu	Parameter	Current Value	Base Case*	Parameter Name
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(4,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5				
D-5	Cd-109 , fish	2.000E+02	2.000E+02	BIOFAC(5,1)
D-5	Cd-109 , crustacea and mollusks	2.000E+03	2.000E+03	BIOFAC(5,2)
D-5				
D-5	Ce-144+D , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
D-5	Ce-144+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Co-57 , fish	3.000E+02	3.000E+02	BIOFAC(7,1)
D-5	Co-57 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(7,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(8,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(8,2)
D-5				
D-5	Cs-134 , fish	2.000E+03	2.000E+03	BIOFAC(9,1)
D-5	Cs-134 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(9,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(10,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(11,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(11,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(13,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(14,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(14,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(15,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(15,2)
D-5				
D-5	Mn-54 , fish	4.000E+02	4.000E+02	BIOFAC(16,1)
D-5	Mn-54 , crustacea and mollusks	9.000E+04	9.000E+04	BIOFAC(16,2)
D-5				
D-5	Na-22 , fish	2.000E+01	2.000E+01	BIOFAC(17,1)
D-5	Na-22 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(17,2)
D-5				
D-5	Nb-94 , fish	3.000E+02	3.000E+02	BIOFAC(18,1)
D-5	Nb-94 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(18,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(19,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(19,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(20,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(21,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(21,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(22,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(22,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(24,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(24,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(25,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(25,2)
D-5				
D-5	Ru-106+D , fish	1.000E+01	1.000E+01	BIOFAC(26,1)
D-5	Ru-106+D , crustacea and mollusks	3.000E+02	3.000E+02	BIOFAC(26,2)
D-5				
D-5	Sb-125+D , fish	1.000E+02	1.000E+02	BIOFAC(27,1)
D-5	Sb-125+D , crustacea and mollusks	1.000E+01	1.000E+01	BIOFAC(27,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(28,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(28,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(29,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(29,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(30,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(30,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(31,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(31,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(32,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(32,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(33,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(33,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter		User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)		1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)		1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)		not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)		2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)		0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)		1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)		1.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)		5.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)		6.800E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)		1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)		1.500E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)		not used	1.000E+03	---	T(8)
R011	Times for calculations (yr)		not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)		not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g):	Ag-110m	1.400E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g):	Al-26	9.700E-02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g):	Am-241	2.800E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g):	Cd-109	2.000E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g):	Ce-144	6.700E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g):	Co-57	1.200E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g):	Co-60	5.300E+00	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g):	Cs-134	6.400E-01	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g):	Cs-137	1.770E+03	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g):	Eu-152	2.200E+00	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g):	Eu-154	1.800E+00	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g):	Eu-155	7.000E-01	0.000E+00	---	S1(14)
R012	Initial principal radionuclide (pCi/g):	Mn-54	1.400E-01	0.000E+00	---	S1(16)
R012	Initial principal radionuclide (pCi/g):	Na-22	3.400E-01	0.000E+00	---	S1(17)
R012	Initial principal radionuclide (pCi/g):	Nb-94	1.330E-01	0.000E+00	---	S1(18)
R012	Initial principal radionuclide (pCi/g):	Pu-238	2.020E+01	0.000E+00	---	S1(22)
R012	Initial principal radionuclide (pCi/g):	Pu-239	1.220E+02	0.000E+00	---	S1(24)
R012	Initial principal radionuclide (pCi/g):	Ru-106	6.000E+00	0.000E+00	---	S1(26)
R012	Initial principal radionuclide (pCi/g):	Sb-125	3.300E+00	0.000E+00	---	S1(27)
R012	Initial principal radionuclide (pCi/g):	Sr-90	1.170E+02	0.000E+00	---	S1(28)
R012	Initial principal radionuclide (pCi/g):	U-235	2.700E+00	0.000E+00	---	S1(33)
R012	Concentration in groundwater (pCi/L):	Ag-110m	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L):	Al-26	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L):	Am-241	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L):	Cd-109	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L):	Ce-144	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L):	Co-57	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L):	Co-60	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L):	Cs-134	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L):	Cs-137	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L):	Eu-152	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L):	Eu-154	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L):	Eu-155	not used	0.000E+00	---	W1(14)
R012	Concentration in groundwater (pCi/L):	Mn-54	not used	0.000E+00	---	W1(16)
R012	Concentration in groundwater (pCi/L):	Na-22	not used	0.000E+00	---	W1(17)
R012	Concentration in groundwater (pCi/L):	Nb-94	not used	0.000E+00	---	W1(18)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(22)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(24)
R012	Concentration in groundwater (pCi/L): Ru-106	not used	0.000E+00	---	W1(26)
R012	Concentration in groundwater (pCi/L): Sb-125	not used	0.000E+00	---	W1(27)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(28)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(33)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.850E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	2.195E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ag-110m				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.588E+00	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Al-26				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.588E+00	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.450E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Cd-109				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.588E+00	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Ce-144				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.926E-04	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Co-57				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.926E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.926E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Cs-134				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.362E-05	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.362E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.547E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.547E-04	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.547E-04	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for Mn-54				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+02	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+02	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+02	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.462E-03	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for Na-22				
R016	Contaminated zone (cm**3/g)	1.000E+01	1.000E+01	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+01	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.874E-02	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Nb-94				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.588E+00	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(22)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(22,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(22)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.463E-04	ALEACH(22)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(22)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(24)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(24,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(24)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.463E-04	ALEACH(24)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(24)
R016	Distribution coefficients for Ru-106				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(26)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(26,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(26)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.588E+00	ALEACH(26)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(26)
R016	Distribution coefficients for Sb-125				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(27)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(27,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(27)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.588E+00	ALEACH(27)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(27)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(28)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(28,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(28)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.696E-03	ALEACH(28)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(28)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(33)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(33,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(33)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.832E-03	ALEACH(33)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(33)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.450E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.547E-04	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.136E-03	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.832E-03	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(21)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(21,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(21)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.921E-03	ALEACH(21)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(21)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(25)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(25,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(25)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.170E-03	ALEACH(25)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(25)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(29)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(29,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(29)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.878E-06	ALEACH(29)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(29)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(30)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(30,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(30)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.878E-06	ALEACH(30)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(30)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(31)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(31,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(31)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.832E-03	ALEACH(31)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(31)
R016	Distribution coefficients for daughter U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(32)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(32,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(32)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.832E-03	ALEACH(32)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(32)
R017	Inhalation rate (m**3/yr)	1.230E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	1.000E+00	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	3.800E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.752E+02	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions

Area:	100.00 square meters
Thickness:	0.15 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ag-110m	1.400E+00
Al-26	9.700E-02
Am-241	2.800E+01
Cd-109	2.000E+01
Ce-144	6.700E+00
Co-57	1.200E+00
Co-60	5.300E+00
Cs-134	6.400E-01
Cs-137	1.770E+03
Eu-152	2.200E+00
Eu-154	1.800E+00
Eu-155	7.000E-01
Mn-54	1.400E-01
Na-22	3.400E-01
Nb-94	1.330E-01
Pu-238	2.020E+01
Pu-239	1.220E+02
Ru-106	6.000E+00
Sb-125	3.300E+00
Sr-90	1.170E+02
U-235	2.700E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	1.000E+01	5.000E+01	6.800E+01	1.000E+02	1.500E+02
TDOSE(t):	1.662E+02	1.612E+02	1.260E+02	4.216E+01	2.498E+01	8.828E+00	0.000E+00
M(t):	6.646E+00	6.446E+00	5.041E+00	1.686E+00	9.992E-01	3.531E-01	0.000E+00

0Maximum TDOSE(t): 1.662E+02 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	2.225E-01	0.0013	6.811E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.576E-06	0.0000
Al-26	2.101E-02	0.0001	6.582E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.713E-07	0.0000
Am-241	3.839E-02	0.0002	2.096E-01	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.709E-02	0.0004
Cd-109	3.884E-03	0.0000	1.603E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.192E-05	0.0000
Ce-144	3.810E-02	0.0002	2.821E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.218E-05	0.0000
Co-57	1.204E-02	0.0001	1.202E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.107E-07	0.0000
Co-60	2.027E+00	0.0122	1.848E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.864E-05	0.0000
Cs-134	1.379E-01	0.0008	4.269E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.644E-05	0.0000
Cs-137	1.607E+02	0.9674	9.487E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.805E-02	0.0003
Eu-152	3.907E-01	0.0024	8.052E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.216E-06	0.0000
Eu-154	3.430E-01	0.0021	8.413E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.097E-05	0.0000
Eu-155	3.715E-03	0.0000	4.597E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.632E-07	0.0000
Mn-54	1.306E-02	0.0001	1.092E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.763E-07	0.0000
Na-22	1.056E-01	0.0006	3.834E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.247E-06	0.0000
Nb-94	1.717E-02	0.0001	4.693E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.160E-07	0.0000
Pu-238	1.046E-04	0.0000	1.340E-01	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.272E-02	0.0003
Pu-239	1.096E-03	0.0000	8.895E-01	0.0054	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.865E-01	0.0017
Ru-106	8.274E-02	0.0005	1.920E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.307E-05	0.0000
Sb-125	1.013E-01	0.0006	3.560E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.657E-06	0.0000
Sr-90	8.040E-02	0.0005	2.559E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.167E-02	0.0001
U-235	6.132E-02	0.0004	5.629E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.778E-04	0.0000
Total	1.644E+02	0.9897	1.242E+00	0.0075	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.669E-01	0.0028

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0	Water Dependent Pathways													
0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.225E-01	0.0013
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.101E-02	0.0001
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.151E-01	0.0019
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.972E-03	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.819E-02	0.0002
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.204E-02	0.0001
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.027E+00	0.0122
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.379E-01	0.0008
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.608E+02	0.9678
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.907E-01	0.0024
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.430E-01	0.0021
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.716E-03	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.306E-02	0.0001
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.056E-01	0.0006
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.717E-02	0.0001
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.769E-01	0.0011
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.177E+00	0.0071
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.281E-02	0.0005
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.013E-01	0.0006
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.463E-02	0.0006
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.743E-02	0.0004
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.662E+02	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	1.645E-02	0.0001	5.020E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.636E-07	0.0000
Al-26	4.277E-03	0.0000	1.336E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.567E-08	0.0000
Am-241	3.778E-02	0.0002	2.049E-01	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.557E-02	0.0004
Cd-109	4.597E-04	0.0000	1.886E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.460E-06	0.0000
Ce-144	1.559E-02	0.0001	1.150E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.534E-05	0.0000
Co-57	4.720E-03	0.0000	4.690E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.382E-07	0.0000
Co-60	1.770E+00	0.0110	1.609E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.717E-05	0.0000
Cs-134	9.819E-02	0.0006	3.030E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.876E-05	0.0000
Cs-137	1.566E+02	0.9716	9.207E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.634E-02	0.0003
Eu-152	3.695E-01	0.0023	7.590E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.688E-06	0.0000
Eu-154	3.158E-01	0.0020	7.721E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.007E-05	0.0000
Eu-155	3.227E-03	0.0000	3.969E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.726E-07	0.0000
Mn-54	5.782E-03	0.0000	4.819E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.778E-08	0.0000
Na-22	7.838E-02	0.0005	2.835E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.662E-06	0.0000
Nb-94	3.498E-03	0.0000	9.528E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.415E-08	0.0000
Pu-238	1.038E-04	0.0000	1.321E-01	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.209E-02	0.0003
Pu-239	1.094E-03	0.0000	8.834E-01	0.0055	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.846E-01	0.0018
Ru-106	8.476E-03	0.0001	1.960E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.396E-06	0.0000
Sb-125	1.607E-02	0.0001	5.628E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.780E-07	0.0000
Sr-90	7.755E-02	0.0005	2.458E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.121E-02	0.0001
U-235	6.085E-02	0.0004	5.560E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.722E-04	0.0000
Total	1.595E+02	0.9895	1.229E+00	0.0076	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.604E-01	0.0029

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.645E-02	0.0001
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.277E-03	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.082E-01	0.0019
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.701E-04	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.562E-02	0.0001
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.720E-03	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.771E+00	0.0110
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.821E-02	0.0006
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.566E+02	0.9719
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.695E-01	0.0023
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.158E-01	0.0020
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.228E-03	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.782E-03	0.0000
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.838E-02	0.0005
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.498E-03	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.743E-01	0.0011
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.169E+00	0.0073
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.483E-03	0.0001
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.607E-02	0.0001
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.122E-02	0.0006
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.688E-02	0.0004
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.612E+02	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	1.086E-12	0.0000	3.217E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.689E-17	0.0000
Al-26	2.568E-09	0.0000	7.806E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.589E-14	0.0000
Am-241	3.268E-02	0.0003	1.665E-01	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.329E-02	0.0004
Cd-109	2.094E-12	0.0000	8.118E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.642E-14	0.0000
Ce-144	4.994E-06	0.0000	3.562E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.850E-09	0.0000
Co-57	1.032E-06	0.0000	9.773E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.964E-11	0.0000
Co-60	5.223E-01	0.0041	4.617E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.214E-05	0.0000
Cs-134	4.624E-03	0.0000	1.381E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.551E-07	0.0000
Cs-137	1.234E+02	0.9795	7.022E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.296E-02	0.0003
Eu-152	2.234E-01	0.0018	4.451E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.095E-06	0.0000
Eu-154	1.500E-01	0.0012	3.559E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.639E-06	0.0000
Eu-155	9.070E-04	0.0000	1.057E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.524E-07	0.0000
Mn-54	3.768E-06	0.0000	3.045E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.914E-11	0.0000
Na-22	5.333E-03	0.0000	1.870E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.096E-07	0.0000
Nb-94	2.109E-09	0.0000	5.565E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.747E-14	0.0000
Pu-238	9.645E-05	0.0000	1.154E-01	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.678E-02	0.0003
Pu-239	1.074E-03	0.0000	8.286E-01	0.0066	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.669E-01	0.0021
Ru-106	1.052E-11	0.0000	2.351E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.273E-15	0.0000
Sb-125	1.022E-09	0.0000	3.458E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.552E-14	0.0000
Sr-90	5.598E-02	0.0004	1.708E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.787E-03	0.0001
U-235	5.670E-02	0.0004	4.975E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.248E-04	0.0000
Total	1.245E+02	0.9879	1.118E+00	0.0089	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.082E-01	0.0032

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.086E-12	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.568E-09	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.525E-01	0.0020
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.139E-12	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.005E-06	0.0000
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.032E-06	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.223E-01	0.0041
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.625E-03	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.235E+02	0.9799
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.234E-01	0.0018
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.500E-01	0.0012
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.073E-04	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.768E-06	0.0000
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.333E-03	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.109E-09	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.523E-01	0.0012
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.097E+00	0.0087
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.052E-11	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.022E-09	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.548E-02	0.0005
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.210E-02	0.0005
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.260E+02	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	1.707E-02	0.0004	6.236E-02	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.996E-02	0.0005
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	1.416E-21	0.0000	8.515E-25	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.877E-24	0.0000
Co-57	5.429E-23	0.0000	4.012E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.038E-27	0.0000
Co-60	2.196E-03	0.0001	1.691E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.108E-08	0.0000
Cs-134	5.600E-09	0.0000	1.421E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.803E-13	0.0000
Cs-137	4.110E+01	0.9750	1.982E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.213E-02	0.0003
Eu-152	2.283E-02	0.0005	3.910E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.476E-07	0.0000
Eu-154	5.243E-03	0.0001	1.072E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.397E-07	0.0000
Eu-155	3.160E-06	0.0000	2.776E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.004E-10	0.0000
Mn-54	2.497E-20	0.0000	1.729E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.790E-25	0.0000
Na-22	3.310E-08	0.0000	9.960E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.837E-13	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	6.924E-05	0.0000	5.967E-02	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.901E-02	0.0005
Pu-239	9.638E-04	0.0000	5.868E-01	0.0139	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.890E-01	0.0045
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.268E-02	0.0003	3.190E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.454E-03	0.0000
U-235	4.012E-02	0.0010	2.903E-03	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.539E-04	0.0000
Total	4.120E+01	0.9774	7.123E-01	0.0169	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.419E-01	0.0057

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.939E-02	0.0024
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.419E-21	0.0000
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.429E-23	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.196E-03	0.0001
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.601E-09	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.112E+01	0.9753
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.283E-02	0.0005
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.243E-03	0.0001
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.161E-06	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.497E-20	0.0000
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.311E-08	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.875E-02	0.0019
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.769E-01	0.0184
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.445E-02	0.0003
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.328E-02	0.0010
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.216E+01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 6.800E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	1.265E-02	0.0005	3.823E-02	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.224E-02	0.0005
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	1.382E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-57	2.497E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	1.803E-04	0.0000	1.292E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.194E-09	0.0000
Cs-134	1.174E-11	0.0000	2.740E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.697E-15	0.0000
Cs-137	2.417E+01	0.9675	1.070E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.548E-03	0.0003
Eu-152	7.889E-03	0.0003	1.248E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.429E-07	0.0000
Eu-154	1.118E-03	0.0000	2.113E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.754E-08	0.0000
Eu-155	2.425E-07	0.0000	1.826E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.634E-11	0.0000
Mn-54	1.003E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Na-22	1.448E-10	0.0000	4.023E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.358E-15	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	5.930E-05	0.0000	4.228E-02	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.347E-02	0.0005
Pu-239	8.959E-04	0.0000	4.792E-01	0.0192	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.544E-01	0.0062
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	6.291E-03	0.0003	1.430E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.519E-04	0.0000
U-235	3.334E-02	0.0013	2.180E-03	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.925E-04	0.0000
Total	2.423E+01	0.9700	5.621E-01	0.0225	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.875E-01	0.0075

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 6.800E+01 years

0	Water Dependent Pathways													
0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.311E-02	0.0025
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.382E-28	0.0000
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.497E-30	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.803E-04	0.0000
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.175E-11	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.417E+01	0.9678
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.889E-03	0.0003
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.118E-03	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.426E-07	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.003E-26	0.0000
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.448E-10	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.582E-02	0.0022
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.344E-01	0.0254
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.086E-03	0.0003
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.571E-02	0.0014
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.498E+01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	7.067E-03	0.0008	1.387E-02	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.439E-03	0.0005
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	1.886E-06	0.0000	1.156E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.545E-11	0.0000
Cs-134	1.810E-16	0.0000	3.538E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.191E-20	0.0000
Cs-137	8.366E+00	0.9476	3.097E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.895E-03	0.0002
Eu-152	1.066E-03	0.0001	1.420E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.625E-08	0.0000
Eu-154	6.406E-05	0.0000	1.020E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.330E-09	0.0000
Eu-155	2.320E-09	0.0000	1.253E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.808E-13	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Na-22	8.243E-15	0.0000	1.934E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.134E-19	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	4.402E-05	0.0000	1.985E-02	0.0022	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.326E-03	0.0007
Pu-239	7.234E-04	0.0001	2.894E-01	0.0328	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.323E-02	0.0106
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	1.623E-03	0.0002	2.973E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.355E-04	0.0000
U-235	2.149E-02	0.0024	1.135E-03	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.019E-04	0.0000
Total	8.398E+00	0.9512	3.243E-01	0.0367	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.061E-01	0.0120

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.538E-02	0.0029
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.887E-06	0.0000
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.810E-16	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.368E+00	0.9478
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.067E-03	0.0001
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.406E-05	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.321E-09	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.243E-15	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.622E-02	0.0030
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.834E-01	0.0434
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.789E-03	0.0002
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.273E-02	0.0026
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.828E+00	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.500E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.500E+02 years

0	Water Dependent Pathways													
0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-110m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cd-109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ce-144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Mn-54	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Na-22	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ru-106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sb-125	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	1.000E+01	5.000E+01	6.800E+01	1.000E+02	1.500E+02
Ag-110m+D	Ag-110m+D	1.000E+00	1.589E-01	1.175E-02	7.761E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Al-26	Al-26	1.000E+00	2.166E-01	4.410E-02	2.647E-08	5.638E-36	0.000E+00	0.000E+00	0.000E+00
0Am-241	Am-241	1.000E+00	1.125E-02	1.101E-02	9.017E-03	3.549E-03	2.254E-03	9.059E-04	0.000E+00
Am-241	Np-237+D	1.000E+00	7.117E-09	2.112E-08	1.326E-07	3.845E-07	4.059E-07	3.459E-07	0.000E+00
Am-241	U-233	1.000E+00	5.925E-16	4.097E-15	1.703E-13	2.098E-12	2.788E-12	2.944E-12	0.000E+00
Am-241	Th-229+D	1.000E+00	4.688E-19	6.971E-18	1.967E-15	1.394E-13	2.756E-13	5.169E-13	0.000E+00
Am-241	äDSR(j)		1.125E-02	1.101E-02	9.017E-03	3.550E-03	2.254E-03	9.063E-04	0.000E+00
0Cd-109	Cd-109	1.000E+00	1.986E-04	2.350E-05	1.069E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ce-144+D	Ce-144+D	1.000E+00	5.700E-03	2.332E-03	7.470E-07	2.118E-22	2.067E-29	6.391E-42	0.000E+00
0Co-57	Co-57	1.000E+00	1.003E-02	3.934E-03	8.604E-07	4.524E-23	2.081E-30	1.696E-43	0.000E+00
0Co-60	Co-60	1.000E+00	3.825E-01	3.341E-01	9.856E-02	4.144E-04	3.402E-05	3.559E-07	0.000E+00
0Cs-134	Cs-134	1.000E+00	2.155E-01	1.535E-01	7.227E-03	8.751E-09	1.835E-11	2.829E-16	0.000E+00
0Cs-137+D	Cs-137+D	1.000E+00	9.085E-02	8.849E-02	6.977E-02	2.323E-02	1.366E-02	4.727E-03	0.000E+00
0Eu-152	Eu-152	7.208E-01	1.280E-01	1.211E-01	7.319E-02	7.479E-03	2.585E-03	3.494E-04	0.000E+00
0Eu-152	Eu-152	2.792E-01	4.958E-02	4.690E-02	2.835E-02	2.897E-03	1.001E-03	1.354E-04	0.000E+00
Eu-152	Gd-152	2.792E-01	3.726E-18	1.086E-17	5.710E-17	8.854E-17	7.548E-17	4.640E-17	0.000E+00
Eu-152	äDSR(j)		4.958E-02	4.690E-02	2.835E-02	2.897E-03	1.001E-03	1.354E-04	0.000E+00
0Eu-154	Eu-154	1.000E+00	1.906E-01	1.755E-01	8.333E-02	2.913E-03	6.212E-04	3.559E-05	0.000E+00
0Eu-155	Eu-155	1.000E+00	5.309E-03	4.611E-03	1.296E-03	4.515E-06	3.466E-07	3.315E-09	0.000E+00
0Mn-54	Mn-54	1.000E+00	9.330E-02	4.130E-02	2.692E-05	1.784E-19	7.165E-26	2.723E-37	0.000E+00
0Na-22	Na-22	1.000E+00	3.107E-01	2.305E-01	1.569E-02	9.737E-08	4.258E-10	2.424E-14	0.000E+00
0Nb-94	Nb-94	1.000E+00	1.291E-01	2.630E-02	1.586E-08	3.453E-36	0.000E+00	0.000E+00	0.000E+00
0Pu-238	Pu-238	1.840E-09	1.611E-11	1.588E-11	1.387E-11	7.173E-12	5.084E-12	2.388E-12	0.000E+00
0Pu-238	Pu-238	1.000E+00	8.756E-03	8.628E-03	7.539E-03	3.898E-03	2.763E-03	1.298E-03	0.000E+00
Pu-238	U-234	1.000E+00	3.445E-09	1.021E-08	6.313E-08	1.645E-07	1.616E-07	1.159E-07	0.000E+00
Pu-238	Th-230	1.000E+00	2.515E-14	1.743E-13	7.438E-12	1.025E-10	1.428E-10	1.629E-10	0.000E+00
Pu-238	Ra-226+D	1.000E+00	1.300E-16	1.936E-15	5.559E-13	4.226E-11	8.584E-11	1.682E-10	0.000E+00
Pu-238	Pb-210+D	1.000E+00	1.532E-20	4.680E-19	7.924E-16	2.057E-13	4.867E-13	1.058E-12	0.000E+00
Pu-238	äDSR(j)		8.756E-03	8.628E-03	7.539E-03	3.899E-03	2.763E-03	1.298E-03	0.000E+00

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	1.000E+01	5.000E+01	6.800E+01	1.000E+02	1.500E+02
Pu-239	Pu-239	1.000E+00	9.649E-03	9.583E-03	8.988E-03	6.368E-03	5.200E-03	3.142E-03	0.000E+00
Pu-239	U-235+D	1.000E+00	1.230E-11	3.674E-11	2.449E-10	9.190E-10	1.083E-09	1.113E-09	0.000E+00
Pu-239	Pa-231	1.000E+00	1.186E-16	8.232E-16	3.555E-14	5.193E-13	7.453E-13	9.051E-13	0.000E+00
Pu-239	Ac-227+D	1.000E+00	4.973E-18	7.335E-17	1.906E-14	9.740E-13	1.693E-12	2.566E-12	0.000E+00
Pu-239	äDSR(j)		9.649E-03	9.583E-03	8.988E-03	6.368E-03	5.200E-03	3.142E-03	0.000E+00
0Ru-106+D	Ru-106+D	1.000E+00	1.380E-02	1.414E-03	1.754E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Sb-125+D	Sb-125+D	1.000E+00	3.070E-02	4.871E-03	3.098E-10	3.081E-42	0.000E+00	0.000E+00	0.000E+00
0Sr-90+D	Sr-90+D	1.000E+00	8.088E-04	7.796E-04	5.597E-04	1.235E-04	6.056E-05	1.529E-05	0.000E+00
0U-235+D	U-235+D	1.000E+00	2.497E-02	2.477E-02	2.299E-02	1.596E-02	1.315E-02	8.351E-03	0.000E+00
U-235+D	Pa-231	1.000E+00	3.612E-07	1.072E-06	6.735E-06	1.894E-05	1.933E-05	1.499E-05	0.000E+00
U-235+D	Ac-227+D	1.000E+00	2.015E-08	1.381E-07	5.258E-06	4.739E-05	5.690E-05	5.290E-05	0.000E+00
U-235+D	äDSR(j)		2.497E-02	2.477E-02	2.300E-02	1.603E-02	1.323E-02	8.419E-03	0.000E+00

The DSR includes contributions from associated (half-life ó 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	1.000E+01	5.000E+01	6.800E+01	1.000E+02	1.500E+02
Ag-110m	1.573E+02	2.127E+03	3.221E+13	*4.754E+15	*4.754E+15	*4.754E+15	*4.754E+15
Al-26	1.154E+02	5.670E+02	9.445E+08	*1.921E+10	*1.921E+10	*1.921E+10	*1.921E+10
Am-241	2.222E+03	2.271E+03	2.773E+03	7.043E+03	1.109E+04	2.759E+04	*3.431E+12
Cd-109	1.259E+05	1.064E+06	2.338E+14	*2.584E+15	*2.584E+15	*2.584E+15	*2.584E+15
Ce-144	4.386E+03	1.072E+04	3.347E+07	*3.191E+15	*3.191E+15	*3.191E+15	*3.191E+15
Co-57	2.492E+03	6.355E+03	2.906E+07	*8.465E+15	*8.465E+15	*8.465E+15	*8.465E+15
Co-60	6.536E+01	7.484E+01	2.537E+02	6.033E+04	7.348E+05	7.024E+07	*1.132E+15
Cs-134	1.160E+02	1.629E+02	3.459E+03	2.857E+09	1.362E+12	*1.295E+15	*1.295E+15
Cs-137	2.752E+02	2.825E+02	3.583E+02	1.076E+03	1.830E+03	5.288E+03	*8.704E+13
Eu-152	1.408E+02	1.488E+02	2.462E+02	2.409E+03	6.972E+03	5.157E+04	*1.765E+14
Eu-154	1.312E+02	1.425E+02	3.000E+02	8.582E+03	4.025E+04	7.024E+05	*2.639E+14
Eu-155	4.709E+03	5.422E+03	1.929E+04	5.537E+06	7.214E+07	7.541E+09	*4.652E+14
Mn-54	2.680E+02	6.053E+02	9.288E+05	*7.746E+15	*7.746E+15	*7.746E+15	*7.746E+15
Na-22	8.046E+01	1.084E+02	1.594E+03	2.568E+08	5.871E+10	1.031E+15	*6.247E+15
Nb-94	1.936E+02	9.506E+02	1.576E+09	*1.875E+11	*1.875E+11	*1.875E+11	*1.875E+11
Pu-238	2.855E+03	2.898E+03	3.316E+03	6.413E+03	9.047E+03	1.926E+04	*1.712E+13
Pu-239	2.591E+03	2.609E+03	2.781E+03	3.926E+03	4.807E+03	7.956E+03	*6.214E+10
Ru-106	1.811E+03	1.768E+04	1.425E+13	*3.348E+15	*3.348E+15	*3.348E+15	*3.348E+15
Sb-125	8.143E+02	5.132E+03	8.069E+10	*1.033E+15	*1.033E+15	*1.033E+15	*1.033E+15
Sr-90	3.091E+04	3.207E+04	4.467E+04	2.024E+05	4.128E+05	1.635E+06	*1.365E+14
U-235	1.001E+03	1.009E+03	1.087E+03	1.560E+03	1.890E+03	2.969E+03	*2.161E+06

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ag-110m	1.400E+00	0.000E+00	1.589E-01	1.573E+02	1.589E-01	1.573E+02
Al-26	9.700E-02	0.000E+00	2.166E-01	1.154E+02	2.166E-01	1.154E+02
Am-241	2.800E+01	0.000E+00	1.125E-02	2.222E+03	1.125E-02	2.222E+03
Cd-109	2.000E+01	0.000E+00	1.986E-04	1.259E+05	1.986E-04	1.259E+05
Ce-144	6.700E+00	0.000E+00	5.700E-03	4.386E+03	5.700E-03	4.386E+03
Co-57	1.200E+00	0.000E+00	1.003E-02	2.492E+03	1.003E-02	2.492E+03
Co-60	5.300E+00	0.000E+00	3.825E-01	6.536E+01	3.825E-01	6.536E+01
Cs-134	6.400E-01	0.000E+00	2.155E-01	1.160E+02	2.155E-01	1.160E+02
Cs-137	1.770E+03	0.000E+00	9.085E-02	2.752E+02	9.085E-02	2.752E+02
Eu-152	2.200E+00	0.000E+00	1.776E-01	1.408E+02	1.776E-01	1.408E+02
Eu-154	1.800E+00	0.000E+00	1.906E-01	1.312E+02	1.906E-01	1.312E+02
Eu-155	7.000E-01	0.000E+00	5.309E-03	4.709E+03	5.309E-03	4.709E+03
Mn-54	1.400E-01	0.000E+00	9.330E-02	2.680E+02	9.330E-02	2.680E+02
Na-22	3.400E-01	0.000E+00	3.107E-01	8.046E+01	3.107E-01	8.046E+01
Nb-94	1.330E-01	0.000E+00	1.291E-01	1.936E+02	1.291E-01	1.936E+02
Pu-238	2.020E+01	0.000E+00	8.756E-03	2.855E+03	8.756E-03	2.855E+03
Pu-239	1.220E+02	0.000E+00	9.649E-03	2.591E+03	9.649E-03	2.591E+03
Ru-106	6.000E+00	0.000E+00	1.380E-02	1.811E+03	1.380E-02	1.811E+03
Sb-125	3.300E+00	0.000E+00	3.070E-02	8.143E+02	3.070E-02	8.143E+02
Sr-90	1.170E+02	0.000E+00	8.088E-04	3.091E+04	8.088E-04	3.091E+04
U-235	2.700E+00	0.000E+00	2.497E-02	1.001E+03	2.497E-02	1.001E+03

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	5.000E+01	6.800E+01	1.000E+02	1.500E+02
Ag-110m	Ag-110m	1.000E+00	2.225E-01	1.645E-02	1.086E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Al-26	Al-26	1.000E+00	2.101E-02	4.277E-03	2.568E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Am-241	Am-241	1.000E+00	3.151E-01	3.082E-01	2.525E-01	9.938E-02	6.310E-02	2.537E-02	0.000E+00
0Np-237	Am-241	1.000E+00	1.993E-07	5.914E-07	3.713E-06	1.077E-05	1.136E-05	9.686E-06	0.000E+00
0U-233	Am-241	1.000E+00	1.659E-14	1.147E-13	4.767E-12	5.874E-11	7.808E-11	8.243E-11	0.000E+00
0Th-229	Am-241	1.000E+00	1.313E-17	1.952E-16	5.508E-14	3.902E-12	7.716E-12	1.447E-11	0.000E+00
0Cd-109	Cd-109	1.000E+00	3.972E-03	4.701E-04	2.139E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ce-144	Ce-144	1.000E+00	3.819E-02	1.562E-02	5.005E-06	1.419E-21	1.382E-28	0.000E+00	0.000E+00
0Co-57	Co-57	1.000E+00	1.204E-02	4.720E-03	1.032E-06	5.429E-23	2.497E-30	0.000E+00	0.000E+00
0Co-60	Co-60	1.000E+00	2.027E+00	1.771E+00	5.223E-01	2.196E-03	1.803E-04	1.887E-06	0.000E+00
0Cs-134	Cs-134	1.000E+00	1.379E-01	9.821E-02	4.625E-03	5.601E-09	1.175E-11	1.810E-16	0.000E+00
0Cs-137	Cs-137	1.000E+00	1.608E+02	1.566E+02	1.235E+02	4.112E+01	2.417E+01	8.368E+00	0.000E+00
0Eu-152	Eu-152	7.208E-01	2.816E-01	2.663E-01	1.610E-01	1.645E-02	5.686E-03	7.687E-04	0.000E+00
Eu-152	Eu-152	2.792E-01	1.091E-01	1.032E-01	6.237E-02	6.373E-03	2.203E-03	2.978E-04	0.000E+00
Eu-152	äDOSE(j)		3.907E-01	3.695E-01	2.234E-01	2.283E-02	7.889E-03	1.067E-03	0.000E+00
0Gd-152	Eu-152	2.792E-01	8.198E-18	2.389E-17	1.256E-16	1.948E-16	1.661E-16	1.021E-16	0.000E+00
0Eu-154	Eu-154	1.000E+00	3.430E-01	3.158E-01	1.500E-01	5.243E-03	1.118E-03	6.406E-05	0.000E+00
0Eu-155	Eu-155	1.000E+00	3.716E-03	3.228E-03	9.073E-04	3.161E-06	2.426E-07	2.321E-09	0.000E+00
0Mn-54	Mn-54	1.000E+00	1.306E-02	5.782E-03	3.768E-06	2.497E-20	1.003E-26	0.000E+00	0.000E+00
0Na-22	Na-22	1.000E+00	1.056E-01	7.838E-02	5.333E-03	3.311E-08	1.448E-10	8.243E-15	0.000E+00
0Nb-94	Nb-94	1.000E+00	1.717E-02	3.498E-03	2.109E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Pu-238	Pu-238	1.840E-09	3.254E-10	3.207E-10	2.802E-10	1.449E-10	1.027E-10	4.825E-11	0.000E+00
Pu-238	Pu-238	1.000E+00	1.769E-01	1.743E-01	1.523E-01	7.875E-02	5.582E-02	2.622E-02	0.000E+00
Pu-238	äDOSE(j)		1.769E-01	1.743E-01	1.523E-01	7.875E-02	5.582E-02	2.622E-02	0.000E+00
0U-234	Pu-238	1.000E+00	6.958E-08	2.062E-07	1.275E-06	3.322E-06	3.263E-06	2.340E-06	0.000E+00
0Th-230	Pu-238	1.000E+00	5.079E-13	3.521E-12	1.503E-10	2.070E-09	2.884E-09	3.290E-09	0.000E+00
0Ra-226	Pu-238	1.000E+00	2.625E-15	3.910E-14	1.123E-11	8.537E-10	1.734E-09	3.397E-09	0.000E+00
0Pb-210	Pu-238	1.000E+00	3.095E-19	9.454E-18	1.601E-14	4.155E-12	9.831E-12	2.137E-11	0.000E+00

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	1.000E+01	5.000E+01	6.800E+01	1.000E+02	1.500E+02
Pu-239	Pu-239	1.000E+00	1.177E+00	1.169E+00	1.097E+00	7.769E-01	6.344E-01	3.834E-01	0.000E+00
0U-235	Pu-239	1.000E+00	1.501E-09	4.482E-09	2.988E-08	1.121E-07	1.322E-07	1.358E-07	0.000E+00
U-235	U-235	1.000E+00	6.743E-02	6.688E-02	6.206E-02	4.310E-02	3.550E-02	2.255E-02	0.000E+00
U-235	äDOSE(j)		6.743E-02	6.688E-02	6.206E-02	4.310E-02	3.550E-02	2.255E-02	0.000E+00
0Pa-231	Pu-239	1.000E+00	1.447E-14	1.004E-13	4.337E-12	6.335E-11	9.093E-11	1.104E-10	0.000E+00
Pa-231	U-235	1.000E+00	9.751E-07	2.895E-06	1.818E-05	5.113E-05	5.219E-05	4.047E-05	0.000E+00
Pa-231	äDOSE(j)		9.751E-07	2.895E-06	1.818E-05	5.113E-05	5.219E-05	4.047E-05	0.000E+00
0Ac-227	Pu-239	1.000E+00	6.068E-16	8.949E-15	2.325E-12	1.188E-10	2.065E-10	3.131E-10	0.000E+00
Ac-227	U-235	1.000E+00	5.440E-08	3.728E-07	1.420E-05	1.280E-04	1.536E-04	1.428E-04	0.000E+00
Ac-227	äDOSE(j)		5.440E-08	3.728E-07	1.420E-05	1.280E-04	1.536E-04	1.428E-04	0.000E+00
0Ru-106	Ru-106	1.000E+00	8.281E-02	8.483E-03	1.052E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Sb-125	Sb-125	1.000E+00	1.013E-01	1.607E-02	1.022E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Sr-90	Sr-90	1.000E+00	9.463E-02	9.122E-02	6.548E-02	1.445E-02	7.086E-03	1.789E-03	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	5.000E+01	6.800E+01	1.000E+02	1.500E+02
Ag-110m	Ag-110m	1.000E+00	1.400E+00	1.039E-01	7.087E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Al-26	Al-26	1.000E+00	9.700E-02	1.982E-02	1.233E-08	3.217E-36	0.000E+00	0.000E+00	0.000E+00
0Am-241	Am-241	1.000E+00	2.800E+01	2.755E+01	2.384E+01	1.252E+01	9.367E+00	5.595E+00	2.501E+00
0Np-237	Am-241	1.000E+00	0.000E+00	8.991E-06	8.328E-05	3.016E-04	3.582E-04	4.198E-04	4.569E-04
0U-233	Am-241	1.000E+00	0.000E+00	1.968E-11	1.837E-09	3.415E-08	5.556E-08	9.631E-08	1.560E-07
0Th-229	Am-241	1.000E+00	0.000E+00	6.206E-16	5.893E-13	5.898E-11	1.347E-10	3.632E-10	9.595E-10
0Cd-109	Cd-109	1.000E+00	2.000E+01	2.369E+00	1.085E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ce-144	Ce-144	1.000E+00	6.700E+00	2.749E+00	9.065E-04	3.038E-19	3.303E-26	1.377E-38	0.000E+00
0Co-57	Co-57	1.000E+00	1.200E+00	4.712E-01	1.045E-04	6.014E-21	2.959E-28	3.014E-41	0.000E+00
0Co-60	Co-60	1.000E+00	5.300E+00	4.646E+00	1.419E+00	7.284E-03	6.794E-04	1.001E-05	1.376E-08
0Cs-134	Cs-134	1.000E+00	6.400E-01	4.573E-01	2.218E-02	3.201E-08	7.534E-11	1.601E-15	8.010E-23
0Cs-137	Cs-137	1.000E+00	1.770E+03	1.729E+03	1.404E+03	5.557E+02	3.662E+02	1.745E+02	5.479E+01
0Eu-152	Eu-152	7.208E-01	1.586E+00	1.505E+00	9.394E-01	1.157E-01	4.509E-02	8.444E-03	6.162E-04
Eu-152	Eu-152	2.792E-01	6.142E-01	5.829E-01	3.639E-01	4.482E-02	1.747E-02	3.271E-03	2.387E-04
Eu-152	äS(j):		2.200E+00	2.088E+00	1.303E+00	1.605E-01	6.256E-02	1.171E-02	8.548E-04
0Gd-152	Eu-152	2.792E-01	0.000E+00	3.840E-15	3.063E-14	6.895E-14	7.185E-14	7.277E-14	7.186E-14
0Eu-154	Eu-154	1.000E+00	1.800E+00	1.663E+00	8.159E-01	3.445E-02	8.292E-03	6.593E-04	1.262E-05
0Eu-155	Eu-155	1.000E+00	7.000E-01	6.085E-01	1.724E-01	6.351E-04	5.100E-05	5.762E-07	5.227E-10
0Mn-54	Mn-54	1.000E+00	1.400E-01	6.218E-02	4.182E-05	3.328E-19	1.505E-25	7.911E-37	0.000E+00
0Na-22	Na-22	1.000E+00	3.400E-01	2.531E-01	1.777E-02	1.327E-07	6.543E-10	5.179E-14	2.021E-20
0Nb-94	Nb-94	1.000E+00	1.330E-01	2.718E-02	1.690E-08	4.403E-36	0.000E+00	0.000E+00	0.000E+00
0Pu-238	Pu-238	1.840E-09	3.717E-08	3.687E-08	3.429E-08	2.486E-08	2.151E-08	1.662E-08	1.112E-08
Pu-238	Pu-238	1.000E+00	2.020E+01	2.004E+01	1.864E+01	1.351E+01	1.169E+01	9.034E+00	6.042E+00
Pu-238	äS(j):		2.020E+01	2.004E+01	1.864E+01	1.351E+01	1.169E+01	9.034E+00	6.042E+00
0U-234	Pu-238	1.000E+00	0.000E+00	5.687E-05	5.343E-04	2.025E-03	2.431E-03	2.867E-03	3.047E-03
0Th-230	Pu-238	1.000E+00	0.000E+00	2.566E-10	2.461E-08	5.130E-07	8.757E-07	1.646E-06	2.993E-06
0Ra-226	Pu-238	1.000E+00	0.000E+00	3.705E-14	3.554E-11	3.700E-09	8.580E-09	2.365E-08	6.404E-08
0Pb-210	Pu-238	1.000E+00	0.000E+00	2.862E-16	2.607E-12	1.100E-09	3.185E-09	1.123E-08	3.771E-08

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	5.000E+01	6.800E+01	1.000E+02	1.500E+02
Pu-239	Pu-239	1.000E+00	1.220E+02	1.220E+02	1.218E+02	1.209E+02	1.206E+02	1.199E+02	1.188E+02
0U-235	Pu-239	1.000E+00	0.000E+00	1.198E-07	1.166E-06	5.187E-06	6.702E-06	9.017E-06	1.183E-05
U-235	U-235	1.000E+00	2.700E+00	2.684E+00	2.547E+00	2.017E+00	1.816E+00	1.507E+00	1.126E+00
U-235	äS(j):		2.700E+00	2.684E+00	2.547E+00	2.017E+00	1.816E+00	1.507E+00	1.126E+00
0Pa-231	Pu-239	1.000E+00	0.000E+00	1.266E-12	1.222E-10	2.614E-09	4.511E-09	8.639E-09	1.614E-08
Pa-231	U-235	1.000E+00	0.000E+00	5.679E-05	5.389E-04	2.133E-03	2.611E-03	3.185E-03	3.567E-03
Pa-231	äS(j):		0.000E+00	5.679E-05	5.389E-04	2.133E-03	2.611E-03	3.185E-03	3.567E-03
0Ac-227	Pu-239	1.000E+00	0.000E+00	1.329E-14	1.170E-11	8.791E-10	1.805E-09	4.130E-09	8.871E-09
Ac-227	U-235	1.000E+00	0.000E+00	8.920E-07	7.528E-05	9.580E-04	1.355E-03	1.896E-03	2.344E-03
Ac-227	äS(j):		0.000E+00	8.920E-07	7.528E-05	9.580E-04	1.355E-03	1.896E-03	2.344E-03
0Ru-106	Ru-106	1.000E+00	6.000E+00	6.165E-01	7.872E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Sb-125	Sb-125	1.000E+00	3.300E+00	5.251E-01	3.435E-08	4.031E-40	0.000E+00	0.000E+00	0.000E+00
0Sr-90	Sr-90	1.000E+00	1.170E+02	1.131E+02	8.370E+01	2.192E+01	1.199E+01	4.105E+00	7.690E-01

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 14.15 seconds

Appendix E

Closure Summary

E.1.0 Closure Summary

A land use restriction will be applied as the closure in place alternative for CAU 504. The use restriction will be applied to control use and limit access to the sites to prevent inadvertent exposure to the radionuclide contaminated soil identified in the Muckpile (CAS 16-06-01), Contaminated Burial Pit (CAS 16-23-01), Concrete Construction Waste (CAS 16-99-01), Contaminated Area (CAS 16-23-02), and the channel below CAS 16-23-02. The completed land use restriction form and map are included in this appendix. The future use of CAU 504 will be restricted from any activity unless concurrence is obtained from NDEP. Post closure monitoring is not recommended.

The following warning will appear on signs posted every 200 ft along the northern and eastern borders of the CAU 504 boundary:

WARNING!

Radiologically Contaminated Areas
Beyond This Point

FFACO Site: CAU 504
CAS 16-06-01 Muckpile, CAS 16-23-01 Contaminated Burial Pit
CAS 16-23-02 Contaminated Area, CAS 16-99-01 Concrete Construction Waste

Access to this area is Not Permitted Without
U.S. Government Permission

Before Working In This Area,
Contact Real Estate Services at 295-2528

This site can be closed without further corrective action.

CAU Use Restriction Information

CAU Number/Description: 504/16a-Tunnel Muckpile

Applicable CAS Numbers/Descriptions: 16-06-01/Muckpile, 16-23-01/Contaminated Burial Pit, 16-23-02/Contaminated Area, 16-99-01/Concrete Construction Waste

Contact (organization/project): NNSA/NSO Environmental Management

Surveyed Area (UTM, Zone 11, NAD 27, meters): See attached figure

NW Corner	4,096,524 N	571,582 E
N Side # 1	4,096,525 N	571,796 E
N Side # 2	4,096,433 N	571,796 E
N Side # 3	4,096,495 N	572,131 E
N Side # 4	4,096,743 N	572,491 E
NE Corner	4,096,823 N	572,721 E
SE Corner	4,096,559 N	572,862 E
S Side # 1	4,096,406 N	572,619 E
SW Corner	4,096,250 N	571,613 E

Survey Date: 4/3/2007 **Survey Method (GPS, etc):** GPS

Site Monitoring Requirements: None

Required Frequency (quarterly, annually?): N/A
If Monitoring Has Started, Indicate last Completion Date:

Use Restrictions

The future use of any land related to this Corrective Action Unit (CAU), as described by the above surveyed location, is restricted from any DOE or Air Force activity that may alter or modify the containment control as approved by the state and identified in the CAU Closure Report or other CAU documentation unless appropriate concurrence is obtained in advance.

Comments: See the Closure Report for additional information on the condition of the site(s).

Submitted By: /s/Kevin Cabble **Date:** 7/26/2007

cc with copy of survey map (paper and digital (dgn) formats):
CAU Files (2 copies)

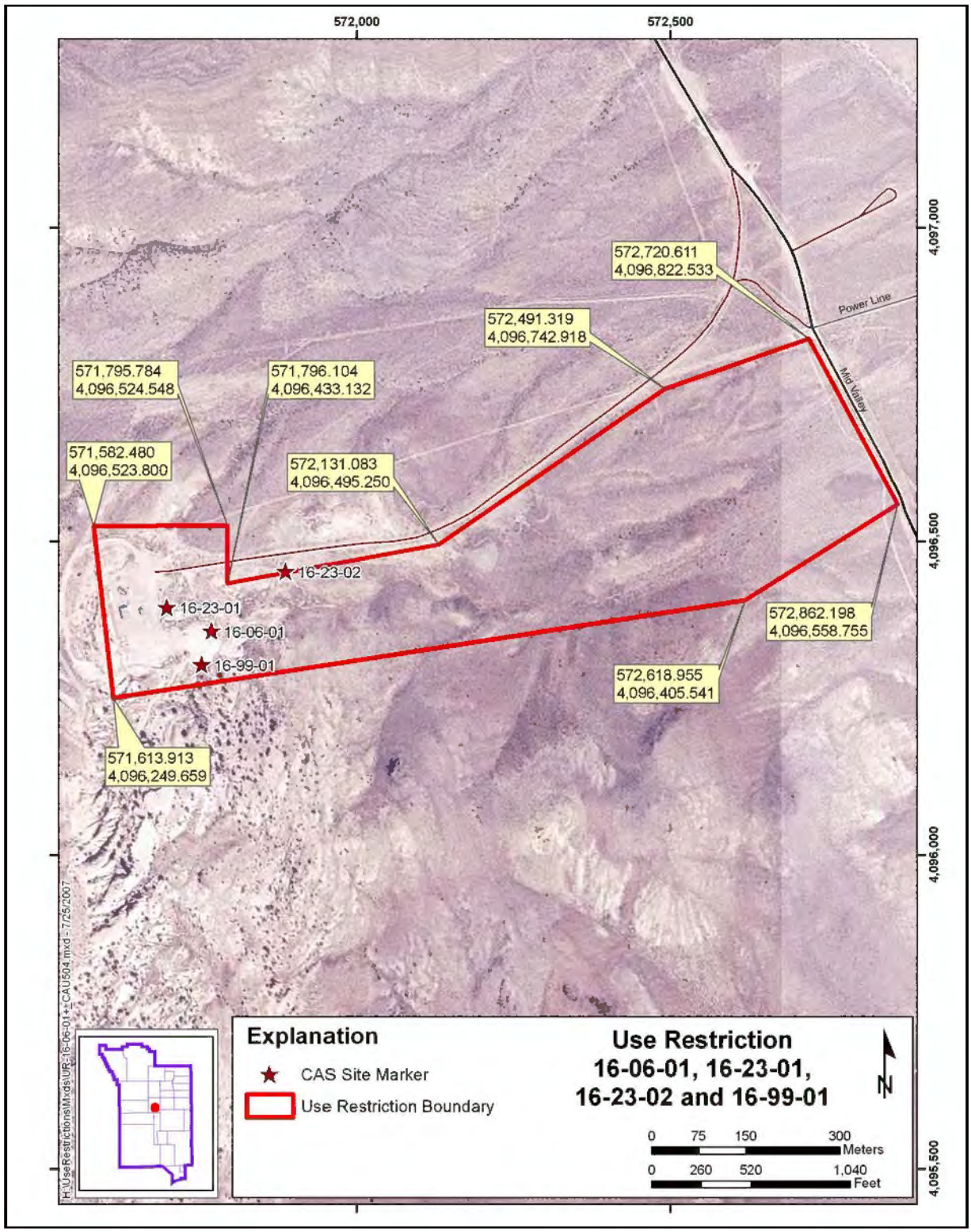

Figure E.1-1
CAU 504 16-a Tunnel Muckpile

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