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

Corrective Action Unit (CAU) Number: 546
CAU Description: Injection Well and Surface Releases
CAU Owner: Industrial Sites - Environmental Restoration (ER)

ROTC No. DOE/NV--1300-ROTC 1 **Page** 1 of 9

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 06/28/2022

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 546.

   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 UR boundary coordinate values changed due to conversion from North American Datum (NAD) 1927 to NAD 1983.

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. UR boundary coordinates need to be in one standardized coordinate system.

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

Corrective Action Unit (CAU) Number: 546
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ROTC No. DOE/NV--1300-ROTC 1 **Page** 2 of 9

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 06/28/2022

Description of Change:

3. Removed sign location information from the UR.

4. Removed specific wording for the warning signs.

Justification:

3. The UR requires that the site be posted with warning signs as needed at points of access. The specific location or spacing of signs are not required for the UR.
4. The required content on warning signs has been standardized through negotiations with NDEP.

Schedule Impacts:

No impacts to schedule.

ROTC applies to the following document(s):

- U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2008. Corrective Action Decision Document/Closure Report for Corrective Action Unit 546: Injection Well and Surface Releases, Nevada Test Site, Nevada, Rev. 0, DOE/NV--1300. Las Vegas, NV.

FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
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ROTC No. DOE/NV--1300-ROTC 1 **Page** 3 of 9

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 06/28/2022

Approvals:

Tiffany A. Gamero Digitally signed by Tiffany A. Gamero Date: 2022.10.02 14:47:10 -07'00' Date _____

Tiffany Gamero
Activity Lead
Environmental Management (EM) Nevada Program

WILHELM WILBORN Digitally signed by WILHELM WILBORN Date: 2022.10.03 11:55:22 -07'00' Date _____

Bill Wilborn
Deputy Program Manager, Operations
Environmental Management (EM) Nevada Program

Christine Andres Digitally signed by Christine Andres Date: 2022.10.17 08:42:42 -07'00' Date _____

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: 546 - Injection Well and Surface Releases

Corrective Action Site (CAS) Number & Description: 09-20-01 - Injection Well

CAU/CAS Owner: Industrial Sites - ER

Note: N/A

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 and chemical contaminants are assumed to be present that exceed final action levels under the Industrial Area (2,000 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	584,786	4,109,728
	2	584,779	4,109,731
	3	584,779	4,109,737
	4	584,786	4,109,736
	5	584,786	4,109,728

[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 transformed from the North American Datum of 1927, and rounded to the nearest meter; resultant coordinates may not reflect the original precision of values contained within the source GIS data set.

Boundary Applies to: Subsurface

Starting Depth: 61 **Ending Depth:**

UR is effective upon acceptance by NDEP.

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

Depth Unit: Centimeters

Survey Source: GPS

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: Ending depth is unknown.

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 546 CADD/CR (DOE/NV--1300), dated 05/23/2022.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2008. Corrective Action Decision Document/Closure Report for Corrective Action Unit 546: Injection Well and Surface Releases, Nevada Test Site, Nevada, Rev. 0, DOE/NV--1300. Las Vegas, NV.

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

Attachments

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

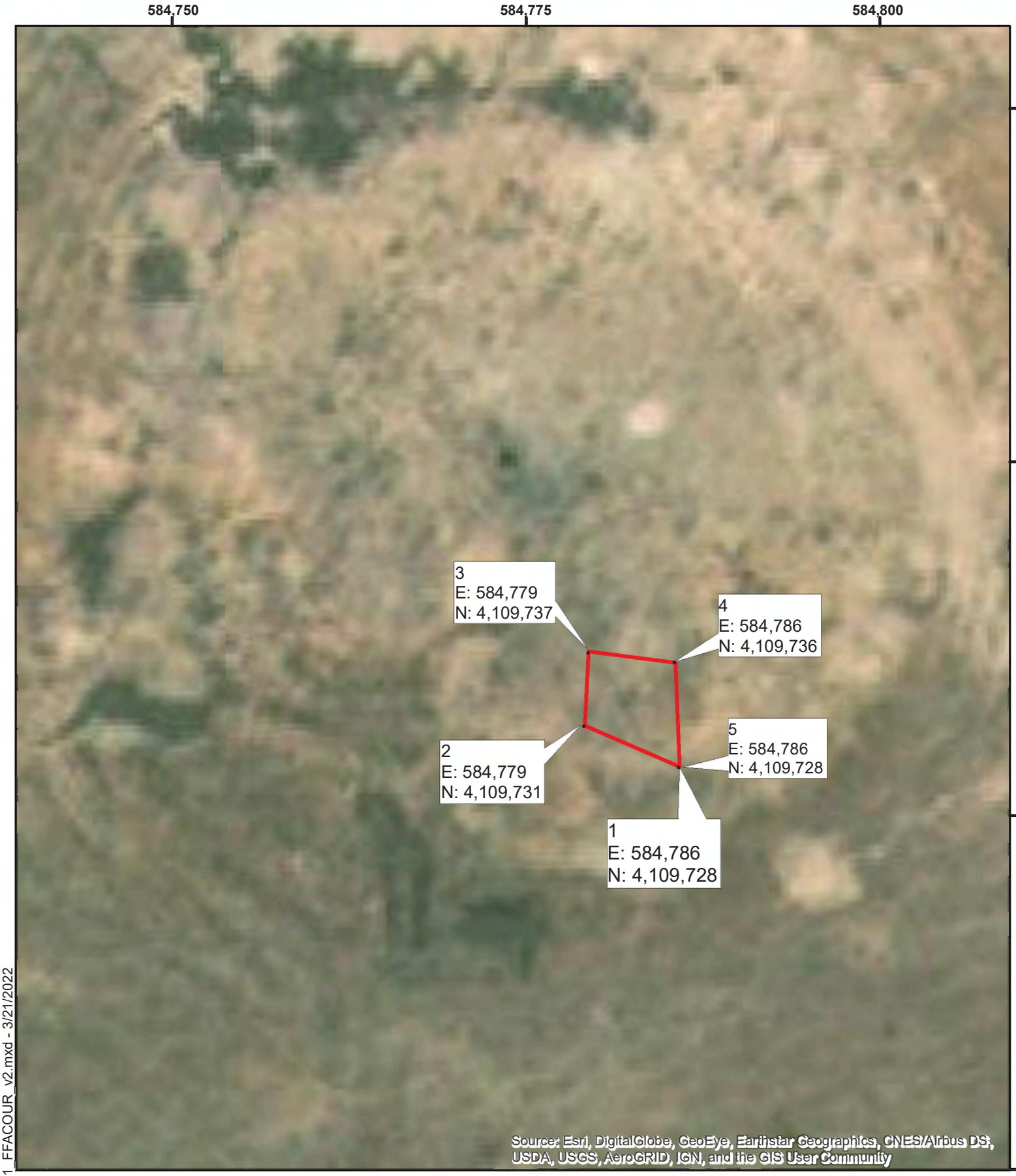
Tiffany A. Gamero Digitally signed by Tiffany A. Gamero Date: 2022.10.02 14:47:47 -07'00'

Date: _____

Tiffany Gamero

Activity Lead

EM Nevada Program



H:\546\GPS\CAS09-20-01_FFACOUR_v2.mxd - 3/21/2022

UNCONTROLLED

CAU 546, CAS 09-20-01
Injection Well
FFACO UR Boundary

Explanation

FFACO UR

0 3 6 12 Meters

0 12.5 25 50 Feet

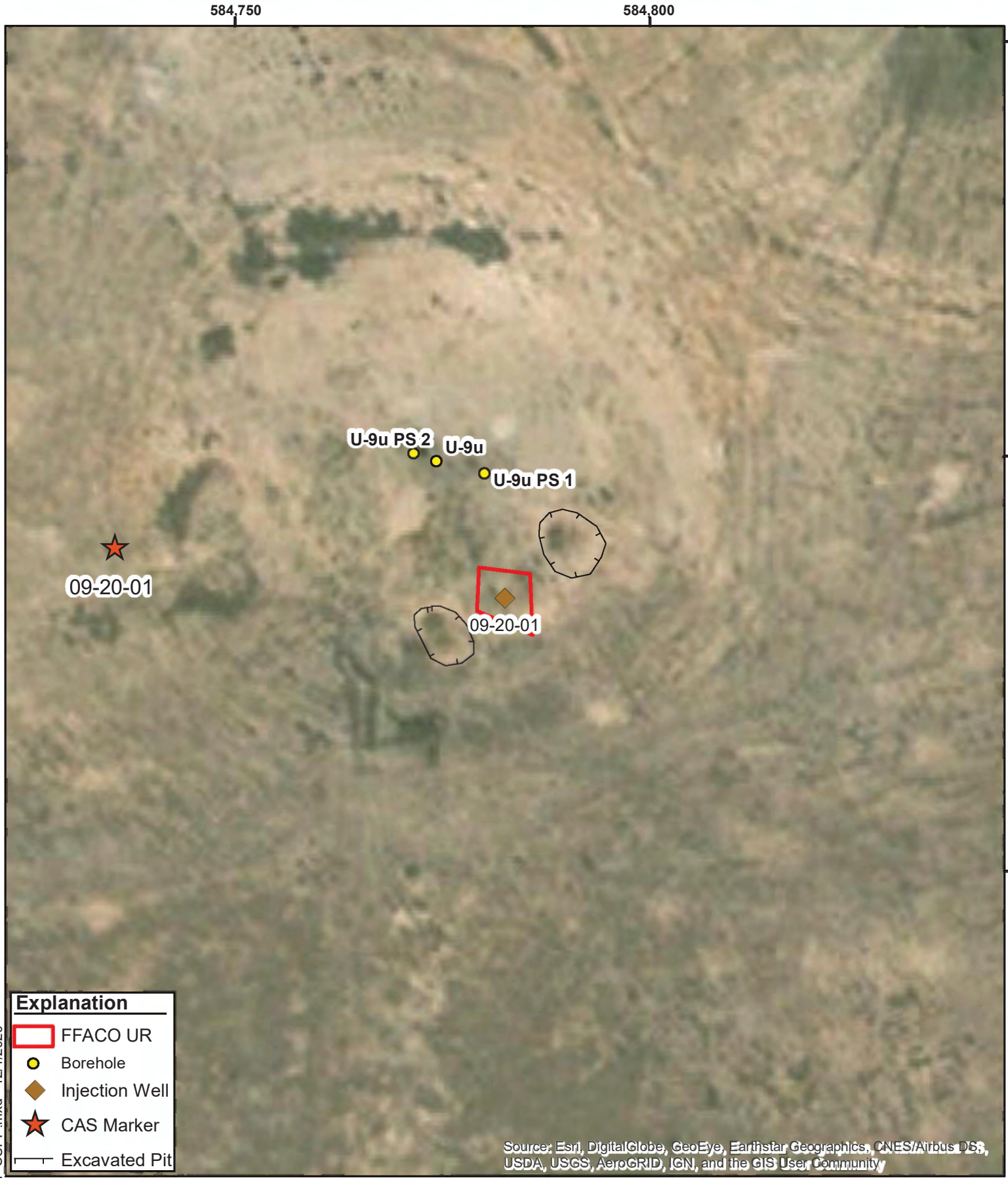
N

Source: Navarro GIS, 2022

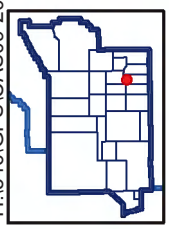
Coordinate System: NAD 1983 UTM Zone 11N, Meter

Supplemental Information Figure

The attached supplemental information figure(s) are included to capture site feature information that was available in previous iterations of this Use Restriction (UR) to prevent loss of that information.



H:\546\GPS\CAS09-20-01_SUPP.mxd - 12/1/2020



Source: Navarro GIS, 2020

UNCONTROLLED

CAU 546, CAS 09-20-01
Supplemental Information
General Location of Site Features

0 5 10 20 Meters

0 20 40 80 Feet

N

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Nevada
Environmental
Restoration
Project

DOE/NV--1300

National Nuclear Security Administration

Corrective Action Decision Document/ Closure Report for Corrective Action Unit 546: Injection Well and Surface Releases Nevada Test Site, Nevada

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December 2008

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CORRECTIVE ACTION DECISION DOCUMENT/ CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 546: INJECTION WELL AND SURFACE RELEASES NEVADA TEST SITE, NEVADA

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Las Vegas, Nevada

Controlled Copy No.: UNCONTROLLED

Revision No.: 0

December 2008

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Derivative Classifier: Joseph Johnston, CO
(Name/personal identifier and position title)
Signature: /s/ Joseph P. Johnston
Date: 12/15/2008

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CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR
CORRECTIVE ACTION UNIT 546:
INJECTION WELL AND SURFACE RELEASES
NEVADA TEST SITE, NEVADA

Approved by: /s/ Kevin Cabble Date: 12/4/2008

Kevin J. Cabble
Federal Sub-Project Director
Industrial Sites Sub-Project

Approved by: /s/ Robert F. Boehlecke Date: 12/8/2008

Robert F. Boehlecke
Federal Project Director
Environmental Restoration Project

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List of Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
bgs	Below ground surface
BMP	Best management practice
CADD	Corrective action decision document
CAI	Corrective action investigation
CAIP	Corrective action investigation plan
CAS	Chemical Abstracts Service
CAS	Corrective action site
CAU	Corrective action unit
CD	Certificate of Disposal
COC	Contaminant of concern
COPC	Contaminant of potential concern
CR	Closure report
Cs	Cesium
CSM	Conceptual site model
DOE	U.S. Department of Energy
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
EML	Environmental Measurements Laboratory
EPA	U.S. Environmental Protection Agency
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level

List of Acronyms and Abbreviations *(Continued)*

FSR	Field-screening result
ft	Foot
GPS	Global Positioning System
ID	Identification
HASL	Health and Safety Laboratory
IDW	Investigation-derived waste
in.	Inch
LCS	Laboratory control sample
LVF	Load Verification Form
MDC	Minimum detectable concentration
mg/kg	Milligrams per kilogram
MS	Matrix spike
MSD	Matrix spike duplicate
N/A	Not applicable
NAC	*Nevada Administrative Code*
NAD	North American Datum
NDEP	Nevada Division of Environmental Protection
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
PACM	Presumed asbestos-containing material
PAL	Preliminary action level
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
POC	Performance objective criteria

List of Acronyms and Abbreviations *(Continued)*

PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RBCA	Risk-based corrective action
RBSL	Risk-based screening level
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radioactive
RPD	Relative percent difference
SCL	Sample collection log
SDG	Sample delivery group
SOP	Standard Operating Procedure
Sr	Strontium
SSTL	Site-specific target level
SVOC	Semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbons
U	Uranium
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
WM	Waste management
µg/kg	Micrograms per kilogram
%R	Percent recovery

Executive Summary

This Corrective Action Decision Document/Closure Report has been prepared for Corrective Action Unit 546, Injection Well and Surface Releases, at the Nevada Test Site, Nevada, in accordance with the *Federal Facility Agreement and Consent Order* (FFACO, 1996; as amended February 2008). Corrective Action Unit (CAU) 546 is comprised of two corrective action sites (CASs):

- 06-23-02, U-6a/Russet Testing Area
- 09-20-01, Injection Well

The purpose of this Corrective Action Decision Document/Closure Report is to provide justification and documentation supporting the recommendation for closure of CAU 546. To achieve this, corrective action investigation (CAI) activities were performed from May 5 through May 28, 2008, as set forth in the *Corrective Action Investigation Plan for Corrective Action Unit 546*: *Injection Well and Surface Releases, Nevada Test Site, Nevada* (NNSA/NSO, 2008). The purpose of the CAI was to fulfill the following data needs as defined during the data quality objective (DQO) process:

- Determine whether a contaminant of concern is present at a given CAS.
- Determine whether sufficient information is available to evaluate potential corrective action alternatives at each CAS.

The CAU 546 dataset from the investigation results 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.

Analytes detected during the CAI were evaluated against final action levels established in this document. No analytes were detected at concentrations exceeding final action levels. However, contaminants of concern were presumed to be present in the subsurface soil at CAS 09-20-01. Therefore, the corrective action of close in place was selected as the preferred alternative for this CAS. Potential source material was removed from CAS 06-23-02; therefore, the corrective action of clean closure was selected as the preferred alternative at this CAS.

Because DQO data needs were met, and corrective actions have been implemented, it has been determined that no further corrective action (based on risk to human receptors) is necessary for the CAU 546 CASs.

The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office provides the following recommendations:

- No further corrective actions are needed for CAU 546 CASs.
- No Corrective Action Plan is required.
- A Notice of Completion to the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office is requested from the Nevada Division of Environmental Protection for closure of CAU 546.
- Corrective Action Unit 546 should be moved from Appendix III to Appendix IV of the *Federal Facility Agreement and Consent Order.*

1.0 Introduction

This Corrective Action Decision Document/Closure Report (CADD/CR) presents information supporting closure of Corrective Action Unit (CAU) 546, Injection Well and Surface Releases, Nevada Test Site (NTS), Nevada. The corrective actions proposed in this document are in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada, U.S. Department of Energy (DOE), and U.S. Department of Defense (FFACO, 1996; as amended February 2008). The NTS is approximately 65 miles northwest of Las Vegas, Nevada (Figure 1-1).

Corrective Action Unit 546 is comprised of the two corrective action sites (CASs) that are shown on Figure 1-2 and listed below:

- 06-23-02, U-6a/Russet Testing Area
- 09-20-01, Injection Well

A detailed discussion of the history of this CAU is presented in the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 546: Injection Well and Surface Releases* (NNSA/NSO, 2008). This document provides or references the specific information necessary to support closure of this CAU.

1.1 Purpose

This CADD/CR provides justification why no further corrective action is necessary, how and why use restrictions (URs) will be applied, and the technical rationale for implemented closure activities. This justification is based on the corrective actions implemented and the results of investigative activities that were conducted in accordance with the CAIP (NNSA/NSO, 2008).

Corrective Action Unit 546, Injection Well and Surface Releases consists of two inactive sites located in Areas 6 and 9. The two CAU 546 sites consist of a testing area located in Area 6 and an injection well located in Area 9. Although the injection well actually functioned as a disposal hole, the FFACO name for the CAS is Injection Well and, therefore, will be referred to as such throughout this document.

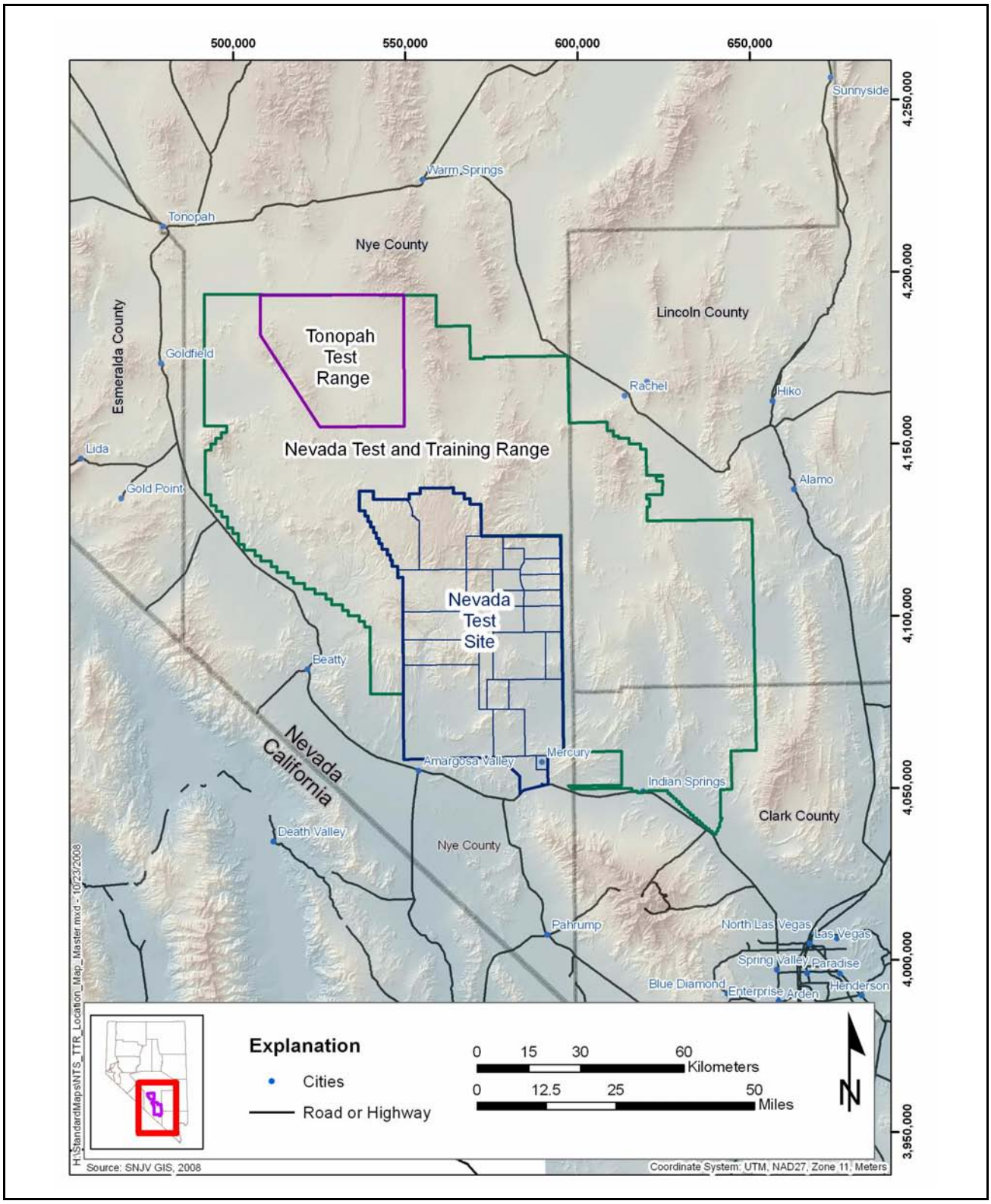

Figure 1-1
Nevada Test Site

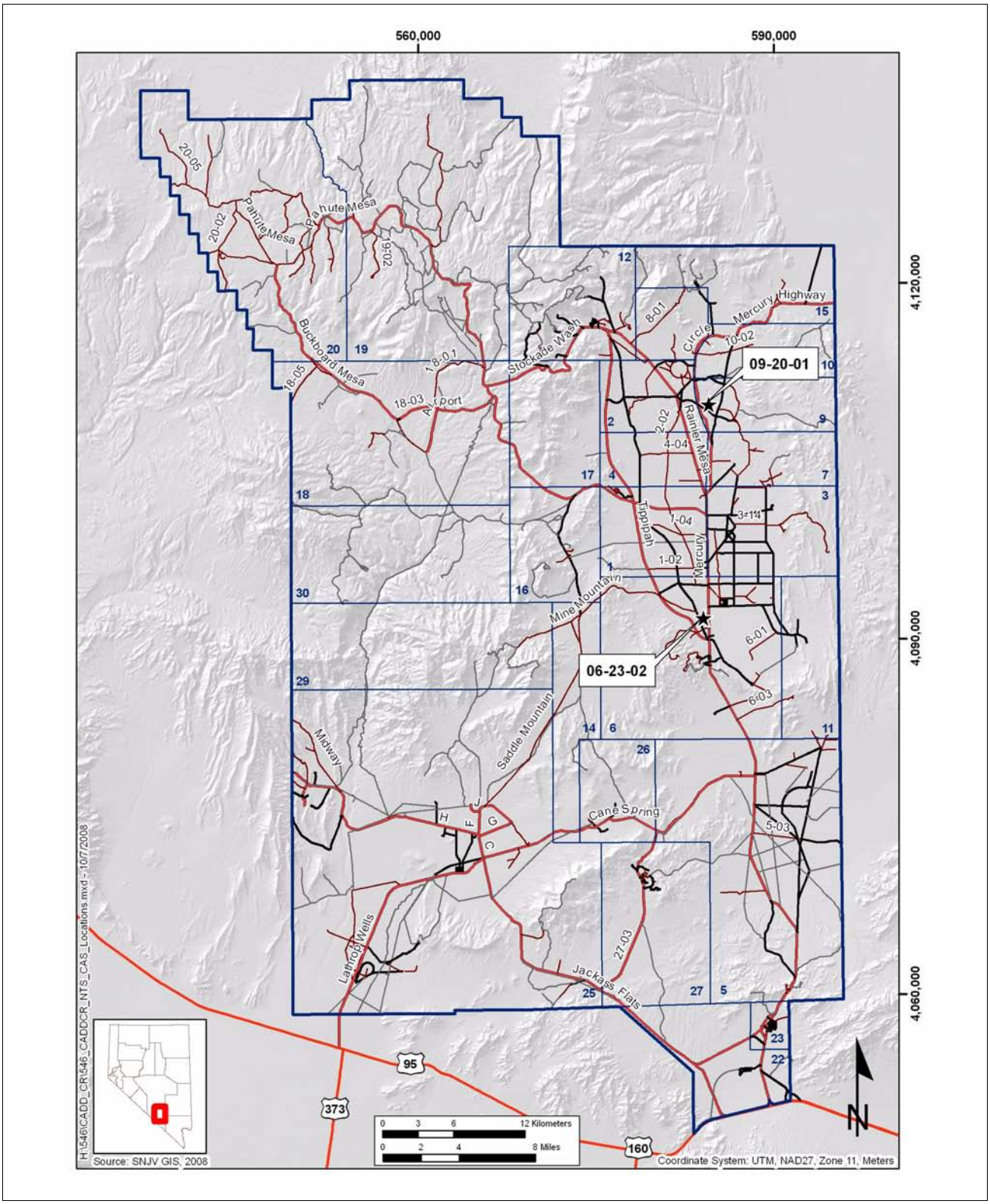

Figure 1-2
Corrective Action Unit 546, CAS Location Map

The Area 6 site (CAS 06-23-02, U-6a/Russet Testing Area) is the location where the Russet Test was conducted on March 5, 1968. This area was used to support both pre- and post-test activities. Currently, there are numerous site components remaining from these activities which are present within the testing area. These include a vent line, subsurface anomaly, discharge pit, soil pile, two muckpiles, and the overall testing area.

The Area 9 site (CAS 09-20-01, Injection Well) is located within the U-9u crater that was created on September 6, 1962, as a result of the Raritan test. The injection well appears in historical photographs to be present in the crater by 1963. Liquid and solid decontamination waste and classified core material was disposed of into the injection well. Records indicate that the injection well was active as late as 1988. West of the injection well is a shallow excavation containing a drum. It is unknown when the drum appeared onsite.

1.2 Scope

The scope of this CADD/CR is to justify that no further corrective action is required at CAU 546, Injection Well and Surface Releases. The activities conducted to accomplish this scope included the following:

- Removal of surface debris and/or materials to facilitate sampling
- Radiological surveys
- Field screening
- Collection and analysis of environmental samples to determine the presence of COCs
- Collection of potential source material (PSM) to determine the potential to generate COCs if released to the environment
- Collection of waste samples to determine the proper disposal of wastes
- Collection of quality control (QC) samples

1.3 Corrective Action Decision Document/Closure Report Contents

This CADD/CR is divided into the following sections and appendices:

Section 1.0 – Introduction: Summarizes the purpose, scope, and contents of this CADD/CR.

Section 2.0 – Corrective Action Investigation (CAI) Summary: Summarizes the investigation field activities, the results of the investigation, the need for corrective action, and a summary of the results of the data quality objective (DQO) assessment.

Section 3.0 – Recommendation: States why no further corrective action is required.

Section 4.0 – References: Provides a list of all referenced documents used in the preparation of this CADD/CR.

Appendix A – *Corrective Action Investigation Results:* Provides a description of the project objectives, field investigation and sampling activities, investigation results, waste management (WM), and quality assurance (QA). Section A.3.0 provides specific information regarding field activities, sampling methods, and laboratory analytical results from the investigation.

Appendix B – *Data Assessment:* Provides a data quality assessment (DQA) that reconciles DQO assumptions and requirements to the investigation results.

Appendix C – *Risk Assessment:* Presents an evaluation of risk associated with the establishment of final action levels (FALs).

Appendix D – *Closure Activity Summary:* Provides details on the completed closure activities and includes the required verification activities and supporting documentation.

Appendix E – *Sample Location Coordinates:* Provides Global Positioning System (GPS) coordinates for CAU 546 sample locations.

Appendix F – *Waste Disposal Documentation:* Provides load verification and shipping documentation for CAU 546.

Appendix G – *Nevada Division of Environmental Protection* (NDEP) *Comments:* Contains NDEP comments on the draft version of this document.

1.3.1 Applicable Programmatic Plans and Documents

Investigation activities were performed in accordance with the following documents:

- CAIP for CAU 546, Injection Well and Surface Releases (NNSA/NSO, 2008)
- *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002)
- FFACO (1996, as amended February 2008)
- Approved procedures

1.3.2 Data Quality Assessment Summary

The DQA is presented in Appendix B and includes an evaluation of the data quality indicators (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 will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA process as presented in Appendix B 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 each CAS are shown in Appendix B. Based on the results of the DQA presented in Appendix B, the nature and extent of COCs at CAU 546 have been adequately identified to support the recommended closure alternatives. The DQA also determined that information generated during the investigation supports the conceptual site model (CSM) assumptions; the data collected met the DQOs, and supports the intended use in the decision-making process.

2.0 Corrective Action Investigation Summary

The following sections summarize the investigation activities, investigation results, and justify why no further corrective action is needed at CAU 546. Detailed investigation activities and results for each CAU 546 CAS are presented in Appendix A.

2.1 Investigation Activities

Corrective action investigation activities were performed as set forth in the CAIP (NNSA/NSO, 2008) from May 5 through May 28, 2008. An additional field activity took place on July 28, 2008. The purpose of the CAU 546 CAI was to address the decision statements in the project-specific DQOs by:

- Determining whether contaminants of concern (COCs) are present in the soils associated with CAU 546.
- Determining the lateral and vertical extent of identified COCs.
- Ensuring adequate data have been collected to close the sites under NDEP, *Resource Conservation and Recovery Act* (RCRA) (CFR, 2007a), *Toxic Substances Control Act* (CFR, 2007b), and DOE requirements.

The scope of the CAI included the following activities:

- Performing radiological surveys (i.e., static, scanning, and swipe collection).
- Field screening soil samples for total alpha and beta/gamma radiation.
- Collecting environmental samples for laboratory analyses to determine the magnitude and extent of COCs, if present.
- Collecting QC samples for laboratory analyses to ensure that the data generated from the analysis of investigation samples meet the requirements of the DQIs.
- Collecting samples of PSM to evaluate potential future impacts to the environment.

A judgmental sampling scheme was implemented to select sample locations and evaluate analytical results, as outlined in the CAIP (NNSA/NSO, 2008). Judgmental sampling allows the methodical

selection of sample locations that target the populations of interest (defined in the DQOs) rather than nonselective random locations.

For the judgmental sampling scheme, individual sample results (rather than average concentrations) are used to compare to final action levels (FALs). Therefore, statistical methods to generate site characteristics (averages) are not necessary (EPA, 2006). If adequate prior information is available on the site of interest, then the sampling may be designed to collect samples only from areas known to have the highest contaminant concentrations on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site contains safe levels of the contaminants without the samples being truly representative of the entire area (EPA, 2006).

The judgmental sampling design was used to confirm the existence of contamination at specific locations and provide information (e.g., extent of contamination) about specific areas of the site.

Confidence in judgmental sampling scheme decisions was established qualitatively by validation of the CSM and justification that sampling locations are the most likely locations to contain a COC, if a COC exists.

Waste characterization activities were conducted to gather sufficient information and data to support proper waste disposal. Information regarding waste characterization is presented in Appendix A.

Radiological surveys (i.e., scanning, static, and swipe collection) were performed at all the CASs during the CAI. Radiological surveys were performed to identify the presence, the nature, and the extent of radiological contaminants at activities statistically distinguishable from background activities (more than 2 times background levels). The radiological surveys were conducted using a handheld plastic scintillation detector in conjunction with a global positioning receiver and datalogger.

The following sections describe specific investigation activities conducted at each CAS. Additional information regarding the investigation is presented in Appendix A.

2.1.1 U-6a/Russet Testing Area (CAS 06-23-02)

The following subsections summarize the activities conducted at CAS 06-23-02.

2.1.1.1 Radiological Survey

A radiological walkover survey was conducted throughout the testing area and on the components (SNJV, 2008). No radiological readings were distinguishable from background readings. However, two sample locations in the testing area and two sample locations east of the vent line were selected to verify the radiological status of the areas with the highest readings. Additionally, swipes were collected from inside the vent line but no elevated radiological readings were recorded.

2.1.1.2 Geophysical Survey

A geophysical survey was conducted over various locations within the test area focusing on the individual components (Weston, 2007). Several anomalies were identified within the two muckpiles which are indicative of debris. Additionally, a subsurface anomaly measuring 43 by 33 ft was identified in the southwestern portion of the southern muckpile. This anomaly was selected as a location of interest and was excavated to determine the need for sample collection at this location. The interference of the fence posts surrounding the soil pile made it impossible to detect anomalies within the pile. The survey showed that the visible pipe at the ground surface adjacent to a concrete pad connects to the inlet pipe present on the western edge of the discharge pit.

2.1.1.3 Visual Inspection

A walkover survey was conducted of the testing area to identify biased sample locations. During the walkover survey, debris consisting of a lead brick, lead battery, and lead slag; hard, yellow material; and an area of stained soil were identified within the testing area. The yellow material was sampled directly and environmental samples of the stained soil and the soil beneath the debris were collected.

The site components were also visually inspected to identify additional biased sample locations not identified in the CAIP (NNSA/NSO, 2008). One additional biasing sample location was identified in the southern muckpile once excavation began. A bucket containing a thick, grease-like substance was found and a sample was collected of the soil beneath the bucket. No additional biasing factors were identified at either of the muckpiles.

A pipe assembly believed to have been associated with the vent line was identified as a potential biasing factor; therefore, one additional sample was collected at this location. Because there were no

surface features associated with the subsurface anomaly, a walkover survey was not applicable. However, once the subsurface anomaly was exposed and determined to consist of various metal debris, a visual inspection was performed and a sample location was selected beneath the anomaly. No additional biasing factors were identified in the discharge pit or the soil pile.

2.1.1.4 Video Survey

A video survey was completed of the vent line and the piping that originates at a concrete pad and terminates in the discharge pit. The video survey of the vent line was conducted to the extent possible to identify a plug, if present, and to determine whether residual material in the piping could be PSM. Forty-seven feet of the vent line was viewed and small amounts of sediment and rust were identified. However, radiological swipes of the pipe and the video equipment determined that this material is not PSM. The vent line extends approximately 12 ft bgs before it turns to become parallel with the ground surface and heads approximately 115 ft west toward the U-6a re-entry shaft. The U-6a re-entry shaft is plugged at the ground surface. The entire length of the vent line was not viewed because the ribbing on the vent line and the flexibility of the cable prevented the video mole from pushing farther than 47 ft into the pipe. Although the vent line was not completely surveyed, enough information was obtained to conclude that there is no contamination in the vent line and it was not plugged.

The discharge pit piping was video surveyed to identify the presence of breaches and residual material that could be PSM. The pipe was surveyed to the extent possible because the pipe had become crimped where it is visible at the ground surface near the concrete pad. This was a result of heavy equipment traveling on the road between the discharge pit and the concrete pad. No breaches or other tie-ins were identified. Coarse gravel and animal remains were identified within the discharge piping; however, no sludge or liquid material was found. No additional biased sample locations were identified based on video survey results.

2.1.1.5 Field Screening

Investigation samples were field screened for alpha and beta/gamma radiation. The field-screening results (FSRs) were compared to field-screening levels (FSLs) to guide subsequent sampling

decisions where appropriate. Additional sampling was not required as FSRs did not exceed FSLs at any sample locations.

2.1.1.6 Sample Collection

Intrusive investigation activities (i.e., surface and shallow subsurface soil sampling) were conducted to support planned decisions. Soil samples were collected using hand sampling equipment and heavy equipment (e.g., a backhoe and excavator).

Decision I sampling activities at CAS 06-23-02 included the collection of 65 environmental samples (including 3 field duplicates [FDs]) from 36 judgmental sample locations: A01 through A36. These locations were selected based on process knowledge that suggested that if contamination was present, these locations were the most likely to contain contaminants. The samples were collected from within the testing area, on and within two muckpiles, near the vent line, beneath the subsurface anomaly, inside and adjacent to the discharge pit, and within the soil pile. The sampling activities at each of these components are discussed in the following sections:

Testing Area - Six environmental surface samples (546A001, 546A008, 546A009, 546A014, 546A036, 546A037) and three PSM samples (546A501 through 546A503) were collected from 0.0 to 0.5 ft bgs at eight locations (546A01, 546A02, 546A03, 546A14, 546A15, 546A16, 546A28, 546A27) to determine whether contaminants had been released in the testing area.

Northern Muckpile - Twenty environmental soil samples (546A010 through 546A013 and 546A020 through 546A035) were collected at depths ranging from 0.0 to 16.5 ft bgs at eight locations (546A10 through 546A13 and 546A21 through 546A24) to determine whether contaminants were present within the component.

Southern Muckpile - Twenty-two environmental soil samples (546A004 through 546A007 and 546A040 through 546A057 [including one FD]) and one PSM sample (546A504) were collected at depths ranging from 0.0 to 14.5 ft bgs at eight locations (546A06 through 546A09 and 546A29 through 546A32) to determine whether contaminants were present within the component.

Vent Line - Four environmental samples (546A002, 546A003, 546A038, 546A039) were collected from 0.0 to 0.5 ft bgs at four locations (546A04, 546A05, 546A25, 546A26) to determine whether the

vent line was the source of a radiological release. Radiological swipes were collected from three locations within the vent line (i.e., at the opening, approximately 1 ft from the opening, and 10 ft from the opening) to determine whether PSM was present.

Subsurface Anomaly - One environmental sample (546A058) was collected from a depth of 7.5 to 8.0 ft bgs at location 546A33 to determine whether contaminants were released from the debris that made up the subsurface anomaly.

Discharge Pit - Five environmental samples (546A015 through 546A019 [including one FD]) were collected from 0.0 to 0.5 ft bgs at four locations (546A017 through 546A20) to determine whether contaminants were release into the discharge pit via piping.

Soil Pile - Seven environmental samples (546A059 through 546A065 [including one FD]) were collected from 0.0 to 5.0 ft bgs at three locations (546A34 through 546A36) to determine whether contaminants were present within the component.

2.1.1.7 Conceptual Site Model Validation

A CSM was developed to represent the release mechanisms and potential migration pathways for contaminant releases at CAU 546 CASs. The CSM and associated discussion for this CAS are provided in the CAIP (NNSA/NSO, 2008).

The migration pathway and release mechanism information gathered during the CAI were consistent with the CSM, and all information gathered during the CAI supports and validates the CSM as presented in the CAIP.

2.1.2 Injection Well (CAS 09-20-01)

The following subsections summarize the activities conducted at CAS 09-20-01.

2.1.2.1 Radiological Survey

A radiological walkover survey was conducted around the injection well and excavated area containing the drum and no readings were distinguishable from background (SNJV, 2007). No

sample locations were selected based on the radiological survey results. The drum was swiped for surface radiological contamination, but no elevated readings were recorded.

2.1.2.2 Visual Inspection

Visual inspections were made of the area surrounding the injection well cover and of the excavated area containing the drum to identify biasing factors (i.e., staining, odor). The visual inspection revealed no additional biasing factors that would have required sampling.

2.1.2.3 Field Screening

Soil samples were screened in the field for alpha and beta/gamma radioactivity. A handheld survey instrument was used to screen for alpha and beta/gamma radioactivity before soil samples were placed in sample jars. The radiological FSRs were compared to FSLs to guide subsequent sampling decisions. Radiological FSRs were all below FSLs.

2.1.2.4 Sample Collection

A total of five environmental soil characterization samples (546B01 through 546B05 [including one FD]) were collected from four locations (546B01 through 546B04) during investigation activities at CAS 09-20-01. The samples near the injection well were collected to determine whether contaminants were released during disposal operations. Samples were collected from 0.0 to 0.5 ft bgs using a scoop and tin.

Decision I surface samples were collected from soil surrounding the injection well and beneath the drum. No Decision II sampling was necessary as all analytical results were below FALs.

2.1.2.5 Conceptual Site Model Validation

A CSM was developed to represent the release mechanisms and potential migration pathways for contaminant releases at CAU 546 CASs. The CSM and associated discussion for this CAS are provided in the CAIP (NNSA/NSO, 2008).

The migration pathway and release mechanism information gathered during the CAI were consistent with the CSM, and all information gathered during the CAI supports and validates the CSM as presented in the CAIP.

2.2 Results

The data summary provided in Section 2.2.1 defines the COPCs that exceeded the FALs (i.e., COCs) within the CAU 546 CASs and the extent of any identified COCs. Section 2.2.2 summarizes the assessment made in Appendix B, which demonstrates that the investigation results satisfy the DQO data requirements.

2.2.1 Summary of Analytical Data

Chemical and radiological results for environmental samples collected at each of the CASs are summarized in Sections 2.2.1.1 and 2.2.1.2. Environmental samples are evaluated against FALs to determine the presence of COCs and the extent of COC contamination, if present.

The preliminary action levels (PALs) for the CAU 546 investigation were determined during the DQO process and are discussed in Section 3.3 of the CAIP (NNSA/NSO, 2008). The FALs used for determining the presence of COCs and for evaluating the need for additional corrective action are defined in Section 2.3. Details about the methods used during this investigation and a comparison of environmental sample results to the FALs are presented in Appendix A.

2.2.1.1 U-6a/Russet Testing Area (CAS 06-23-02)

The maximum concentration of each detected contaminant at this CAS is listed in Table 2-1. All concentrations of each detected contaminant were compared to and were less than the FALs. With the exception of total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), all concentrations of the reported parameters were compared to and were also less than the PALs.

One subsurface sample collected below a bucket containing a grease-like substance exceeded the PAL of 100 milligrams per kilogram (mg/kg) for TPH-DRO. The reported concentration was 790 mg/kg for sample 546A045 at location A30. The TPH-DRO was moved on to a Tier 2 evaluation. The Tier 2 evaluation of TPH-DRO consisted of evaluating the hazardous constituents of

Table 2-1
Maximum Concentrations of Detected Contaminants for CAS 06-23-02, U-6a/Russet Testing Area

Contaminant	Maximum Result	Sample Number	Depth (ft bgs)	Location	FAL	Units
2,4-Dinitrotoluene	1.4	546A045	5.0 - 6.0	A30	1,200	mg/kg
4,4'-DDT	0.0012 (J)	546A060	4.0 - 5.0	A34	7	mg/kg
Actinium-228	2.65	546A040	0.0 - 3.0	A29	5	pCi/g
Acetone	0.0085 (J)	546A058	7.5 - 8.0	A33	54,000	mg/kg
Americium-241	0.96	546A060	4.0 - 5.0	A34	12.7	pCi/g
Arsenic	10	546A008	0.4 - 0.5	A02	23	mg/kg
Barium	270	546A014	0.0 - 0.5	A14	67,000	mg/kg
Cadmium	1.3	546A045	5.0 - 6.0	A30	450	mg/kg
Chromium	13	546A019	0.0 - 0.5	A20	450	mg/kg
Cesium-137	0.26	546A037	0.0 - 0.5	A27	12.2	pCi/g
TPH-DRO	790	546A045	5.0 - 6.0	A30	N/A[a]	mg/kg
Lead	21 (J)	546A008	0.4 - 0.5	A02	800	mg/kg
Mercury	0.052	546A019	0.0 - 0.5	A20	310	mg/kg
Lead-212	2.64 (J+)	546A033	6.0 - 12.0	A24	5	pCi/g
Lead-214	1.74 (J)	546A028	0.0 - 6.0	A23	5	pCi/g
Plutonium-239/240	0.58	546A030	12.0 - 16.0	A23	12.7	pCi/g
Selenium	0.78 (J+)	546A016	0.0 - 0.5	A17	5,100	mg/kg
Silver	0.15	546A059	0.0 - 2.0	A34	5,100	mg/kg
Strontium-90	0.29	546A020	0.0 - 3.0	A21	838	pCi/g
Thorium-234	3.71 (J+)	546A006	0.0 - 0.5	A07	105	pCi/g
Thallium-208	0.79	546A029	6.0 - 12.0	A23	5	pCi/g
Uranium-234	1.65	546A029	6.0 - 12.0	A23	143	pCi/g
Uranium-235	0.097	546A029	6.0 - 12.0	A23	17.6	pCi/g
Uranium-238	1.61	546A013	0.0 - 0.5	A13	105	pCi/g

[a]The FALs for TPH-DRO are the individual hazardous constituents of TPH-DRO.

bgs = Below ground surface
DRO = Diesel-range organics
FAL = Final action level
ft = Foot
mg/kg = Milligrams per kilogram
N/A = Not applicable
pCi/g = Picocuries per gram
TPH = Total petroleum hydrocarbons

J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.

TPH based on their respective PALs. The Tier 2 evaluation is presented in Appendix C. Because the concentrations of the hazardous constituents of TPH-DRO as reported in the volatile organic compound (VOC) and semivolatile organic compound (SVOC) results did not exceed their respective PALs, TPH-DRO is not considered a COC.

2.2.1.2 Injection Well (CAS 09-20-01)

The maximum concentration of each detected COPC at this CAS is listed in Table 2-2.
All concentrations of each detected COPC was compared to the FALs. The radionuclide plutonium (Pu)-239 was the only COPC detected at a concentration of 32.2 picocuries per gram (pCi/g) that exceeded the PAL of 12.7 pCi/g in surface soil sample 546B002 at sample location B02. The radionuclide Pu-239 was moved on to a Tier 2 evaluation in which the Residual Radioactive (RESRAD) code was used to determine the site-specific FAL for this radionuclide. The FAL for Pu-239 was not exceeded and, therefore, is not considered a COC at this CAS. The calculation of the FAL for Pu-239 is presented in Appendix C. Although COCs were not identified in the surface soil during the CAI, it was discussed in the CAIP (NNSA/NSO, 2008) that COCs are assumed to be present in the subsurface soil (see Section A.4.3).

2.2.2 Data Assessment Summary

The DQA is presented in Appendix B 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 will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA process as presented in Appendix B 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

Table 2-2
Maximum Concentrations of Detected Contaminants
for CAS 09-20-01, Injection Well

Contaminant	Maximum Result	Sample Number	Depth (ft bgs)	Location	FAL	Units
Actinium-228	1.99	546B004	0.0 - 0.5	B03	5	pCi/g
Arsenic	3.9	546B001	0.0 - 0.5	B01	23	mg/kg
Barium	150	546B002	0.0 - 0.5	B02	67,000	mg/kg
Cadmium	0.23	546B005	0.0 - 0.5	B04	450	mg/kg
Chromium	8.8	546B002	0.0 - 0.5	B02	450	mg/kg
Cesium-137	1.12 (J)	546B003	0.0 - 0.5	B02	12.2	pCi/g
Europium-152	1.28 (J+)	546B003	0.0 - 0.5	B02	5.67	pCi/g
Lead	13	546B002	0.0 - 0.5	B02	800	mg/kg
Mercury	0.064	546B004	0.0 - 0.5	B03	310	mg/kg
Lead-212	2.12 (J+)	546B005	0.0 - 0.5	B04	5	pCi/g
Lead-214	1.36 (J)	546B005	0.0 - 0.5	B04	5	pCi/g
Plutonium-238	0.49	546B002	0.0 - 0.5	B02	13	pCi/g
Plutonium-239/240	32.2 (J)	546B002	0.0 - 0.5	B02	1,890	pCi/g
Selenium	0.48 (J-)	546B003	0.0 - 0.5	B02	5,100	mg/kg
Thorium-234	2.56 (J+)	546B004	0.0 - 0.5	B03	105	pCi/g
Thallium-208	0.65	546B005	0.0 - 0.5	B04	5	pCi/g
Uranium-234	1.62	546B003	0.0 - 0.5	B02	143	pCi/g
Uranium-235	0.073	546B001	0.0 - 0.5	B01	17.6	pCi/g
Uranium-238	1.11	546B005	0.0 - 0.5	B04	105	pCi/g

bgs = Below ground surface
FAL = Final action level
ft = Foot
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram

J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.
J- = The result is an estimated quantity, but the result may be biased low.

Sample locations that support the presence and/or extent of contamination at each CAS are shown in Appendix A. Based on the results of the DQA presented in Appendix B, the DQO requirements have been met. The DQA also determined that information generated during the investigation

support the revised CSM assumptions and the data collected support their intended use in the decision-making process.

2.3 Justification for No Further Action

No further corrective action is justified based on an evaluation of risk to ensure protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2006a), feasibility, and cost effectiveness. The decision for no further corrective action was based on a corrective action of clean closure at CAS 06-23-02 and a corrective action of close in place at CAS 09-20-01. This 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 2.3.3.

2.3.1 CAS 06-23-02, U-6a/Russet Testing Area

No COCs were identified in environmental samples at CAS 06-23-02. However, as PSM was present in the form of a lead brick, lead battery, and lead slag, the debris and the soil that were in contact with the debris were removed under a corrective action of clean closure. As a best management practice (BMP), the vent line and pipe assemblies throughout CAS 06-23-02 were cut to below grade and grouted.

2.3.2 CAS 09-20-01, Injection Well

Although no COPCs were detected in surface soil at concentrations exceeding FALs, COCs were presumed to be present in the subsurface soil. Therefore, the corrective action of close in place was selected as the preferred alternative. The extent of the contamination is discussed in Section A.4.3. Closure activities include posting UR signage around the injection well and grouting the subsided area beneath the injection well.

Based on the corrective actions taken, there is no complete pathway to human receptors because all COCs are in subsurface soil and a UR is in place to prevent inadvertent contact with contaminants. Therefore, no further corrective action (based on risk to human receptors) is necessary for CAS 09-20-01.

2.3.3 Final Action Levels

The CAU 546 FALs are risk-based cleanup goals that, if met, will ensure that each release site will not pose an unacceptable risk to human health and the environment and that conditions at each site are in compliance with all applicable laws and regulations. The risk-based corrective action (RBCA) process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process conforms with NAC Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2006b). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2006c) requires the use of American Society for Testing and Materials (ASTM) Method E 1739-95 (ASTM, 1995) 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."

This RBCA process defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- 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 [NNSA/NSO, 2008]). 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 site-specific target levels (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. The TPH concentrations will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of potential concern will be compared to the SSTLs.

- Tier 3 evaluation – Conducted by calculating Tier 3 SSTLs on the basis of more sophisticated risk analyses using methodologies described in Method E 1739-95 that consider site-, pathway-, and receptor-specific parameters.

A Tier 1 evaluation was conducted for all COPCs to determine whether contaminant levels satisfy the criteria for a quick regulatory closure or warrant a more site-specific assessment. This was accomplished by comparing individual source area contaminant concentration results to the Tier 1 action levels (the PALs established in the CAIP [NNSA/NSO, 2008]).

The constituents detected at the CAU 546 CASs that exceeded Tier 1 action levels were:

- TPH at CAS 06-23-02.
- Pu-239 at CAS 09-20-01.

The concentrations of all constituents at these CASs not listed above were below Tier 1 action levels and the corresponding FALs were established as the Tier 1 action levels (i.e., PALs). The constituents at CASs that exceeded Tier 1 action levels were moved to a Tier 2 evaluation.

The evaluation of TPH-DRO at CAS 06-23-02 was moved on to a Tier 2 evaluation. The Tier 2 evaluation of TPH-DRO consisted of evaluating the individual hazardous constituents of TPH based on their respective Tier 2 SSTLs. The Tier 2 SSTLs for the hazardous constituents of TPH-DRO were established as the PALs. None of the individual hazardous constituents of TPH-DRO exceeded the Tier 2 SSTLs. Therefore, corresponding FALs were established at the PAL concentrations, and neither TPH-DRO nor the individual hazardous constituents of TPH-DRO are considered COCs. Additional details of the Tier 2 evaluations for TPH-DRO are provided in Appendix C.

The evaluation for Pu-239/240 at CAS 09-20-01 compared the analytical result for this radionuclide to the Tier 2 action level. The Tier 2 action level was calculated using site-specific information on the detected radionuclide and other site-specific physical characteristics using the RESRAD code (version 6.3). This calculation determined the concentration of Pu-239/240 needed to sum to an exposed dose of 25 millirem per year to a site receptor (based on the relative abundance). These concentrations were then established as the FAL for Pu-239/240. Additional details of the Tier 2 evaluation for Pu-239/240 at CAS 09-20-01 are provided in Appendix C.

The FALs for all CAU 546 COPCs are shown in Table 2-3.

Table 2-3
Definition of Final Action Levels for CAU 546 Contaminants of Potential Concern

COPCs	Tier 1-Based FALs	Tier 2-Based FALs	Tier 3-Based FALs
VOCs	CASs 06-23-02 and 09-20-01	N/A	N/A
SVOCs	CASs 06-23-02 and 09-20-01	N/A	N/A
PCBs	CASs 06-23-02 and 09-20-01	N/A	N/A
Pesticides	CASs 06-23-02 and 09-20-01	N/A	N/A
RCRA metals	CASs 06-23-02 and 09-20-01	N/A	N/A
TPH-DRO	CAS 09-20-01	Region 9 PRGs[a] for TPH-DRO constituents at CAS 06-23-02	N/A
Gamma Spectroscopy	CASs 06-23-02 and 09-20-01	N/A	N/A
Radionuclides	CASs 06-23-02 and 09-20-01 (with the exception of Pu-239/240 at CAS 09-20-01)	RESRAD[b]-derived values for Pu-239 at CAS 09-20-01	N/A

[a]Based on U.S Environmental Protection Agency *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).
[b]Residual Radioactive Material Code (RESRAD), version 6.4 (Yu et al., 2001), see Tables 2-1 through 2-3 for individual FALs.

COPC = Contaminant of potential concern
DRO = Diesel-range organics
FAL = Final action level
N/A = Not applicable
PCB = Polychlorinated biphenyl
Pu = Plutonium
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

3.0 Recommendation

No further corrective action is required at CAU 546 based on the implementation of the following actions:

- Close CAS 06-23-02, U-6a/Russet Testing Area, under the corrective action alternative of clean closure, as no COCs were identified and PSM was removed.
- Close CAS 09-20-01, Injection Well, under the corrective action alternative of close in place because of the assumed subsurface COCs in the soil. The UR form and map are filed in the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Facility Information Management System, the FFACO database, and the NNSA/NSO CAU/CAS files.

Selection of these corrective actions are consistent with past practices for CASs that do not contain COCs and for CASs that do contain COCs where corrective actions have been implemented to remove control access to COCs. These corrective actions were evaluated based on technical merits focusing on performance, reliability, feasibility, and safety.

The NNSA/NSO requests that NDEP issue a Notice of Completion for CAU 546 and approval to move CAU 546 from Appendix III to Appendix IV of the FFACO.

4.0 References

ASTM, see American Society for Testing and Materials.

American Society for Testing and Materials. 1995. *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E 1739-95 (Reapproved 2002). Philadelphia, PA.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2007a. Title 40 CFR Parts 260 - 282, "Hazardous Waste Management." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2007b. Title 40 CFR Part 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce and Prohibitions." Washington, DC: U.S. Government Printing Office.

EPA, see U.S. Environmental Protection Agency.

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

Federal Facility Agreement and Consent Order. 1996 (as amended February 2008). Agreed to by the State of Nevada; U.S. Department of Energy, Environmental Management; U.S. Department of Defense; and U.S. Department of Energy, Legacy Management.

NAC, see *Nevada Administrative Code*.

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

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

Nevada Administrative Code. 2006a. NAC 445A, "Water Controls." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 22 September 2008.

Nevada Administrative Code. 2006b. NAC 445A.227, "Contamination of Soil: Order by Director for Corrective Action; Factors To Be Considered in Determining Whether Corrective Action Required." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 22 September 2008.

Nevada Administrative Code. 2006c. NAC 445A.22705, "Contamination of Soil: Evaluation of Site by Owner or Operator; Review of Evaluation by Division." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 22 September 2008.

SNJV, see Stoller-Navarro Joint Venture.

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

Stoller-Navarro Joint Venture Geographic Information Systems. 2008. ESRI ArcGIS Software.

Stoller-Navarro Joint Venture. 2007. *Radiological Land Area Survey: CAU 546, Injection Well, at the Nevada Test Site.* October. Las Vegas, NV.

Stoller-Navarro Joint Venture. 2008. *Radiological Land Area Survey: CAU 546, Injection Well and Surface Releases CAS 06-23-02, U-6a Russet Testing Area at the Nevada Test Site.* 19 February. Las Vegas, NV.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2006. *Industrial Sites Project Establishment of Final Action Levels*, Rev. 0, DOE/NV--1107. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2008. *Corrective Action Investigation Plan for Corrective Action Unit 546: Injection Well and Surface Releases, Nevada Test Site, Nevada*, Rev. 0, DOE/NV--1260. Las Vegas, NV.

U.S. Environmental Protection Agency. 2004. *Region 9 Preliminary Remediation Goals (PRGs)*. As accessed at http://www.epa.gov/region09/waste/sfund/prg/index.htm on 22 September 2008. Prepared by S.J. Smucker. San Francisco, CA.

U.S. Environmental Protection Agency. 2006. *EPA Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4. Washington, DC.

Weston, see Weston Solutions, Inc.

Weston Solutions, Inc. 2007. *After Action Report: Technical Services for Preliminary Assessment Geophysical Investigations, Nevada Test Site Corrective Action Sites, Nye County, Nevada.* September. Prepared for Stoller-Navarro Joint Venture. West Chester, PA.

Yu, C., A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4, Argonne National Laboratory, Environmental Assessment Division, Argonne, IL.

Appendix A

Corrective Action Investigation Results

A.1.0 Introduction

This appendix presents the CAI activities and analytical results for CAU 546. Corrective Action Unit 546 is located in Areas 6 and 9 of the NTS (Figure 1-1) and is comprised of the two CASs listed below:

- 06-23-02, U-6a/Russet Testing Area
- 09-20-01, Injection Well

Corrective Action Site 06-23-02 is located in Area 6 of the NTS and consists of potential releases associated with two muckpiles, a discharge pit, soil pile, vent line, subsurface anomaly, and the overall testing area. The components and testing area were a result of the Russet nuclear test conducted in 1968.

Corrective Action Site 09-20-01 is located in Area 9 of the NTS, within the U-9u crater, and consists of an injection well and drum. The injection well received decontamination waste and classified core. The origin of the drum is unknown.

Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the CAIP (NNSA/NSO, 2008).

A.1.1 Project Objectives

The primary objective of the investigation was to provide sufficient information to document completion of appropriate corrective actions and to support a recommendation for closure of the CAU 546 CASs. This objective was achieved by identifying the absence or presence of COCs and the vertical and lateral extent of the COCs, if present.

The selection of soil and/or waste characterization sample locations was based on site conditions, and the strategy developed during the DQO process as outlined in the CAIP (NNSA/NSO, 2008). The sampling strategy implemented a judgmental sampling approach at both CASs.

A.1.2 Content

This appendix describes the investigation and presents the results. The contents of this appendix are as follows:

- Section A.1.0 describes the investigation background, objectives, and content.
- Section A.2.0 provides an investigation overview.
- Sections A.3.0 and A.4.0 provide CAS-specific information regarding the field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section A.5.0 summarizes waste management activities.
- Section A.6.0 discusses the QA and QC processes followed and the results of QA/QC activities.
- Section A.7.0 provides a summary of the investigation results.
- Section A.8.0 lists the cited references.

The complete field documentation and laboratory data, including field activity daily logs, sample collection logs (SCLs), analysis request/chain-of-custody forms, soil sample descriptions, laboratory certificates of analyses, analytical results, and surveillance results are retained in project files as hard copies or electronic media.

A.2.0 Investigation Overview

Field investigation and sampling activities for the CAU 546 CAI were conducted from May 5 through May 28, 2008, with the vent line being opened and surveyed on July 28, 2008. Table A.2-1 lists the CAI activities that were conducted at each of the CASs.

Table A.2-1
Corrective Action Investigation Activities Conducted at Each Corrective Action Site To Meet CAIP Requirements for CAU 546

Corrective Action Investigation Activities	Corrective Action Site	
	06-23-02	09-20-01
Inspected and verified the CAS components identified in the CAIP.	X	X
Performed site walkovers to identified biased sampling locations.	X	X
Conducted scanning radiological walkover surveys (i.e., soil, debris) using a handheld detector and a GPS receiver with a TSCITM data logger.	X	X
Performed swipe sampling for removable radioactivity using a handheld survey instrument and/or a gamma scintillator (Building 23-153, Mercury, NV).	X	X
Conducted geophysical surveys.	X	--
Collected biased soil samples.	X	X
Field screened samples for alpha and beta/gamma radiation using a hand-held survey instrument.	X	X
Analyzed samples for gamma radiation using a high-purity germanium gamma spectrometer (Building 23-153, Mercury, NV).	X	X
Collected solid waste characterization samples to support disposal recommendations and determine whether the waste could be a potential source of contamination for the environment (i.e., soil).	X	--
Conducted video surveys using a video-mole survey instrument to identify pipe contents or breaches in the associated piping.	X	--
Submitted select samples for offsite laboratory analysis.	X	X
Collected GPS coordinates for sample locations and points of interest.	X	X

CAIP = Corrective Action Investigation Plan
GPS = Global Positioning System
-- = Not applicable

The investigation and sampling program was managed in accordance with the requirements set forth in the CAIP (NNSA/NSO, 2008). Samples were collected and documented following the CAIP. Quality control samples (e.g., field blanks, equipment rinsate blanks, trip blanks, and duplicate samples) were collected as required by the Industrial Sites QAPP (NNSA/NV, 2002a) and the CAIP. During field activities, waste minimization practices were followed according to approved procedures, including segregation of waste by waste type.

Weather conditions at the site varied to include sun (moderate temperatures), intermittent cloudiness, and light to strong winds. Strong wind gusts intermittently delayed site operations due to the potential for debris and potentially contaminated soil particles to become airborne.

The CASs were investigated by conducting radiological surface screening and surveys, sampling potential contaminant sources, and sampling surface and subsurface soils. Surface soil samples were collected by hand excavation. Subsurface soil samples were collected using an excavator and a backhoe. The soil samples were field screened at specific locations for alpha and beta/gamma radiation and gamma-emitting radionuclides. The results were compared against screening levels to guide in the CAS-specific investigations. Samples of various media (e.g., grease, solids) were collected to support both environmental and waste characterization using disposable sampling equipment.

Except as noted in the following CAS-specific sections, CAU 546 Decision I sampling locations were accessible and sampling activities at planned locations were not restricted. Decision II step-out samples were not required.

Sections A.2.1 through A.2.4 provide the investigation methodology and laboratory analytical information.

A.2.1 Sample Locations

Investigation locations selected for sampling were based on interpretation of aerial and land photographs, interviews with former and current site employees, information obtained during site visits, and site conditions as provided in the CAU 546 CAIP (NNSA/NSO, 2008). Sampling points for each site were selected based on the approach provided in the CAIP. The planned biased sample

locations are discussed in text and represented on figures in the CAIP. Actual environmental sample locations are shown in the figures included in Sections A.3.0 through A.6.0. Some locations were slightly modified from planned positions due to field conditions and observations. Sample locations were staked where appropriate and labeled. The sample locations were surveyed with a GPS instrument. A Trimble Pathfinder ProXRSTM GPS instrument was used for determining the sample location coordinates as well as CAS points of interest. Appendix E presents these data in a tabular format.

A.2.2 Investigation Activities

The investigation activities as listed in Table A.2-1 performed at CAU 546 confirmed with all field investigation requirements stipulated in the CAIP (NNSA/NSO, 2008). The investigation strategy allowed the nature and extent of contamination associated with each CAS to be established. The following sections describe the specific investigation activities that took place at CAU 546.

A.2.2.1 Radiological Surveys

Radiological surveys (i.e., scanning, static, and swipe collection) were performed at all the CASs during the CAI. Radiological surveys were performed to identify the presence, the nature, and the extent of radiological contaminants at activities statistically distinguishable from background activities (more than two times background levels). The radiological surveys were conducted using a handheld plastic scintillation detector in conjunction with a global positioning receiver and datalogger.

A.2.2.2 Field Screening

Field-screening activities for radionuclides were performed as specified in the CAIP (NNSA/NSO, 2008). Site-specific FSLs for alpha and beta/gamma radiation were defined as the mean background activity level plus two times the standard deviation of readings from ten background locations selected near each CAS. The radiation FSLs are instrument-specific and were established for each instrument and CAS before use. The FSLs for gamma-emitting radionuclides were compared to the PALs established in the CAU 546 CAIP.

The CAS-specific sections of this document identify the CASs where field screening was conducted and how the FSLs were used to aid in selecting the samples submitted for laboratory analyses. Field-screening results are recorded on SCLs that are retained in project files.

A.2.2.3 Surface and Subsurface Soil Sampling

Soil samples were collected using "scoop and trowel" (surface hand-grab sampling) and heavy equipment (i.e., excavator and backhoe). All sample locations were initially field screened for alpha and beta/gamma radiation before the start of sampling. Additional screening was conducted during sample collection to both guide the investigation and serve as a health and safety control to protect the sampling team. Labeled VOC sample containers were filled with soil directly from the sample location. Additional soil was transferred into a stainless-steel tin, homogenized, and field screened for alpha and beta/gamma radiation. All remaining sample containers were then filled, excess soil was returned to its original location, and the sample containers appropriately disposed of (based on field-screening and/or analytical results).

A.2.2.4 Waste Characterization Sampling

Characterization of CAS-specific components, objects, materials, and waste was performed to support disposal of these potential remediation wastes and to determine whether the waste in question at these CASs could be PSM. Investigation methods included visual inspection, radiological surveys, and direct sampling of the contents of the PSM.

Samples were analyzed in accordance with the CAIP (NNSA/NSO, 2008). The specific analyses for each CAS are listed in CAS-specific sections, and the analytical results are compared to the federal limits for hazardous waste, NDEP hydrocarbon action limit, landfill acceptance criteria, and the limits in the NTS performance objective criteria (POC) (BN, 1995). The POC limits have been established for NTS hazardous waste generators to ensure that all hazardous waste being shipped offsite does not contain "added radioactivity."

Specific waste characterization sampling and analysis was conducted on the following potential waste streams:

- Swipe samples collected from the vent line, debris (e.g., lead brick, lead battery, lead slag, bucket), and piping at CAS 06-23-02 and the drum at CAS 09-20-01.
- The presumed asbestos-containing material (PACM) found in the southern muckpile and testing area was not collected for sampling but rather, placed in a 55-gallon drum for disposal as asbestos-containing material.
- A solid, yellow material that was identified in three locations in the testing area was sampled.
- A sample of solid material suspected to be grease was collected from a bucket found within the southern muckpile.

A.2.3 Laboratory Analytical Information

Chemical and radiological analyses were performed by Paragon Analytics, Inc., of Fort Collins, Colorado. The analytical suites and laboratory analytical methods used to analyze investigation samples are listed in Table A.2-2. Analytical results are reported in this appendix if they were detected above the minimum detectable concentrations (MDCs). The complete laboratory data packages are available in the project files. Validated analytical data for CAU 546 investigation samples have been compiled and evaluated to confirm the presence of contamination and define the extent of contamination, if present. The analytical results for each CAS are presented in Sections A.3.0 through A.6.0.

The analytical parameters are CAS-specific and were selected through the application of site process knowledge as described in the CAIP DQOs (NNSA/NSO, 2008).

A.2.4 Comparison to Action Levels

A COC is defined as any contaminant present in environmental media exceeding a FAL. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2006).

Table A.2-2
Laboratory Analytical Parameters and Methods, CAU 546 Investigation Samples[a]

Analytical Parameter	Analytical Method[b]
Volatile Organic Compounds	EPA SW-846 8260[c]
Semivolatile Organic Compounds	EPA SW-846 8270[c]
RCRA Metals[d]	EPA SW-846 7470/7471[c]
Total Petroleum Hydrocarbons-Diesel-Range Organics	EPA SW-846 8015M[c]
Polychlorinated Biphenyls	EPA SW-846 8082[c]
Pesticides	EPA SW-846 8081[c]
TCLP Volatile Organic Compounds	EPA SW-846 1311/8260[c]
TCLP Semivolatile Organic Compounds	EPA SW-846 1311/8270[c]
TCLP Metals[d]	EPA SW-846 1311/6010/7470[c]
TCLP Pesticides	EPA SW-846 1311/8081[c]
Gamma Spectroscopy	DOE EML HASL 300[e] Approved Laboratory SOPs[f]
Isotopic Uranium	DOE EML HASL-300[e] U-02-RC Modified, Approved Laboratory SOPs[f]
Isotopic Plutonium	DOE EML HASL-300[e] PU-02-RC/PU-10-RC Modified, Approved Laboratory SOPs[f]
Strontium-90	DOE EML HASL-300, Sr-02-RC Modified, Approved Laboratory SOPs[f]
Gross Alpha/Beta	EPA 900.0[g] Modified, Approved Laboratory SOPs[f]
Tritium	EPA 906.0[g] Modified, Approved Laboratory SOPs[f]

[a]Investigation samples include both environmental and waste characterization samples and associated quality control samples.
[b]The most current EPA, DOE, ASTM, or NIOSH or equivalent accepted analytical method may be used.
[c] Test Method for Evaluating Solid Waste Physical/Chemical Methods, SW-846, 3rd Edition (EPA, 1996).
[d]Arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver.
[e]*The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300 (DOE, 1997).
[f]Laboratory Standard Operating Procedures approved by SNJV in accordance with industry standards and the SNJV analytical laboratory subcontract requirements.
[g]*Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EMSL/ORD, 1980).

Note: The term "modified" indicates modifications of approved methods. All modifications have been approved by the SNJV Analytical Services Department.

ASTM = American Society for Testing and Materials
DOE = U.S. Department of Energy
EML = Environmental Measurements Laboratory
EPA = U.S. Environmental Protection Agency
HASL = Health and Safety Laboratory
NIOSH = National Institute for Occupational Safety and Health
RCRA = *Resource Conservation and Recovery Act*
SNJV = Stoller-Navarro Joint Venture
SOP = Standard Operating Procedure
TCLP = Toxicity Characteristic Leaching Procedure

If COCs are present, corrective action must be considered for the CAS. The CAU 546 investigation FALs are defined for each CAS in Section 2.3.3. Results that are equal to or greater than FALs are identified by bold text in the CAS-specific results tables (Sections A.3.0 through A.6.0).

The evaluation of the need for corrective action includes the potential for wastes that are present at a site to release contamination in the future into environmental media. The vent line was initially considered to contain PSM; however, once the line was opened, it was determined that there was no PSM associated with the vent line. A lead brick, lead battery, and lead slag were identified as PSM. The debris was removed and recycled while the soil was removed from beneath the debris and placed in a drum as generated corrective action waste.

A.3.0 Corrective Action Site 06-23-02, U-6a/Russet Testing Area

Corrective Action Site 06-23-02 is the Russet Testing Area located north of the intersection of Tippipah and Mercury Highways in Area 6 of the NTS (Figure 1-2). The Russet test was conducted in 1968 within an extensive network of subsurface tunnel and drifts. As a result of the test and activities in the testing area, several components were identified for investigation in the CAIP including two muckpiles, a discharge pit, a vent line, a soil pile, a subsurface anomaly, and the overall testing area (NNSA/NSO, 2008). Additional detail is provided in the CAIP.

A.3.1 Corrective Action Investigation

A total of 65 characterization samples (including 3 FDs), 4 PSM samples, and 9 radiological swipes were collected during investigation activities at CAS 06-23-02. The sample identifications (IDs), locations, types, and analyses are listed in Table A.3-1. The sample locations are shown on Figure A.3-1. The specific CAI activities conducted to satisfy the CAIP requirements at this CAS (NNSA/NSO, 2008) are described in the following sections.

A.3.1.1 Field Screening

Investigation samples were field screened for alpha and beta/gamma radiation, and gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. No FSLs were exceeded in the samples from this CAS.

A.3.1.2 Radiological Surveys

A radiological walkover survey was conducted throughout the testing area and on the components (SNJV, 2008). No radiological readings were distinguishable from background readings. However, two samples (546A036 and 546A037) in the testing area and two samples (546A038 and 546A039) east of the vent line were collected to verify the radiological status of the areas with the highest readings (Figure A.3-1). Additionally, swipes were collected from inside the vent line and surveyed, but no elevated radiological readings were recorded.

Table A.3-1
Samples Collected at CAS 06-23-02, U-6a/Russet Testing Area
(Page 1 of 7)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Diesel-Range Organics	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium-90	SVOCs	TCLP Metals	TCLP Pesticides	TCLP SVOCs	TCLP VOCs	Tritium	Isotopic Uranium	VOCs
Testing Area																				
A01	546A001	0.1 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
	546A501	0.0 - 0.1	Solid	Potential Source Material	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A02	546A008	0.4 - 0.5	Soil	Environmental	X	--	--	X	X	X	--	--	X	--	--	--	--	--	--	X
A03	546A009	0.4 - 0.5	Soil	Environmental	X	--	--	X	X	X	--	--	X	--	--	--	--	--	--	X
A14	546A014	0.0 - 0.5	Soil	Environmental	X	--	--	X	X	X	--	--	X	--	--	--	--	--	--	X
A15	546A502	0.0 - 0.1	Solid	Potential Source Material	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A16	546A503	0.0 - 0.1	Solid	Potential Source Material	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A27	546A037	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A28	546A036	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
Vent Line																				
A04	546A002	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A05	546A003	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--

Table A.3-1
Samples Collected at CAS 06-23-02, U-6a/Russet Testing Area
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Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Diesel-Range Organics	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium-90	SVOCs	TCLP Metals	TCLP Pesticides	TCLP SVOCs	TCLP VOCs	Tritium	Isotopic Uranium	VOCs
A25	546A039	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A26	546A038	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
Southern Muckpile																				
A06	546A007	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A07	546A006	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A08	546A005	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A09	546A004	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A29	546A040	0.0 - 3.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A041	0.0 - 3.0	Soil	Field Duplicate of #546A040	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A042	3.0 - 6.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A043	6.0 - 9.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A044	10.0 - 10.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--

Table A.3-1
Samples Collected at CAS 06-23-02, U-6a/Russet Testing Area
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Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Diesel-Range Organics	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium-90	SVOCs	TCLP Metals	TCLP Pesticides	TCLP SVOCs	TCLP VOCs	Tritium	Isotopic Uranium	VOCs
A30	546A045	5.0 - 6.0	Soil	Environmental	X	--	--	X	X	X			X	--	--	--	--	--	--	X
	546A046	0.0 - 5.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A047	5.0 - 10.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A048	10.0 - 14.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A049	14.0 - 14.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A504	N/A	Solid	Potential Source Material	X	X	--	X	X	X	X	X	X	X	X	X	X	--	X	X
A31	546A050	0.0 - 4.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A051	4.0 - 8.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A052	8.0 - 12.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A053	12.0 - 12.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A32	546A054	0.0 - 3.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A055	3.0 - 6.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A056	6.0 - 9.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A057	10.0 - 10.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--

Table A.3-1
Samples Collected at CAS 06-23-02, U-6a/Russet Testing Area
(Page 4 of 7)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Diesel-Range Organics	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium-90	SVOCs	TCLP Metals	TCLP Pesticides	TCLP SVOCs	TCLP VOCs	Tritium	Isotopic Uranium	VOCs
Northern Muckpile																				
A10	546A010	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A11	546A011	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A12	546A012	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A13	546A013	0.0 - 0.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A21	546A020	0.0 - 3.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A021	3.0 - 6.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A022	6.0 - 9.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A023	12.0 - 12.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A22	546A024	0.0 - 4.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A025	4.0 - 8.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A026	8.0 - 12.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A027	12.0 - 12.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--

Table A.3-1
Samples Collected at CAS 06-23-02, U-6a/Russet Testing Area
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Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Diesel-Range Organics	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium-90	SVOCs	TCLP Metals	TCLP Pesticides	TCLP SVOCs	TCLP VOCs	Tritium	Isotopic Uranium	VOCs
A23	546A028	0.0 - 6.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A029	6.0 - 12.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A030	12.0 - 16.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A031	16.0 - 16.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
A24	546A032	0.0 - 6.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A033	6.0 - 12.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A034	12.0 - 16.0	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
	546A035	16.0 - 16.5	Soil	Environmental	--	X	--	--	--	--	X	X	--	--	--	--	--	--	X	--
Discharge Pit																				
A17	546A015	0.0 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
	546A016	0.0 - 0.5	Soil	Field Duplicate of #546A015	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A18	546A017	0.0 - 0.3	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A19	546A018	0.0 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A20	546A019	0.0 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X

Table A.3-1
Samples Collected at CAS 06-23-02, U-6a/Russet Testing Area
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Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Diesel-Range Organics	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium-90	SVOCs	TCLP Metals	TCLP Pesticides	TCLP SVOCs	TCLP VOCs	Tritium	Isotopic Uranium	VOCs
Subsurface Anomaly																				
A33	546A058	7.5 - 8.0	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
Soil Pile																				
A34	546A059	0.0 - 2.0	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
	546A060	4.0 - 5.0	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
	546A061	4.0 - 5.0	Soil	Field Duplicate of #546A060	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A35	546A062	0.0 - 2.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
	546A063	4.0 - 5.0	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
A36	546A064	0.0 - 2.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
	546A065	4.0 - 5.0	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	--	--	--	--	X	X
Water																				
N/A	546A301	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X
N/A	546A302	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X
N/A	546A303	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X

Table A.3-1
Samples Collected at CAS 06-23-02, U-6a/Russet Testing Area
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Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Diesel-Range Organics	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium-90	SVOCs	TCLP Metals	TCLP Pesticides	TCLP SVOCs	TCLP VOCs	Tritium	Isotopic Uranium	VOCs
N/A	546A304	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X
Sample Table	546A305	N/A	Water	Field Blank	X	X	X	X	X	X	X	X	X	--	--	--	--	X	X	X
Bldg. 153	546A306	N/A	Water	Source Material Quality Control	X	X	X	X	X	X	X	X	X	--	--	--	--	X	X	X
N/A	546A307	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X
N/A	546A308	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X
N/A	546A309	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X
Decon Pad	546A310	N/A	Water	Equipment Rinsate	X	X	X	X	X	X	X	X	X	--	--	--	--	X	X	X
N/A	546A311	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X

bgs = Below ground surface
decon = Decontamination
ft = Foot
N/A = Not applicable
PBC = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TCLP = Toxicity Characteristic Leaching Procedure
VOC = Volatile organic compound
-- = Not required

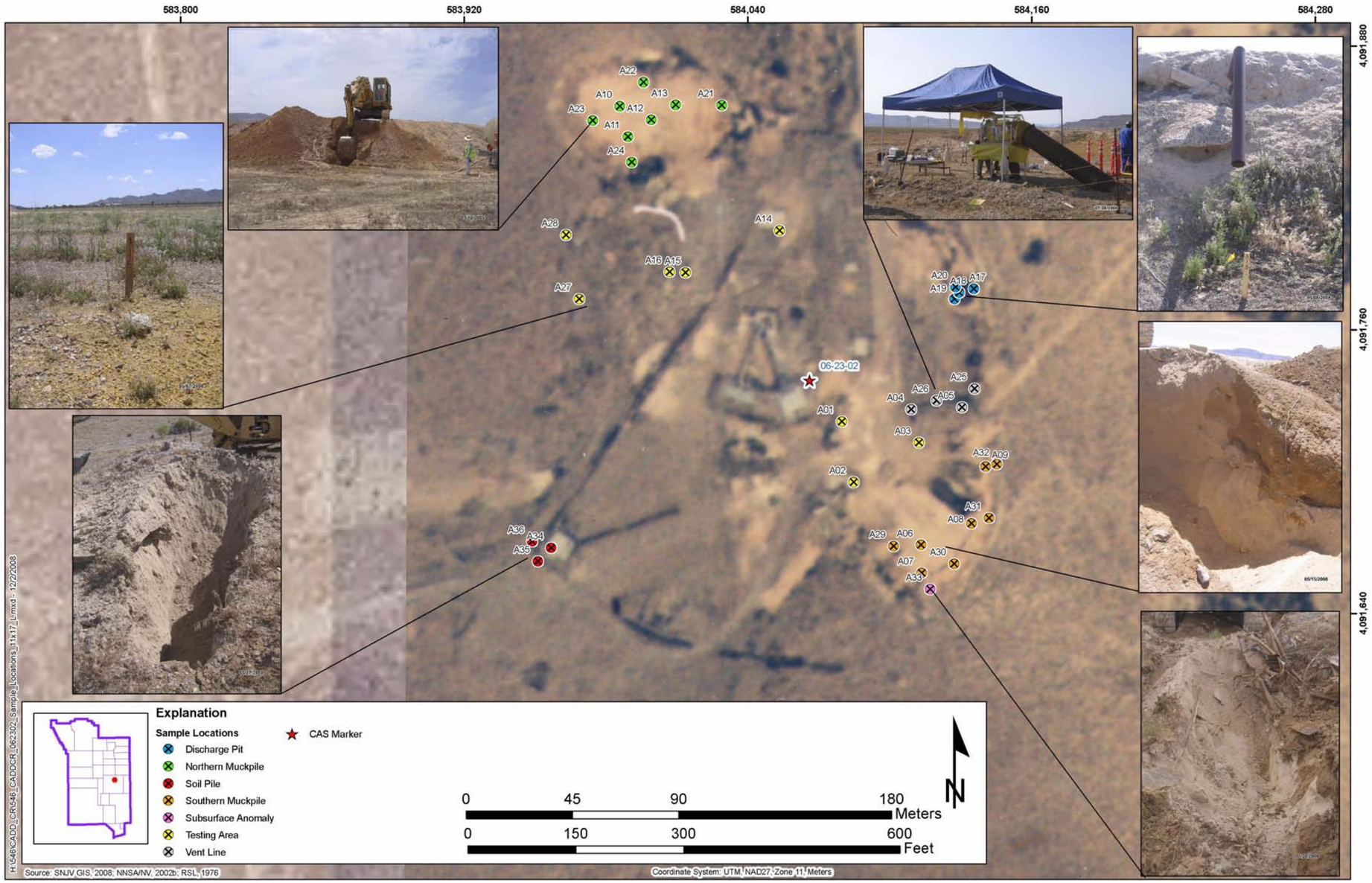

Figure A.3-1
Sample Locations at CAS 06-23-02, U-6a/Russet Testing Area

Results for the radiological swipe surveys completed on the vent line, debris (lead brick, lead battery, lead slag, bucket), and pipe assemblies that were collected at CAS 06-23-02 indicated no removable alpha and beta/gamma contamination.

A.3.1.3 Visual Inspections

A walkover survey was conducted of the testing area and components to identify additional biased sample locations. Within the testing area, debris consisting of a lead brick and battery were identified during the walkover; therefore, the soil beneath the debris became biased sample locations (A02 and A03, respectively). Lead slag was found on a concrete pad; the material was removed and drummed for disposal. There were three locations (A01, A15, A16) that consisted of hard, yellow material that had deteriorated into chip sized pieces as well as an area of stained soil (location A14) that was identified during the walkover survey. The yellow material was directly sampled (546A501, 546A502, 546A503) as a PSM sample while the stained soil was collected as an environmental sample (546A014). Other than the previously identified site components, there were no other biasing factors within the testing area that were identified for sampling.

The site components were also visually inspected to identify biased sample locations if present. At the two muckpiles, the four surface sample locations proposed in the CAIP were selected from naturally formed drainage areas on top of the two muckpiles because this is the most likely release pathway for potential contamination where COCs, if present, would likely have accumulated and migrated away from the piles. One additional biasing factor was identified in the southern muckpile once excavation began. A bucket containing a thick, grease-like substance was found and a sample (546A045) was collected of the soil beneath the bucket. No additional biasing factors were identified during the excavation of either of the muckpiles.

A biased sample location (A05) was selected east of the vent line, directly beneath the opening of a pipe assembly. This location was selected because the pipe assembly may have been associated with the vent line and could have been a source of a radiological release.

Because there were no visible surface features associated with the subsurface anomaly, a walkover survey was not applicable. However, once the subsurface anomaly was exposed and was determined to be various metal debris, a visual inspection was performed and a sample location was selected

beneath the anomaly (A33). Because the debris (metal scrap, t-posts, chain link fencing, I-beams, metal mesh, piping, etc.) was determined not to have the potential to release contamination into the environmental media, additional samples were not collected.

During the initial walkover survey of the discharge pit, it was noted that there was staining present. Upon further inspection, it was determined that the discoloration was due to approximately 0.5 to 1.0 inch (in). of dead vegetation that was present on a concrete pad/concrete spill within the pit. This in-depth visual inspection resulted in this planned sample location being eliminated from within the discharge pit. No other biasing factors were identified as a result of visual inspection.

A visual inspection of the soil pile during the walkover or excavation activities did not result in any additional sample locations. Sample locations identified during the visual inspection are shown on Figure A.3-1.

A.3.1.4 Video Surveys

A video survey was completed of the vent line and the piping that originates at a concrete pad and terminates in the discharge pit. The video survey of the vent line was conducted only to the extent possible to identify a plug, if present, and to determine whether residual material in the piping could be PSM. Forty-seven feet of the vent line was viewed; small amounts of sediment and rust were identified but radiological swipes of the pipe and the video equipment determined that this material was not radiologically impacted and, therefore, is not PSM. The vent line extends approximately 12 ft bgs before it turns to become parallel with the ground surface, and heads approximately 115 ft west toward the U-6a re-entry shaft. The U-6a re-entry shaft is plugged to the ground surface. Because of the large diameter of the vent line, the flexibility of the cable, and the ribbing of the pipe, it was not possible to push the video camera further than 47 ft into the pipe.

The pipe leading from the concrete pad to the discharge pit was video surveyed to identify the presence of breaches, unknown tie-ins, or residual material that could be PSM. The pipe that was exposed at the surface near the concrete pad was crimped due to heavy equipment crossing and prevented accessing the entire length of the pipe. Therefore, the pipe was surveyed from an opening near the discharge pit that was visible at the ground surface. No breaches or other tie-ins were identified. Coarse gravel and animal remains were identified within the discharge piping; however,

no sludge or liquid material were found. No additional biased sample locations were identified based on video survey results.

A.3.1.5 Sample Collection

Intrusive investigation activities (i.e., surface and subsurface soil sampling) were conducted to support investigation activities. Decision I environmental sampling activities included the collection of biased surface and subsurface soil samples from the testing area, vent line, northern muckpile, southern muckpile, subsurface anomaly, discharge pit, and the soil pile. There were no access issues for the surface sample locations. A backhoe/excavator was used to collect the subsurface samples.

Testing Area - Sampling activities within the testing area included the collection of six environmental samples from six locations (A01, A02, A03, A14, A27, A28). A solid, chunky, yellow material was present on the ground surface at sample location A01; the material and the environmental media beneath this material was collected as samples 546A001 and 546A501, respectively. Two additional samples of hard, yellow material were collected (546A502 and 546A503) from locations A15 and A16. A lead brick and lead battery were present on the ground surface at sample locations A02 and A03; approximately 3 in. of soil was collected from beneath this debris and placed in a drum. Verification samples 546A008 and 546A009 were collected at the next interval to determine whether there had been a release associated with the lead brick and/or lead battery. Discolored soil was identified adjacent to a concrete pad; sample 546A014 was collected at this sample location (A14). Sample locations A27 and A28 (samples 546A037 and 546A036, respectively) were selected based on slightly elevated readings identified from a radiological walkover survey. As specified in the CAIP (NNSA/NSO, 2008), the surface soil samples were collected from 0.0 to 0.5 ft bgs and the locations are shown on Figure A.3-1.

Vent Line - Four environmental samples were collected near the vent line. Sample 546A002 (location A04) was collected directly beneath the opening of the vent line while sample 546A003 was collected approximately 20 ft east of the vent line (location A05). Sample location A05 was selected based on the presence of a small diameter pipe that may have been associated with the vent line activities. Samples 546A038 and 546A039 (locations A26 and 25, respectively) were selected based on slightly elevated readings identified from a radiological walkover survey. All four samples were collected from 0.0 to 0.5 ft bgs.

Northern Muckpile - Twenty environmental soil samples were collected from various areas of the northern muckpile. Samples 546A010 through 546A013 were collected from natural drainage areas that had formed on the top of the muckpile. The four sample locations (A10 through A13) were selected to represent each side of the muckpile and to monitor areas where contaminants, if present, would collect and migrate from the pile to the surrounding soil. These samples were collected from the top of the muckpile at a depth of 0.0 to 0.5 ft. The remaining samples (546A020 through 546A035) were collected from four separate trenches (sample locations A21 through A24). Because there were no biasing factors present (e.g., staining or elevated radiological readings), the trench locations were selected from the highest part of the muckpile on each of the four sides (north, west, south, and east), and three samples were collected from equally spaced, vertical intervals within each trench. A fourth sample was collected at the muckpile/native soil interface at each trench location. The sample depth ranged from 0.0 to 16.5 ft from the top of the muckpile. Sample locations are shown on Figure A.3-1.

Southern Muckpile - Twenty two environmental soil samples, including one FD, were collected from various areas of the southern muckpile. Samples 546A004 through 546A007 were collected from natural drainage areas that had formed on the top of the muckpile. These samples were collected from the top of the muckpile at a depth of 0.0 to 0.5 ft. The four sample locations (A06 through A09) were selected to represent each side of the muckpile and to monitor areas where contaminants, if present, would collect and migrate from the pile to the surrounding soil. The remaining samples (546A040 through 546A057) were collected from within four separate trenches (sample locations A29 through A32). As with the northern muckpile, there were no biasing factors (chemical, visual, or radiological) that would have guided the sampling, except as described below. Therefore, the samples from each of the four trenches were collected at equal vertical intervals throughout the thickness of the pile with the trench locations being spaced equally around the pile. In addition, a sample was collected from each trench at the muck/native soil interface. In one of the trenches (location A30), a bucket of PSM was identified. A sample of the material within the bucket was collected (546A504) as well as the soil directly below the bucket (546A045). No additional biasing factors were found within the trench (location A30). The sample depths from within all of the trenches ranged from 0.0 to 14.5 ft from the top of the muckpile. The sample locations are shown on Figure A.3-1.

Subsurface Anomaly - One environmental sample 546A058 was collected from beneath the debris (metal, rebar, t-posts, etc.) that was identified as the subsurface anomaly (location A33). The sample was collected from a depth of 7.5 to 8.0 ft and is shown on Figure A.3-1.

Discharge Pit - Five environmental samples (including one FD) were collected from various locations within and outside of the discharge pit. Samples 546A015 and 546A016 (FD) were collected from beneath the outlet pipe (location A17) that extends through the eastern berm of the pit. Two samples, 546A017 and 546A018, were collected from each of the two inlet pipes (locations A18 and A19). Sample 546A019 was collected at location A20, which was the lowest point in the pit. The sample locations are shown on Figure A.3-1.

Soil Pile - Seven environmental samples (including one FD) were collected from various locations within the soil pile. Since there were no biasing factors (e.g., staining or elevated radiological readings), the soil pile was divided into thirds and trenches excavated through each third of the pile. As there were no biasing factors identified within each excavated area, one sample was collected within the pile from the middle point of each trench based on the total height at that location. A second sample was collected at the muckpile/native soil interface at each trench location. The sample depths ranged from 0.0 to 5.0 ft from the top of the soil pile. The sample locations are shown on Figure A.3-1.

The analytical results for waste characterization samples are discussed in Section A.5.0.

A.3.1.6 Deviations

Environmental investigation samples were collected as outlined in the CAIP (NNSA/NSO, 2008) and submitted for laboratory analysis. The only minor deviation to the planned sampling was one sample that could not be collected in the discharge pit because of an existing concrete pad. Because the soil on top of the pad was not stained but discolored due to dead vegetation, this deviation is not significant.

A.3.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAIP (NNSA/NSO, 2008). Investigation samples were

analyzed for the CAIP-specified COPCs that included VOCs, SVOCs, TPH-DRO, RCRA metals, PCBs, pesticides, gamma-emitting radionuclides, isotopic uranium (U), isotopic Pu, and strontium (Sr)-90. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table A.2-2. Table A.3-1 lists the sample-specific analytical suite for CAS 06-23-02. The waste characterization analytical results are discussed in Section A.5.0.

An evaluation was conducted on all contaminants detected above MDCs by comparing individual concentration or activity results against the FALs. Establishment of the FALs is presented in Appendix D. Analytical results from the soil samples with concentrations exceeding MDCs are summarized in the following sections.

A.3.2.1 Volatile Organic Compounds

Analytical results for VOCs detected in soil samples above MDCs are presented in Table A.3-2. No VOCs were detected at concentrations exceeding their respective PALs. The FALs were established at the corresponding PAL concentrations.

Table A.3-2
Sample Results for VOCs Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Acetone
Final Action Levels[a]			54,000
A14	546A014	0.0 - 0.5	0.0079 (J)
A33	546A058	7.5 - 8.0	0.0085 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value.

A.3.2.2 Semivolatile Organic Compounds

Analytical results for SVOCs detected in soil samples above MDCs are presented in Table A.3-3. No SVOCs were detected at concentrations exceeding the respective PALs. The FALs were established at the corresponding PAL concentrations.

Table A.3-3
Sample Results for SVOCs Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			2,4-Dinitrotoluene
Final Action Levels[a]			1,200
A30	546A045	5.0 - 6.0	1.4

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

A.3.2.3 Total Petroleum Hydrocarbons

Analytical results for TPH-DRO detected in soil samples above MDCs are presented in Table A.3-4. One subsurface sample exceeded the PAL of 100 mg/kg for TPH-DRO. The TPH-DRO was moved to a Tier 2 evaluation and FALs were established for the hazardous constituents of TPH-DRO. The evaluations of the hazardous constituents of TPH-DRO are presented in Sections A.3.2.1 and A.3.2.2. Because none of the hazardous constituents of TPH-DRO exceeded their respective PALs, TPH-DRO is not considered a COC.

A.3.2.4 RCRA Metals

Analytical results for RCRA metals detected in soil samples above MDCs are presented in Table A.3-5. No metals were detected at concentrations exceeding their PALs. The FALs were established at the corresponding PAL concentrations.

A.3.2.5 Polychlorinated Biphenyls

Polychlorinated biphenyls were not detected above their respective MDCs at this CAS.

Table A.3-4
Sample Results for TPH-DRO Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Total Petroleum Hydrocarbons-Diesel-Range Organics
Preliminary Action Levels[a]			**100**
A01	546A001	0.1 - 0.5	10
A14	546A014	0.0 - 0.5	78
A30	546A045	5.0 - 6.0	**790**

[a]Based on *Nevada Administrative Code*, "Contamination of Soil: Establishment of Action Levels" (NAC, 2006).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

Table A.3-5
Sample Results for RCRA Metals Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)							
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**450[b]**	**450[b]**	**800[b]**	**310[b]**	**5,100[b]**	**5,100[b]**
A01	546A001	0.1 - 0.5	4	250	0.28	6.4 (J)	20 (J)	0.02	0.77 (J+)	--
A02	546A008	0.4 - 0.5	10	220	0.61	12 (J)	21 (J)	0.03	0.41 (J+)	--
A03	546A009	0.4 - 0.5	3.7	150	0.14	5.6 (J)	9.5 (J)	0.017	--	--
A14	546A014	0.0 - 0.5	5.6	270	0.28	9.5 (J)	17 (J)	0.012	--	--
A17	546A015	0.0 - 0.5	4.7	150	0.25	7.6	10	0.026	--	--
	546A016	0.0 - 0.5	5.3	160	0.27	7.7	11	0.03	0.78 (J+)	--
A18	546A017	0.0 - 0.3	5.3	200	0.29	10	13	0.033	--	--
A19	546A018	0.0 - 0.5	5.1	250	0.31	7.5	12	0.019	0.43 (J+)	--
A20	546A019	0.0 - 0.5	6.3	180	0.38	13	14	0.052	--	--
A30	546A045	5.0 - 6.0	9.8	240	1.3	12	16	0.026	--	--

Table A.3-5
Sample Results for RCRA Metals Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)							
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**450[b]**	**450[b]**	**800[b]**	**310[b]**	**5,100[b]**	**5,100[b]**
A33	546A058	7.5 - 8.0	5.3	220 (J)	0.21	11 (J)	14 (J)	0.011 (J-)	--	--
A34	546A059	0.0 - 2.0	3.5	170 (J)	0.21	4.9 (J)	8.9 (J)	0.009 (J-)	--	0.15
	546A060	4.0 - 5.0	3.7	150 (J)	0.19	5.4 (J)	10 (J)	0.011 (J-)	--	0.12
	546A061	4.0 - 5.0	3.7	140 (J)	0.22	5.4 (J)	8.9 (J)	0.014 (J-)	--	0.13
A35	546A062	0.0 - 2.5	3.9	150 (J)	0.18	5.6 (J)	8.8 (J)	0.014 (J-)	--	--
	546A063	4.0 - 5.0	3.7	140 (J)	0.16	6 (J)	8.9 (J)	0.0095 (J-)	--	--
A36	546A064	0.0 - 2.5	3.2	160 (J)	0.17	5.1 (J)	7.9 (J)	0.0096 (J-)	--	0.12
	546A065	4.0 - 5.0	3.6	140 (J)	0.17	5.5 (J)	8.9 (J)	0.0084 (J-)	--	--

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

-- = Not detected above minimum detectable concentrations.
J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.
J- = The result is an estimated quantity, but the result may be biased low.

A.3.2.6 Pesticides

Analytical results for pesticides detected in soil samples above MDCs are presented in Table A.3-6. No pesticides were detected at concentrations exceeding their PALs. The FALs were established at the corresponding PAL concentrations.

Table A.3-6
Sample Results for Pesticides Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			4,4'-DDT
Final Action Levels[a]			7
A34	546A060	4.0 - 5.0	0.0012 (J)
A34	546A061	4.0 - 5.0	0.001 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value.

A.3.2.7 Gamma-Emitting Radionuclides

Analytical results for gamma-emitting radionuclides detected in soil samples above MDCs are presented in Table A.3-7. No gamma-emitting radionuclides were detected at concentrations exceeding their PALs. The FALs were established at the corresponding PAL concentrations.

A.3.2.8 Plutonium, Strontium-90, and Uranium Isotopes

Analytical results for isotopic Pu, Sr-90, and isotopic U detected in soil samples above MDCs are presented in Table A.3-8. No isotopic Pu or U exceeded the PALs. The FALs were established at the corresponding PAL concentrations.

A.3.3 Nature and Extent of Contamination

Based on the analytical results for soil samples collected within CAS 06-23-02, no COCs were identified.

A.3.4 Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2008) were met at this CAS, and no revisions were necessary to the CSM.

Table A.3-7
Sample Results for Gamma-Emitting Radionuclides Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 1 of 5)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a]**	**5[a]**	**105[b]**
A01	546A001	0.1 - 0.5	1.5	--	--	1.51 (J+)	1.02 (J)	0.473	2.13 (J+)
A04	546A002	0.0 - 0.5	1.33	--	--	1.42 (J+)	0.86 (J)	0.48	1.83 (J+)
A05	546A003	0.0 - 0.5	1.37	0.6	--	1.48	0.91 (J)	0.435	--
A06	546A007	0.0 - 0.5	1.77	--	--	2.37 (J+)	1.55 (J)	0.77	--
A07	546A006	0.0 - 0.5	2.17	--	--	2.33 (J+)	1.35 (J)	0.67	3.71 (J+)
A08	546A005	0.0 - 0.5	2.35	--	--	2.34 (J+)	1.36 (J)	0.733	2.78 (J+)
A09	546A004	0.0 - 0.5	2.23	--	--	2.33 (J+)	1.36 (J)	0.727	2.58 (J+)
A10	546A010	0.0 - 0.5	1.97	--	--	2.21 (J+)	1.4 (J)	0.67	--
A11	546A011	0.0 - 0.5	2.28	--	--	2.32 (J+)	1.21 (J)	0.61	--
A12	546A012	0.0 - 0.5	1.83	--	--	2.03 (J+)	1.35 (J)	0.61	--
A13	546A013	0.0 - 0.5	2.17	--	--	2.35 (J+)	1.63 (J)	0.62	--
A17	546A015	0.0 - 0.5	1.23	0.42 (J)	--	1.5 (J)	1.31 (J)	0.47	--
	546A016	0.0 - 0.5	1.61	--	--	1.57 (J)	1.08 (J)	0.47	--
A18	546A017	0.0 - 0.3	1.6	--	--	1.46 (J)	1.2 (J)	0.44	--

Table A.3-7
Sample Results for Gamma-Emitting Radionuclides Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 2 of 5)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a]**	**5[a]**	**105[b]**
A19	546A018	0.0 - 0.5	1.63	0.38 (J)	--	1.58 (J)	1.12 (J)	0.7	--
A20	546A019	0.0 - 0.5	1.66	--	--	2.19 (J)	1.34 (J)	0.59	--
A21	546A020	0.0 - 3.0	1.91	--	--	2.36 (J+)	1.43 (J)	0.75	--
	546A021	3.0 - 6.0	2.23	--	--	2.58 (J+)	1.29 (J)	0.68	--
	546A022	6.0 - 9.0	1.78	--	--	2.08 (J+)	1.28 (J)	0.56	--
	546A023	12 - 12.5	1.33	--	--	1.95 (J+)	1.33 (J)	0.64	3.4 (J+)
A22	546A024	0.0 - 4.0	2.36	--	--	2.42 (J+)	1.23 (J)	0.79	--
	546A025	4.0 - 8.0	2.02	--	--	2.4 (J+)	1.45 (J)	0.67	--
	546A026	8.0 - 12.0	1.98	--	--	1.81 (J+)	1.36 (J)	0.71	--
	546A027	12.0 - 12.5	1.22	--	--	1.76 (J+)	1.13 (J)	0.65	--
A23	546A028	0.0 - 6.0	1.94	--	--	2.51 (J+)	1.74 (J)	0.78	--
	546A029	6.0 - 12.0	2.26	--	--	2.44 (J+)	1.55 (J)	0.79	--
	546A030	12.0 - 16.0	1.51	--	0.25	1.71 (J+)	1.1 (J)	0.56	--
	546A031	16.0 - 16.5	1.31	--	--	1.62 (J+)	1.05 (J)	0.43	--

Table A.3-7
Sample Results for Gamma-Emitting Radionuclides Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 3 of 5)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a]**	**5[a]**	**105[b]**
A24	546A032	0.0 - 6.0	1.71	--	--	2.21 (J+)	1.4 (J)	0.72	--
	546A033	6.0 - 12.0	1.61	--	--	2.64 (J+)	1.59 (J)	0.73	--
	546A034	12.0 - 16.0	1.93	--	--	2.23 (J+)	1.58 (J)	0.67	--
	546A035	16 - 16.5	1.36	--	--	1.61 (J+)	1.07 (J)	0.474	1.86 (J+)
A25	546A039	0.0 - 0.5	1.42	--	--	1.5 (J+)	1.15 (J)	0.494	--
A26	546A038	0.0 - 0.5	1.36	--	--	1.51 (J+)	1.13 (J)	0.52	--
A27	546A037	0.0 - 0.5	1.28	--	0.26	1.47 (J+)	1.17 (J)	0.48	--
A28	546A036	0.0 - 0.5	1.55	--	--	1.79 (J+)	1.17 (J)	0.469	1.88 (J+)
A29	546A040	0.0 - 3.0	2.65	--	--	2.11 (J+)	1.4 (J)	0.68	--
	546A041	0.0 - 3.0	2.24	--	--	2.57 (J+)	1.61 (J)	0.709	3.36 (J+)
	546A042	3.0 - 6.0	1.96	--	--	1.86 (J+)	1.11 (J)	0.52	--
	546A043	6.0 - 9.0	1.84	--	--	1.75 (J+)	1.05 (J)	0.53	--
	546A044	10.0 - 10.5	1.42	--	--	1.55 (J+)	1.17 (J)	0.48	--

Table A.3-7
Sample Results for Gamma-Emitting Radionuclides Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 4 of 5)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a]**	**5[a]**	**105[b]**
A30	546A046	0.0 - 5.0	2.51	--	--	2.42 (J+)	1.59 (J)	0.74	--
	546A047	5.0 - 10.0	2.17	--	--	2.29 (J+)	1.52 (J)	0.72	--
	546A048	10.0 - 14.0	1.83	--	--	2.25 (J+)	1.38 (J)	0.67	--
	546A049	14.0 - 14.5	1.41	--	--	1.77 (J+)	1.5 (J)	0.6	--
A31	546A050	0.0 - 4.0	2.11	--	--	2.31 (J+)	1.57 (J)	0.73	--
	546A051	4.0 - 8.0	2.24	--	--	2.36 (J+)	1.41 (J)	0.75	3.06 (J+)
	546A052	8.0 - 12.0	1.83	--	--	2.11 (J+)	1.27 (J)	0.61	--
	546A053	12 - 12.5	1.84	--	--	2.17 (J+)	1.52 (J)	0.64	--
A32	546A054	0.0 - 3.0	2.14	--	--	2.13 (J+)	1.48 (J)	0.72	--
	546A055	3.0 - 6.0	1.91	--	--	2.25 (J+)	1.5 (J)	0.73	--
	546A056	6.0 - 9.0	1.92	--	--	2.17 (J+)	1.27 (J)	0.55	--
	546A057	10.0 - 10.5	1.69	--	--	1.82 (J+)	1.18 (J)	0.47	--
A33	546A058	7.5 - 8.0	1.57	--	--	2.02 (J)	1.28 (J)	0.56	--

Table A.3-7
Sample Results for Gamma-Emitting Radionuclides Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 5 of 5)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a]**	**5[a]**	**105[b]**
A34	546A059	0.0 - 2.0	1.15	--	--	1.32	1.01 (J)	0.47	--
	546A060	4.0 - 5.0	1.4	0.96	--	1.32	0.92 (J)	0.49	--
	546A061	4.0 - 5.0	1.1	--	--	1.42	0.74 (J)	0.41	--
A35	546A062	0.0 - 2.5	1.37	--	--	1.51	1.06 (J)	0.37	--
	546A063	4.0 - 5.0	1.14	--	--	1.5 (J)	0.87 (J)	0.42	--
A36	546A064	0.0 - 2.5	1.24	--	--	1.42	0.85 (J)	0.399	--
	546A065	4.0 - 5.0	1.59	--	--	1.47 (J)	0.98 (J)	0.47	--

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment" (DOE, 1993).
[b]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.

bgs = Below ground surface
DOE = U.S. Department of Energy
ft = Foot
NCRP = National Council on Radiation Protection and Measurements
pCi/g = Picocuries per gram
-- = Not detected above minimum detectable concentrations.
J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.

Table A.3-8
Sample Results for Isotopes Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 1 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Plutonium-239/240	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**12.7**	**838**	**143**	**17.6**	**105**
A01	546A001	0.1 - 0.5	--	--	0.85	--	0.89
A04	546A002	0.0 - 0.5	0.205	--	0.68	0.037	0.61
A05	546A003	0.0 - 0.5	--	--	0.64	--	0.76
A06	546A007	0.0 - 0.5	--	--	1.42	0.068	1.4
A07	546A006	0.0 - 0.5	--	--	1.45	0.071	1.49
A08	546A005	0.0 - 0.5	--	--	1.39	0.097	1.35
A09	546A004	0.0 - 0.5	--	--	1.38	0.068	1.43
A10	546A010	0.0 - 0.5	--	--	1.45	0.051	1.54
A11	546A011	0.0 - 0.5	--	--	1.42	0.074	1.41
A12	546A012	0.0 - 0.5	--	--	1.56	0.054	1.46
A13	546A013	0.0 - 0.5	--	--	1.46	0.063	1.61
A17	546A015	0.0 - 0.5	0.097	--	0.72	--	0.71
	546A016	0.0 - 0.5	0.06	--	0.78	0.04	0.86
A18	546A017	0.0 - 0.3	0.127	--	0.79	--	0.86
A19	546A018	0.0 - 0.5	--	--	0.93	0.059	0.94
A20	546A019	0.0 - 0.5	0.058	--	0.89	--	0.89
A21	546A020	0.0 - 3.0	--	0.29	1.47	0.056	1.46
	546A021	3.0 - 6.0	--	--	1.29	0.061	1.27
	546A022	6.0 - 9.0	--	--	1.17	--	1.16
	546A023	12 - 12.5	--	--	1.07	0.042	1.18

Table A.3-8
Sample Results for Isotopes Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 2 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Plutonium-239/240	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**12.7**	**838**	**143**	**17.6**	**105**
A22	546A024	0.0 - 4.0	--	--	1.44	0.083	1.39
	546A025	4.0 - 8.0	--	--	1.39	0.058	1.45
	546A026	8.0 - 12.0	--	--	1.28	--	1.21
	546A027	12.0 - 12.5	--	--	0.73	--	0.75
A23	546A028	0.0 - 6.0	--	--	1.4	0.089	1.48
	546A029	6.0 - 12.0	--	--	1.65	0.097	1.56
	546A030	12.0 - 16.0	0.58	--	0.93	--	0.9
	546A031	16.0 - 16.5	--	--	0.74	--	0.73
A24	546A032	0.0 - 6.0	--	--	1.38	0.048	1.39
	546A033	6.0 - 12.0	--	--	1.38	0.057	1.44
	546A034	12.0 - 16.0	--	--	1.37	0.063	1.5
	546A035	16.0 - 16.5	--	--	0.65	0.022	0.66
A25	546A039	0.0 - 0.5	0.114 (J)	--	0.67	--	0.75
A26	546A038	0.0 - 0.5	0.077 (J)	--	0.78	--	0.76
A27	546A037	0.0 - 0.5	0.337 (J)	--	0.83	0.048	0.73
A28	546A036	0.0 - 0.5	0.213 (J)	--	0.76	0.049	0.72
A29	546A040	0.0 - 3.0	--	--	1.48	0.085	1.47
	546A041	0.0 - 3.0	--	--	1.5	0.074	1.46
	546A042	3.0 - 6.0	--	--	1.19	0.046	1.17
	546A043	6.0 - 9.0	--	--	0.97	0.046	1
	546A044	10.0 - 10.5	--	--	0.75	--	0.79

Table A.3-8
Sample Results for Isotopes Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 3 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Plutonium-239/240	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**12.7**	**838**	**143**	**17.6**	**105**
A30	546A046	0.0 - 5.0	--	--	1.4	0.051	1.51
	546A047	5.0 - 10.0	--	--	1.43	0.093	1.41
	546A048	10.0 - 14.0	--	--	1.34	0.043	1.36
	546A049	14.0 - 14.5	--	--	0.81	0.049	0.81
A31	546A050	0.0 - 4.0	--	--	1.54	0.066	1.46
	546A051	4.0 - 8.0	--	--	1.43	0.063	1.44
	546A052	8.0 - 12.0	--	--	1.3	0.062	1.29
	546A053	12.0 - 12.5	--	--	1.33	0.082	1.38
A32	546A054	0.0 - 3.0	--	--	1.38	0.081	1.36
	546A055	3.0 - 6.0	--	--	1.45	0.071	1.56
	546A056	6.0 - 9.0	0.44	--	1.19	--	1.28
	546A057	10.0 - 10.5	--	--	0.81	0.067	0.82
A33	546A058	7.5 - 8.0	--	--	0.93	0.075	0.83
A34	546A059	0.0 - 2.0	0.113	--	0.66	0.035	0.72
	546A060	4.0 - 5.0	0.056	--	0.67	0.039	0.69
	546A061	4.0 - 5.0	--	--	0.73	--	0.7
A35	546A062	0.0 - 2.5	0.058	--	0.79	0.043	0.79
	546A063	4.0 - 5.0	--	--	0.71	0.055	0.81

Table A.3-8
Sample Results for Isotopes Detected above Minimum Detectable Concentrations at CAS 06-23-02, U-6a/Russet Testing Area
(Page 4 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Plutonium-239/240	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**12.7**	**838**	**143**	**17.6**	**105**
A36	546A064	0.0 - 2.5	0.039	--	0.63	--	0.65
	546A065	4.0 - 5.0	--	--	0.74	--	0.82

[a]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.

bgs = Below ground surface
ft = Foot
NCRP = National Council on Radiation Protection and Measurements
pCi/g = Picocuries per gram

-- = Not detected above minimum detectable concentrations.
J = Estimated value.

A.4.0 Corrective Action Site 09-20-01, Injection Well

Corrective Action Site 09-20-01 is located in the U-9u crater in the central western portion of Area 9. The CAS consists of an injection well that received classified core as well as liquid and solid decontamination waste and a rusted, empty drum located in a nearby shallow excavation. The injection well appears to be present within the crater as of 1963 and was reportedly still active in 1988. It is unknown when the drum appeared onsite. The injection well and drum were identified for investigation in the CAIP (NNSA/NSO, 2008).

A.4.1 Corrective Action Investigation

A total of five characterization samples (including one FD) were collected during investigation activities at CAS 09-20-01. The sample IDs, locations, types, and analyses are listed in Table A.4-1. The sample locations are shown on Figure A.4-1. The specific CAI activities conducted to satisfy the CAIP requirements at this CAS (NNSA/NSO, 2008) are described in the following sections.

A.4.1.1 Field Screening

Investigation samples were field screened for alpha and beta/gamma radiation, and gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. No FSLs were exceeded in any samples from this CAS.

A.4.1.2 Radiological Surveys

A radiological walkover survey was conducted around the injection well and excavated area containing the drum (SNJV, 2007). No radiological readings were distinguishable from background readings. No sample locations were selected based on the lack of radiological biasing factors. Additionally, the drum was swiped for surface radiological contamination, but no elevated readings were identified.

A.4.1.3 Visual Inspections

Visual inspections were made of the area surrounding the injection well cover and of the excavated area containing the drum. The inspection was performed to identify biasing factors (i.e., staining,

Table A.4-1
Samples Collected at CAS 09-20-01, Injection Well

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	TPH-DRO	Gamma Spectroscopy	Gross Alpha/Beta	RCRA Metals	PCBs	Pesticides	Isotopic Plutonium	Strontium	SVOCs	Tritium	Isotopic Uranium	VOCs
B01	546B001	0.0 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	X	X
B02	546B002	0.0 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	X	X
	546B003	0.0 - 0.5	Soil	Field Duplicate of #546B002	X	X	--	X	X	X	X	X	X	--	X	X
B03	546B004	0.0 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	X	X
B04	546B005	0.0 - 0.5	Soil	Environmental	X	X	--	X	X	X	X	X	X	--	X	X
N/A	546B301	N/A	Water	Trip Blank	--	--	--	--	--	--	--	--	--	--	--	X
N/A	546B302	N/A	Water	Field Blank	X	X	X	X	X	X	X	X	X	X	X	X

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
N/A = Not applicable
PCB = Polychlorinated biphenyl

RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

-- = Not required

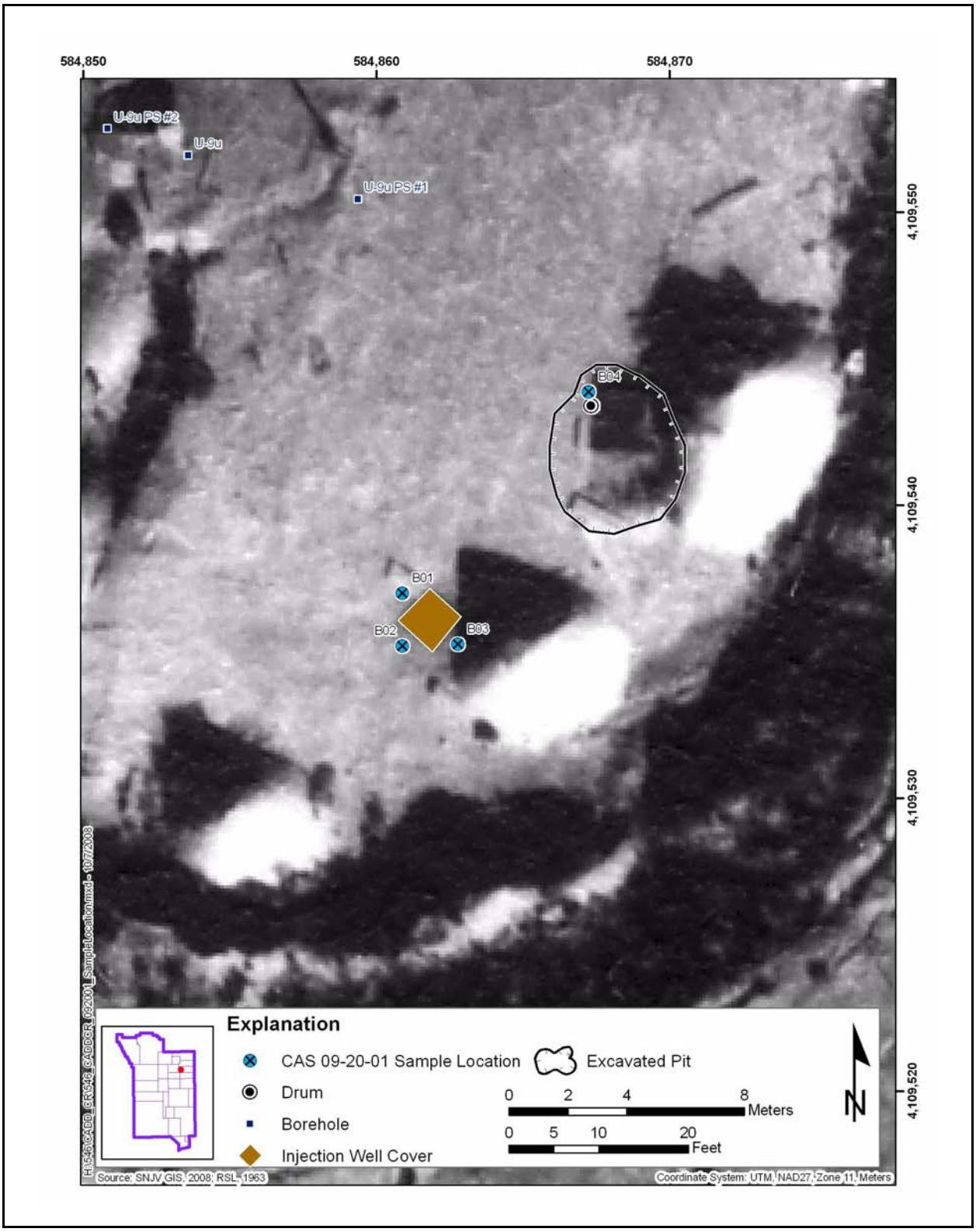

Figure A.4-1
Sample Locations at CAS 09-20-01, Injection Well

odor) surrounding the injection well and beneath the drum. Because there were no additional biasing factors identified during the initial inspection, no additional sampling locations were identified.

A.4.1.4 Sample Collection

A total of five environmental soil characterization samples (including one FD) were collected from four locations (B01 through B04) during investigation activities at CAS 09-20-01. Sample locations B01 through B03 are located directly adjacent to three sides of the injection well. Sample location B04 was selected from beneath the drum, in the shallow excavated area. All of the samples were collected using hand sampling techniques and disposable sampling equipment from 0.0 to 0.5 ft bgs. The sample locations are shown in Figure A.4-1.

Decision I surface samples were collected from soil surrounding the injection well and beneath the drum. No Decision II sampling was necessary as all analytical results were below FALs.

A.4.1.5 Deviations

Investigation samples were collected as outlined in the CAIP (NNSA/NSO, 2008) and submitted for laboratory analysis. The were no deviations from this plan.

A.4.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAIP (NNSA/NSO, 2008). Investigation samples were analyzed for the CAIP-specified COPCs, which included VOCs, SVOCs, TPH-DRO, RCRA metals, PCBs, pesticides, gamma-emitting radionuclides, isotopic U, isotopic Pu, and Sr-90. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table A.2-2. Table A.4-1 lists the sample-specific analytical suite for CAS 09-20-01. The waste characterization analytical results are discussed in Section A.5.0.

Analytical results from the soil samples with concentrations exceeding MDCs are summarized in the following sections. An evaluation was conducted on all contaminants detected above MDCs by comparing individual concentration or activity results against the FALs. Establishment of the FALs is presented in Appendix D.

A.4.2.1 Volatile Organic Compounds

Volatile organic compounds were not detected above their respective MDCs at this CAS.

A.4.2.2 Semivolatile Organic Compounds

Semivolatile organic compounds were not detected above their respective MDCs at this CAS.

A.4.2.3 Total Petroleum Hydrocarbons

Total petroleum hydrocarbons-DRO were not detected above their respective MDCs at this CAS.

A.4.2.4 RCRA Metals

Analytical results for RCRA metals detected in soil samples above MDCs are presented in Table A.4-2. No metals were detected at concentrations exceeding their PALs. The FALs were established at the corresponding PAL concentrations.

A.4.2.5 Polychlorinated Biphenyls

Polychlorinated biphenyls were not detected above their respective MDCs at this CAS.

A.4.2.6 Pesticides

Pesticides were not detected above their respective MDCs at this CAS.

A.4.2.7 Gamma-Emitting Radionuclides

Analytical results for gamma-emitting radionuclides detected in soil samples above MDCs are presented in Table A.4-3. No gamma-emitting radionuclides were detected at concentrations exceeding their PALs. The FALs were established at the corresponding PAL concentrations.

A.4.2.8 Plutonium, Strontium-90, and Uranium Isotopes

Analytical results for isotopic Pu and isotopic U detected in soil samples above MDCs are presented in Table A.4-4. Plutonium-239/240 concentrations detected at CAS 09-20-01 were moved to a Tier 2 evaluation in which RESRAD was used to determine the site-specific FALs for radionuclides under

Table A.4-2
Sample Results for RCRA Metals Detected above Minimum Detectable Concentrations at CAS 09-20-01, Injection Well

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)						
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium
Final Action Levels			**23[a]**	**67,000[b]**	**450[b]**	**450[b]**	**800[b]**	**310[b]**	**5,100[b]**
B01	546B001	0.0 - 0.5	3.9	130	0.18	7.5	11	0.038	--
B02	546B002	0.0 - 0.5	3.5	150	0.14	8.8	13	0.028	--
	546B003	0.0 - 0.5	3.3	130	0.15	7.9	12	0.031	0.48 (J-)
B03	546B004	0.0 - 0.5	3.8	110	0.14	7.6	11	0.064	--
B04	546B005	0.0 - 0.5	3.6	120	0.23	7.7	11	0.039	--

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

-- = Not detected above minimum detectable concentrations.
J- = The result is an estimated quantity, but the result may be biased low.

the industrial scenario. Plutonium-239/240 did not exceed the FAL of 1,890 pCi/g at any location. No other isotopic radionuclides were detected at activities exceeding their PALs, therefore, the FALs were established at the corresponding PAL activities for all isotopic radionuclides except Pu-239/40.

A.4.3 Nature and Extent of Contamination

Based on the analytical results for soil samples collected within CAS 09-20-01, no COCs were identified. However, it is discussed in the CAIP (NNSA/NSO, 2008) that COCs were assumed to be subsurface based on the type of wastes disposed. It was determined that the collection of subsurface samples by drilling would present significant risks and may not provide useful additional information on the nature and extent of contamination, based on the proximity of the nuclear cavity, and would not affect the selected corrective action of close in place. Investigation of CAU 542 disposal holes with similar histories and CSMs revealed that contamination had not migrated more than 15 ft from

Table A.4-3
Samples Results for Gamma-Emitting Radionuclides Detected above Minimum Detectable Concentrations at CAS 09-20-01, Injection Well

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Cesium-137	Europium-152	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.2[b]**	**5.67[b]**	**5[a]**	**5[a]**	**5[a]**	**105[b]**
B01	546B001	0.0 - 0.5	1.95	0.096 (J)	0.69 (J+)	1.9 (J+)	1.17 (J)	0.59	--
B02	546B002	0.0 - 0.5	1.41	0.93 (J)	1.19 (J+)	1.72 (J+)	1.17 (J)	0.57	--
	546B003	0.0 - 0.5	1.92	1.12 (J)	1.28 (J+)	2.05 (J+)	1.25 (J)	0.632	2.31 (J+)
B03	546B004	0.0 - 0.5	1.99	0.216 (J)	0.525 (J+)	1.96 (J+)	1.2 (J)	0.604	2.56 (J+)
B04	546B005	0.0 - 0.5	1.91	0.35 (J)	--	2.12 (J+)	1.36 (J)	0.65	--

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment" (DOE, 1993).
[b]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.

bgs = Below ground surface
DOE = U.S. Department of Energy
ft = Foot
NCRP = National Council on Radiation Protection and Measurements
pCi/g = Picocuries per gram

-- = Not detected above minimum detectable concentrations.
J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.

Table A.4-4
Sample Results for Isotopes Detected above Minimum Detectable Concentrations at CAS 09-20-01, Injection Well

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Plutonium-238	Plutonium-239/240	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**13**	**1,890[b]**	**143**	**17.6**	**105**
B01	546B001	0.0 - 0.5	--	0.331	1.25	0.073	1.07
B02	546B002	0.0 - 0.5	0.49	32.2	0.92	0.054	0.92
	546B003	0.0 - 0.5	0.132	130	1.62	7.9	0.89
B03	546B004	0.0 - 0.5	--	110	1.31	--	1.03
B04	546B005	0.0 - 0.5	--	120	1.55	0.063	1.11

[a]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.
[b]Tier 2 derived action level (see Appendix C).

bgs = Below ground surface
ft = Foot
NCRP = National Council on Radiation Protection and Measurement
pCi/g = Picocuries per gram

-- = Not detected above minimum detectable concentrations.

the release point at the bottom of the disposal holes. Based on this process knowledge, the extent of contamination in subsurface soil at CAS 09-20-01 was assumed to be the same.

A.4.4 Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2008) were met at this CAS, and no revisions were necessary to the CSM.

A.5.0 Waste Management

Waste management areas were established and managed as specified in the CAIP (NNSA/NSO, 2008). For regulated wastes, the amount, type, and source of waste placed into each container was recorded in waste management logbooks at the time the waste was generated, and the logbooks were maintained in the project file.

A.5.1 Waste Streams

The waste streams listed in Table A.5-1 were generated at CAU 546.

A.5.2 Waste Generated

A.5.2.1 CAS 06-23-02

Due to the investigation activities at CAS 06-23-02, three drums of investigation-derived waste (IDW) were generated. One drum of solid hazardous waste was sent for treatment/disposal at a commercial RCRA Treatment/Storage/Disposal Facility via the NTS Area 5 Hazardous Waste Pad. One drum of hydrocarbon waste was disposed of at the Area 9 U10c Industrial Landfill. One drum of friable asbestos waste was sent for disposal to the Area 23 Sanitary Landfill. (See Appendix F for waste disposition documentation.)

One pile of industrial debris was generated, as a BMP, and was sent for disposal to the Area 9 U10c Industrial Landfill. (See Appendix F for waste disposition documentation.)

Table A.5-1
Waste Summary

Waste Characterization						Waste Disposition			
CAS	**Waste Items**	**Hazardous**	**Hydrocarbon**	**PCBs**	**Radioactive**	**Disposal Facility**	**Waste Volume**	**Disposal Date**	**Disposal Document**
06-23-02	Lead slag, soil, debris	Yes	No	No	No	Area 5 Hazardous Waste Storage Unit	55 gallons	11-13-2008	CD (pending)
06-23-02	Grease, debris	No	Yes	No	No	Area 9 U10c	55 gallons	11-13-2008	LVF
06-23-02	Asbestos	No	No	No	No	Area 23 Landfill	55 gallons	11-13-2008	LVF
06-23-02	Pipe debris, bulk	No	No	No	No	Area 9 U10c	55 gallons	11-13-2008	LVF
09-20-01	Debris (empty drum)	No	No	No	No	Area 9 U10c	45 pounds	11-13-2008	LVF

CD = Certificate of Disposal
LVF = Load Verification Form
PCB = Polychlorinated biphenyl

A.5.2.2 CAS 09-20-01

One item of bulk debris (a rusted empty drum) was generated, as a BMP, and was sent for disposal to the Area 9 U10c Industrial Landfill.

A.5.2.3 Waste Characterization

All waste dispositions were based on process knowledge, radiological surveys, site samples, and direct samples of the waste when necessary. Waste characterization and disposition was based on federal and state regulations, permit limitations, and disposal facility acceptance criteria. Personal protective equipment (PPE) and disposable sampling equipment generated during site activities were determined to be sanitary based on observation and process knowledge. The waste was bagged, marked, and placed in a roll-off for disposition at the industrial landfill.

Four waste characterization samples were collected at CAS 06-23-02 and analyzed for the parameters listed in Table A.3-1. Three of the four samples were collected of hard, yellow material. The results showed that the material was not hazardous and, therefore, not PSM. The last sample was of a grease-like material. The results indicated that the material needs to be disposed of as hydrocarbon waste. No waste characterization samples were collected at CAS 09-20-01. Table A.5-2 lists the detected results. All analytical data were reviewed to determine a recommended waste disposal path for the waste streams. Complete results (including nondetect results) for all samples are retained in the project files.

A.5.3 Waste Disposition

Waste was disposed of at the following locations:

- Solid hazardous waste was sent for treatment/disposal to a commercial RCRA Treatment/Storage/Disposal Facility via the NTS Area 5 Hazardous Waste Pad.
- Hydrocarbon waste was sent for disposal to the Area 9 U10c Industrial Landfill.
- Friable asbestos waste was sent for disposal to the Area 23 Sanitary Landfill.
- Industrial debris was sent for disposal to the Area 9 U10c Industrial Landfill.

Table A.5-2
Waste Management Results Detected at CAS 06-23-02, U-6a/Russet Testing Area
(Page 1 of 2)

Sample Location	Sample Number	Matrix	Parameter	Result	Units
A01	546A501[a]	Solid	Actinium-228	1.5	pCi/g
			Thallium-208	0.46	pCi/g
			Lead-214	1.08 (J)	pCi/g
			Lead-212	1.32 (J+)	pCi/g
			Uranium-234	0.95	pCi/g
			Uranium-238	1.01	pCi/g
			Lead	12	mg/kg
			Arsenic	4.6	mg/kg
			Barium	140	mg/kg
			Cadmium	0.36	mg/kg
			Chromium	6.2	mg/kg
			Selenium	0.46 (J+)	mg/kg
			Mercury	0.013	mg/kg
			TPH-DRO	11	mg/kg
			Acetone	25	µg/kg
			Bis(2-Ethylhexyl)Phthalate	90 (J)	µg/kg
A15	546A502[a]	Solid	Uranium-234	0.139	pCi/g
			Uranium-238	0.095	pCi/g
			Lead	2.6	mg/kg
			Silver	0.14	mg/kg
			Arsenic	0.68	mg/kg
			Barium	27	mg/kg
			Cadmium	0.14	mg/kg
			Chromium	14	mg/kg
			Mercury	0.0072	mg/kg

Table A.5-2
Waste Management Results Detected at CAS 06-23-02, U-6a/Russet Testing Area
(Page 2 of 2)

Sample Location	Sample Number	Matrix	Parameter	Result	Units
A16	546A503[a]	Solid	Actinium-228	1.19	pCi/g
			Lead-214	0.63 (J)	pCi/g
			Lead-212	0.62 (J+)	pCi/g
			Uranium-234	0.51	pCi/g
			Plutonium-239/240	0.065	pCi/g
			Uranium-238	0.453	pCi/g
			Lead	11	mg/kg
			Arsenic	3.1	mg/kg
			Barium	150	mg/kg
			Cadmium	0.53	mg/kg
			Chromium	8.9	mg/kg
			Mercury	0.021	mg/kg
			Indeno(1,2,3-cd)Pyrene	120 (J)	µg/kg
A30 (5-Gallon Bucket)	546A504[b]	Solid	Uranium-234	0.196	pCi/g
			Uranium-238	0.184	pCi/g
			Lead	2.5	mg/kg
			Silver	0.094	mg/kg
			Arsenic	1.4 (J-)	mg/kg
			Barium	6,900	mg/kg
			Cadmium	0.45	mg/kg
			Chromium	1.1	mg/kg
			Selenium	0.93 (J-)	mg/kg
			Mercury	0.0053	mg/kg
			TPH-DRO	310,000 (J)	mg/kg
			4,4'-DDE	59 (J)	µg/kg

[a]Samples 546A501 through 546A503 consisted of hard, yellow material.
[b]Sample 546A504 was a grease-like substance.

DRO = Diesel-range organics
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram
TPH = Total petroleum hydrocarbons
µg/kg = Micrograms per kilogram

J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.
J- = The result is an estimated quantity, but the result may be biased low.

A.6.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 546 CAI. The following sections discuss the data validation process, QC samples, and nonconformances. A detailed evaluation of the DQIs is presented in Appendix B.

Laboratory analyses were conducted for samples used in the decision-making process to provide a quantitative measurement of any COPCs present. Rigorous QA/QC was implemented for all laboratory samples including documentation, verification and validation of analytical results, and affirmation of DQI requirements related to laboratory analysis. Detailed information regarding the QA program is contained in the Industrial Sites QAPP (NNSA/NV, 2002a).

A.6.1 Data Validation

Data validation was performed in accordance with the Industrial Sites QAPP and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 546 were evaluated for data quality in a tiered process and are presented in Sections A.6.1.1 through A.6.1.3. Data were reviewed to ensure that samples were appropriately processed and analyzed, and the results were evaluated using validation criteria. Documentation of the data qualifications resulting from these reviews is retained in project files as a hard copy and electronic media.

One hundred percent of the data analyzed as part of this investigation were subjected to Tier I and Tier II evaluations. A Tier III evaluation was performed on approximately 5 percent of the data analyzed.

A.6.1.1 Tier I Evaluation

Tier I evaluation for chemical and radiochemical analysis examines, but is not limited to:

- Sample count/type consistent with chain of custody.
- Analysis count/type consistent with chain of custody.
- Correct sample matrix.
- Significant problems stated in cover letter or case narrative.
- Completeness of certificates of analysis.

- Completeness of signatures, dates, and times on chain of custody.
- Condition-upon-receipt variance form included.
- Requested analyses performed on all samples.
- Date received/analyzed given for each sample.
- Correct concentration units indicated.
- Electronic data transfer supplied.
- Results reported for field and laboratory QC samples.
- Whether or not the deliverable met the overall objectives of the project.

A.6.1.2 Tier II Evaluation

Tier II evaluation for chemical analysis examines, but is not limited to:

- Correct detection limits achieved.
- Sample date, preparation date, and analysis date for each sample.
- Holding time criteria met.
- Quality control batch association for each sample.
- Cooler temperature upon receipt.
- Sample pH for aqueous samples, as required.
- Detection limits properly adjusted for dilution, as required.
- Blank contamination evaluated and applied to sample results/qualifiers.
- Matrix spike (MS)/matrix spike duplicate (MSD) percent recoveries (%R) and relative percent differences (RPDs) evaluated and qualifiers applied to laboratory results, as necessary.
- Field duplicate RPDs evaluated using professional judgment and qualifiers applied to laboratory results, as necessary.
- Laboratory duplicate RPDs evaluated and qualifiers applied to laboratory results, as necessary.
- Surrogate %R evaluated and qualifiers applied to laboratory results, as necessary.
- Laboratory control sample (LCS) %R evaluated and qualifiers applied to laboratory results, as necessary.

- Initial and continuing calibration evaluated and qualifiers applied to laboratory results, as necessary.
- Internal standard evaluation.
- Mass spectrometer tuning criteria.
- Organic compound quantitation.
- Inductively coupled plasma interference check sample evaluation.
- Graphite furnace atomic absorption QC.
- Inductively coupled plasma serial dilution effects.
- Recalculation of 10 percent of laboratory results from raw data.

Tier II evaluation for radiochemical analysis examines, but is not limited to:

- Correct detection limits achieved.
- Blank contamination evaluated and, if significant, qualifiers are applied to sample results.
- Certificate of Analysis consistent with data package documentation.
- Quality control sample results (duplicates, LCSs, laboratory blanks) evaluated and used to determine laboratory result qualifiers.
- Sample results, uncertainty, and MDC evaluated.
- Detector system calibrated with National Institute of Standards and Technology (NIST)- traceable sources.
- Calibration sources preparation was documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations.
- Detector system response to daily or weekly background and calibration checks for peak energy, peak centroid, peak full-width half-maximum, and peak efficiency, depending on the detection system.
- Tracers NIST-traceable, appropriate for the analysis performed, and recoveries that met QC requirements.
- Documentation of all QC sample preparation complete and properly performed.

- Spectra lines, photon emissions, particle energies, peak areas, and background peak areas support the identified radionuclide and its concentration.

A.6.1.3 Tier III Evaluation

The Tier III review is an independent examination of the Tier II evaluation. A Tier III review of 5 percent of the sample analytical data was performed by TLI Solutions, of Lakewood, Colorado. Tier II and Tier III results were compared and where differences are noted, data were reviewed and changes were made accordingly. This review included the following additional evaluations.

Review of:

- Case narrative, chain of custody, and sample receipt forms.
- Lab qualifiers (applied appropriately).
- Method of analyses performed as dictated by the chain of custody.
- Raw data including chromatograms, instrument printouts, preparation logs, and analytical logs.
- Manual integrations to determine whether the response if appropriate.
- Data packages for completeness.

Determine sample results qualifiers through the evaluation of (but not limited to):

- Tracers and quality control sample results (e.g.,duplicates, laboratory control samples, blanks, matrix spikes) evaluated and used to determine sample results qualifiers.
- Sample preservation, sample preparation/extraction and run logs, sample storage, and holding time.
- Instrument and detector tuning.
- Initial and continuing calibrations.
- Calibration verification (initial, continuing, second source).
- Retention times.
- Second column and/or second detector confirmation.
- Mass spectra interpretation.

- Interference check samples and serial dilutions.
- Post digestion spikes and method of standard additions.
- Breakdown evaluations.

Calculations checks of:

- At least one analyte per QC sample of its source recovery.
- At least one analyte per initial calibration curve, continuing calibration verification, and second source recovery.
- At least one analyte per sample that contains positive results (hits). Radiochemical results only require calculation checks on activity concentrations (not error).

Verify that target compound detects identified in the raw data are reported on the results form. Document any anomalies for the laboratory to clarify or rectify. The contractor should be notified of any anomalies.

A.6.2 Field Quality Control Samples

Field QC samples consisted of nine trip blanks, one equipment rinsate blank, two field blanks, one source blank, four full laboratory controls, and four FDs collected and submitted for analysis by the laboratory analytical methods shown in Table A.2-2. The QC samples were assigned individual sample numbers and sent to the laboratory "blind." Additional samples were selected by the laboratory to be analyzed as laboratory duplicates.

Review of the field blank analytical data resulted in no detected field blank contamination. Field blanks, source blanks, and equipment rinsates were analyzed for the applicable parameters listed in Table A.2-2 and trip blanks were analyzed for VOCs only.

During the CAI, four FDs were sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in Table A.2-2. For these samples, precision for the duplicate results (i.e., RPDs between the environmental sample results and their corresponding FD sample results) were evaluated. All the duplicate comparisons for the field duplicates were within control limits except the RPD for Pu-238, Pu-239, and U-234. This is likely due to the potential that discrete particles of contamination were present within the samples.

A.6.2.1 Laboratory Quality Control Samples

Analysis of method QC blanks were performed on each sample delivery group (SDG) for inorganics. All the duplicate comparisons for the field duplicate were within control limits except the RPDs for Pu-238, Pu-239, and U-234. No field samples were qualified based on high RPDs, which were probably due to inhomogenity of the plutonium and uranium contamination. Analysis for surrogate spikes and QC blanks were performed on each SDG for organics only. Initial and continuing calibration and LCSs were performed for each SDG. The results of these analyses were used to qualify associated environmental sample results. Documentation of data qualifications resulting from the application of these guidelines is retained in project files in hard copies and electronic media.

The laboratory included a QC blank, LCS, and a laboratory duplicate sample with each batch of field samples analyzed for radionuclides.

A.6.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

A.6.4 Laboratory Nonconformances

Laboratory nonconformances are generally due to inconsistencies in the analytical instrumentation operation, sample preparations, extractions, missed holding times, and fluctuations in internal standard and calibration results. Four nonconformances were issued by the laboratories that may or may not have resulted in qualifying data. These laboratory nonconformances have been accounted for and resolved during the data qualification process.

A.7.0 Summary

Organic, inorganic, and radionuclide contaminants detected in environmental samples during the CAI were evaluated against FALs to determine the nature and extent of COCs for CAU 546. Assessment of the data generated from investigation activities indicates the FALs were not exceeded in any samples collected at CAU 546. The following summarizes the results for each CAS.

CAS 06-23-02, U-6a/Russet Testing Area

Based on the observations, the geophysical and radiological surveys conducted, and the analytical results of the environmental samples collected at this CAS, PSM was present in the form of a lead brick, lead battery, and lead slag. The debris and the soil that were in contact with the debris were removed under a corrective action of clean closure. The vent line and pipe assemblies throughout the test area were cut at the ground surface and grouted as a BMP.

CAS 09-20-01, Injection Well

Based on the observations, the radiological surveys conducted, and the analytical results of the environmental samples collected at this CAS, no COCs have been released to the surface soil at this CAS. However, as discussed in the CAIP and the DQOs, COCs are assumed to be present in the subsurface soil at the injection well. Therefore, a corrective action of close in place was implemented. Closure activities at this site included establishing an FFACO UR at this CAS and backfilling the subsided area beneath the injection well cover. No further corrective action is required at this CAS.

A.8.0 References

BN, see Bechtel Nevada.

Bechtel Nevada. 1995. *Nevada Test Site Performance Objective for Certification of Nonradioactive Hazardous Waste,* Rev. 0, G-E11/96.01. Las Vegas, NV.

DOE, see U.S. Department of Energy.

EMSL/ORD, see Environmental Monitoring and Support Laboratory Office.

EPA, see U.S. Environmental Protection Agency.

Environmental Monitoring and Support Laboratory Office of Research and Development. 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water,* EPA-600/4-80-032. August. Cincinnati, OH. U.S. Environmental Protection Agency.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (SAIC), "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV.

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

NCRP, see National Council on Radiation Protection and Measurements.

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

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

National Council on Radiation Protection and Measurements. 1999. *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies*, Report No. 129. Bethesda, MD.

Nevada Administrative Code. 2006. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 22 September 2008.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

RSL, Remote Sensing Laboratory.

Remote Sensing Laboratory. 1963. Aerial photograph "U9 AU Pre T-1," 11 December. Las Vegas, NV: EG&G Energy Measurements, Inc.

Remote Sensing Laboratory. 1976. Aerial photograph "1099-2-25," 11 August. Las Vegas, NV: EG&G Energy Measurements, Inc.

SNJV, see Stoller-Navarro Joint Venture.

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

Stoller-Navarro Joint Venture Geographic Information Systems. 2008. ESRI ArcGIS Software.

Stoller-Navarro Joint Venture. 2007. *Radiological Land Area Survey: CAU 546, Injection Well, at the Nevada Test Site.* October. Las Vegas, NV.

Stoller-Navarro Joint Venture. 2008. *Radiological Land Area Survey: CAU 546, Injection Well and Surface Releases CAS 06-23-02, U-6a Russet Testing Area at the Nevada Test Site.* 19 February. Las Vegas, NV.

U.S. Department of Energy. 1997. *The Procedures Manual of the Environmental Measurements Laboratory,* HASL-300. 28th Ed., Vol. I. February. New York, NY.

U.S. Department of Energy. 1993. *Radiation Protection of the Public and the Environment,* DOE Order 5400.5, Change 2. Washington, DC.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002b. *Nevada Test Site Orthophoto Site Atlas,* DOE/NV/11718--604. Prepared by Bechtel Nevada. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2006. *Industrial Sites Project Establishment of Final Action Levels,* Rev. 0, DOE/NV--1107. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2008. *Corrective Action Investigation Plan for Corrective Action Unit 546: Injection Well and Surface Releases, Nevada Test Site, Nevada,* Rev. 0, DOE/NV--1260. Las Vegas, NV.

U.S. Environmental Protection Agency. 1996. *Test Method for Evaluating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition. Washington, DC. As accessed at http://www.epa.gov/epaoswer/hazwaste/test/main.htm on 22 September.

U.S. Environmental Protection Agency. 2004. *Region 9 Preliminary Remediation Goals (PRGs)*. Washington, DC. As accessed at http://www.epa.gov/region09/waste/sfund/prg/index.htm on 22 September. Prepared by S.J. Smucker. San Francisco, CA.

Appendix B

Data Assessment

B.1.0 Data Assessment

The DQA process is the scientific evaluation of the actual investigation results to determine whether the DQO criteria established in the CAIP (NNSA/NSO, 2008) were met and whether DQO decisions can be resolved 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 those decisions at an appropriate level of confidence. Using both the DQO and DQA processes help to ensure that DQO decisions are sound and defensible.

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 as follows:

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

Step 2: Conduct a Preliminary Data Review – Perform a preliminary data review by 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 dataset 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 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.

B.1.1 Review DQOs and Sampling Design

This section contains a review of the DQO process presented in Appendix A of the CAIP (NNSA/NSO, 2008). The DQO decisions are presented with the DQO provisions to limit false negative or false positive decision errors. Special features, potential problems, or deviations to the sampling design are also presented.

B.1.1.1 Decision I

The Decision I statement as presented in the CAIP: "Is a contaminant present within a CAS at a concentration that could pose an unacceptable risk to human health and the environment?" (NNSA/NSO, 2008).

Decision I Rules:

- If the population parameter of any COPC in a target population exceeds the FAL for that COPC, then the COPC is identified as a COC.
- If a COC is detected, then the Decision II statement must be resolved.
- If COCs are not identified, then the investigation is complete.

B.1.1.1.1 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 locations selected will identify COCs if present anywhere within the CAS.
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 dataset is of sufficient quality and completeness.

Criterion 1:

The following methods (stipulated in the CAU 546 DQOs [NNSA/NSO, 2008]) were used in selecting sample locations.

Judgmental sample locations were selected based on field-screening techniques and biasing factors. Sample location selection techniques used were:

- Presence of site components (e.g., muckpiles, discharge pit, soil pile)
- Elevated readings identified from radiological walkover surveys
- Geophysical anomalies
- Visual indicator nondiscoloration or naturally formed drainage areas
- Presence of debris and piping

Criterion 2:

All samples were analyzed using the analytical methods listed in Table 3-2 of the CAIP and for the chemical and radiological parameters listed in Section A.3.2.2 of the CAIP (NNSA/NSO, 2008). Table B.1-1 provides a reconciliation of samples analyzed to the planned analytical program.

Table B.1-1
CAU 546 Analyses Performed

CAS	VOCs	SVOCs	PCBs	RCRA Metals	TPH-DRO	Pesticides	Gamma Spectroscopy	Isotopic Uranium	Isotopic Plutonium	Strontium-90
06-23-02	RS	RS	RS	RS	RS	S	RS	RS	RS	RS
09-20-01	RS	RS	RS	RS	RS	S	RS	RS	RS	RS

DRO = Diesel-range organics
PCB = Polychlorinated biphenyl
RCRA =*Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
RS = Required and submitted
S = Not required but submitted

Samples were submitted for all of the analytical methods in the analytical program specified in Section A.3.2.2 of the CAIP (NNSA/NSO, 2008).

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The sensitivity acceptance criterion defined in the CAIP is that analytical detection limits will be less than the corresponding action level

(NNSA/NSO, 2008). All detection limits were less than PALs; therefore, the DQI for sensitivity has been met.

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 are presented in Table 6-1 of the CAIP (NNSA/NSO, 2008). As presented in Tables B.1-2 and B.1-3, these criteria were met for each of the DQIs.

Precision

Precision was evaluated as described in Section 6.2 of the CAIP (NNSA/NSO, 2008). Table B.1-2 provides the chemical and radiological precision analysis results for all constituents that were qualified for precision. The chemical analyte qualified for precision was barium. Radionuclides qualified for precision were cesium (Cs)-137 and Pu-239/240.

As shown in Table B.1-2, the precision rate for Cs-137 was above the CAIP acceptance criterion of 80 percent. The precision rate for all other constituents is 100 percent, with the exception of barium and Pu-239/240. The precision rate for barium of 65.2 percent was based on differences in laboratory duplicate sample results. This indicates that barium concentrations at this location have more spatial variability than expected. However, there is a negligible potential for a false negative DQO decision error for the barium analyses because the FAL (67,000 mg/kg) is approximately 248 times higher than the highest reported barium result (270 mg/kg).

Table B.1-2
Precision Measurements

Analyte	CAS Number	User Test Panel	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Cesium-137	10045-97-3	Gamma	5	66	92.4
Plutonium-239/240	15117-48-3	Plutonium	22	66	66.7
Barium	7440-39-3	Metals	8	23	65.2

CAS = Chemical Abstracts Service

The precision rate for Pu-239/240 of 66.7 percent can be attributed to high variability in the sampled matrix. This indicates the potential that discrete particles of contamination are present within the sample. Therefore, mixing will not produce homogeneity. This does not mean the precision of the measurement is poor but that activities are variable within the sample. This is commonly observed in isotopic Pu results as a single particle of plutonium within a sample can result in detectable activities attributed to the entire sample. However, there is negligible potential for a false negative DQO decision error for the Pu-239/240 analyses because the FAL (1,890 pCi/g) is approximately 59 times higher than the highest reported Pu-239/240 activity (32.2 pCi/g).

As the precision rates for all other constituents exceed the acceptance criteria for precision, the dataset is determined to be acceptable for the DQI of precision.

Accuracy

Accuracy was evaluated as described in Section 6.2 of the CAIP (NNSA/NSO, 2008). Table B.1-3 provides the chemical accuracy analysis results for all constituents qualified for accuracy. Accuracy rates are above the CAIP criterion of 80 percent for all constituents. There were no radiological data qualified for accuracy.

Table B.1-3
Accuracy Measurements

Analyte	CAS Number	User Test Panel	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Chlorobenzene	108-90-7	VOCs	1	23	95.7
Toluene	108-88-3	VOCs	1	23	95.7

CAS = Chemical Abstracts Service
VOC = Volatile organic compound

Representativeness

The DQO process as identified in Appendix A of the CAIP (NNSA/NSO, 2008) was used to address sampling and analytical requirements for CAU 546. During this process, appropriate locations were selected that enabled the samples collected to be representative of the population parameters identified in the DQO (the most likely locations to contain contamination and locations that bound COCs). The sampling locations identified in the Criterion 1 discussion meet this criterion.

Therefore, the analytical data acquired during the CAU 546 CAI are considered representative of the population parameters.

Comparability

Field sampling, as described in the CAIP (NNSA/NSO, 2008), was performed and documented in accordance with approved procedures that are comparable to standard industry practices. Approved analytical methods and procedures per DOE 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 for the NTS. Therefore, project datasets are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting DQO requirements.

Also, standard, approved field and analytical methods ensured that data were appropriate for comparison to the investigation action levels specified in the CAIP.

Completeness

The CAIP (NNSA/NSO, 2008) defines acceptable criteria for completeness to be that the dataset is sufficiently complete to be able to make the DQO decisions. This is initially evaluated as 80 percent of CAS-specific noncritical analytes identified in the CAIP having valid results and 100 percent of critical analytes (including Decision II samples) having valid results. Critical analytes for CAU 546 are identified as Pu-239, Pu-240, U-235, and U-238 at CAS 06-23-02 (see Table 3-3 of the CAIP).

There were no rejected data, therefore, the DQIs for completeness have been met.

B.1.1.1.2 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/QC samples nonfield blanks, trip blanks, LCSs, and method blanks were used to determine whether a false positive analytical result may have occurred. Of the 18 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 also minimized the potential for cross contamination that could lead to a false positive analytical result.

B.1.1.2 Decision II

Decision II samples were not collected since there were no COCs identified as a result of the CAI. As discussed in Section 1.1 of the CAIP (NNSA/NSO, 2008), COCs were presumed present in the subsurface soil at CAS 09-20-01 and would not require sample collection. Therefore, although COCs are presumed present, no Decision II samples were collected. Lateral and vertical extent of contamination was determined from process knowledge of CASs with similar histories and CSMs (see Section A.4.3).

B.1.1.3 Sampling Design

The CAIP (NNSA/NSO, 2008) made the following commitments for sampling:

1. Judgmental sampling will be conducted at CAS 06-23-02 and the surface soil at CAS 09-20-01.

   Result: Specific features specified in the CAIP (e.g., muckpiles, soil pile, discharge pit, injection well) were accessible and sampled with hand sampling equipment and excavation. Locations with biasing factors (e.g., areas of staining, debris of concern, subsurface geophysical anomalies) were determined onsite during a walkover survey and sampled subsequently.

2. No sampling required of the subsurface soil at CAS 09-20-01.

   Result: COCs are presumed present in the subsurface soil at CAS 09-20-01.

B.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 nonconformance report when data quality does not meet contractual requirements. All data received from the analytical laboratories met contractual requirements, and a QA nonconformance report was not 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.

B.1.3 Select the Test and Identify Key Assumptions

The test for making DQO Decision I was the comparison of the maximum analyte result from each CAS to the corresponding FAL. The key assumptions that could impact a DQO decision are listed in Table B.1-4.

B.1.4 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 546 DQOs and Table B.1-4.

B.1.4.1 Other DQO Commitments

The CAIP (NNSA/NSO, 2008) made the following commitments for sampling:

1. Decision II sampling will consist of defining the extent of contamination where COCs have been confirmed at the Decision I locations. No COCs were identified during the CAI, so Decision II sampling was not required. As stated in the CAIP, COCs were assumed to be present in subsurface soil at CAS 09-20-01 but sampling would not be required.

B.1.5 Draw Conclusions from the Data

This section resolves the two DQO decisions for each of the CAU 546 CASs.

B.1.5.1 Decision Rules for Decision I

Decision Rule:

- If the population parameter of any COPC in the Decision I population of interest (defined in Step 4 of the CAIP) exceeds the corresponding FAL, then that contaminant is identified as a COC, and Decision II samples will be collected, else no further investigation is needed for that COPC in that population.

- If a COC exists at any CAS, then a corrective action will be determined, else no further corrective action is necessary.

Table B.1-4
Key Assumptions

Exposure Scenario	Site workers are only exposed to contaminants of concern (COCs) through oral ingestion, inhalation, external exposure to radiation, or dermal contact (by absorption) of COCs absorbed into the soils. Exposure to contamination is limited to industrial site workers, construction/remediation workers, and military personnel conducting training. The investigation results did not reveal any potential exposures other than those identified in the conceptual site model (CSM).
Affected Media	Surface soil, shallow subsurface soil, and potentially perched (shallow) groundwater. Deep groundwater contamination is not a concern. Contaminants migrating to regional aquifers are not considered. The investigation results did not reveal any affected media other than those identified in the CSM.
Location of Contamination/Release Points	The area of contamination is contiguous. The extent of COC concentration decreases away from the area of contamination. The investigation results did not reveal any locations of contamination or release points other than those identified in the CSM.
Transport Mechanisms	Surface transport may occur as a result of a spill or storm water runoff. Surface transport beyond shallow substrate is not a concern. The investigation results did not reveal any transport mechanisms other than those identified in the CSM.
Preferential Pathways	None. The investigation results did not reveal any preferential pathways other than those identified in the CSM.
Lateral and Vertical Extent of Contamination	Subsurface contamination, if present, is contiguous and decreases with distance and depth from the source. Surface contamination may occur laterally as a result of a spill or storm water runoff. The investigation results did not reveal any lateral and vertical extent of contamination other than those identified in the CSM.
Groundwater Impacts	None. The investigation results did not reveal groundwater impacts other than those identified in the CSM.
Future Land Use	Nonresidential. The investigation results did not reveal any future land uses other than those identified in the CSM.
Other Data Quality Objective Assumptions	None.

- If a waste is present that, if released, has the potential to cause the future contamination of site environmental media, then a corrective action will be determined, else no further action is necessary.

Result: The analysis of the hazardous constituents of diesel are all below their respective PALs; therefore, TPH-DRO is not considered a COC. The FAL for Pu-239/240 identified at CAS 09-20-01was calculated using a RESRAD analysis based on the Industrial Worker Scenario (Yu et al., 2001). The Pu-239/240 FAL for the CAS 09-20-01 under the Industrial Scenario is the residual radioactive material guideline values for single radionuclides. The FAL for Pu-239/240 was not exceeded; therefore, Pu-239/240 is not a COC. The debris (lead brick, lead battery, lead slag) that could have resulted in future contamination of site environmental media was removed as corrective action waste.

B.1.5.2 Decision Rules for Decision II

Decision Rule:

- If the population parameter (the observed concentration of any COC) in the Decision II population of interest (defined in Step 4 of the CAIP) exceeds the corresponding FAL, in any bounding direction, then additional samples will be collected to complete the Decision II evaluation, else the extent of the COC contamination has been defined.

- If valid analytical results are available for the waste characterization samples defined in Section A.9.0 of the CAIP, then the decision will be that sufficient information exists to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, else collect additional waste characterization samples.

Result: Decision II samples were not collected because there were no COCs identified as a result of the CAI. As discussed in Section 1.1 of the CAIP (NNSA/NSO, 2008), COCs were presumed present in the subsurface soil at CAS 09-20-01 and would not require sample collection. Therefore, although COCs are presumed present, no Decision II samples were collected. Lateral and vertical extent of contamination was determined from process knowledge of CASs with similar histories and CSMs (see Section A.4.3).

B.2.0 References

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

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*, Rev. 3, DOE/NV--372. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2008. *Corrective Action Investigation Plan for Corrective Action Unit 546: Injection Well and Surface Releases, Nevada Test Site, Nevada*, Rev. 0, DOE/NV--1260. Las Vegas, NV.

Yu, C., A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4, Argonne National Laboratory, Environmental Assessment Division, Argonne, IL.

Appendix C

Risk Assessment

C.1.0 Risk Assessment

The RBCA process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process conforms with NAC Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2006a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2006b) requires the use of ASTM Method E 1739-95 (ASTM, 1995) 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 evaluation of the need for corrective action includes the potential for wastes that are present at a site to release contamination in the future into environmental media. The debris was removed while the soil below each piece of debris was removed and placed in a drum as generated corrective action waste.

The evaluation of the need for corrective action included the potential for wastes that are present at a site to cause the future contamination of site environmental media if the wastes were to be released. To evaluate the potential for the debris to result in the introduction of a COC to the surrounding environmental media, the following conservative assumptions were made:

- That any containment of contaminants in the waste would fail at some point, thus, releasing them to the surrounding media.
- The resulting concentration of contaminants in the surrounding media would be equal to the concentration of contaminants in the waste.

Sample results demonstrated that no PSM is associated with the vent line. A lead brick, lead battery, and lead slag were determined to be PSM based on the presence of elemental lead.

This section contains documentation of the RBCA process used to establish FALs described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process defines three tiers (or levels) to establish FALs used to evaluate DQO decisions:

- Tier 1 – Sample results from source areas (highest concentrations) compared to risk-based screening levels (RBSLs) (i.e., 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 1 formulas.

- Tier 3 – Sample results from exposure points compared to SSTLs and points of compliance calculated using chemical fate/transport and probabilistic modeling.

The RBCA decision process stipulated in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006) is summarized in Figure C.1-1.

C.1.1 A. Scenario

Corrective Action Unit 546, Injection Well and Surface Releases, consists of the following two inactive sites within Area 6 and Area 9 of the NTS:

- 06-23-02, U-6a/Russet Testing Area
- 09-20-01, Injection Well

Corrective Action Site 06-23-02 are the potential releases associated with activities conducted at the Russet Testing Area located north of the intersection of Tippipah and Mercury Highways in Area 6 of the NTS. The Russet test was conducted in 1968 within an extensive network of subsurface tunnel and drift systems. As a result of the test and activities in the testing area, several components were identified for investigation including two muckpiles, a discharge pit, a vent line, a soil pile, a subsurface anomaly, and the overall testing area.

Corrective Action Site 09-20-01 is located in the U-9u crater in the central western portion of Area 9. The CAS consists of an injection well that received classified core as well as liquid and solid decontamination waste and a rusted, empty drum located in a nearby shallow excavation. The injection well appears to be present within the crater as of 1963 and was reportedly still active in 1988. It is unknown when the drum appeared onsite. The injection well and drum were identified as components at this site requiring investigation.

C.1.2 B. Site Assessment

The CAI involved sampling at the U-6a/Russet Testing Area and the injection well/drum location to assess their potential to cause present and future harm to human health and the environment. Corrective Action Site 06-23-02 and surface soils at CAS 09-20-01 had no soil concentrations above

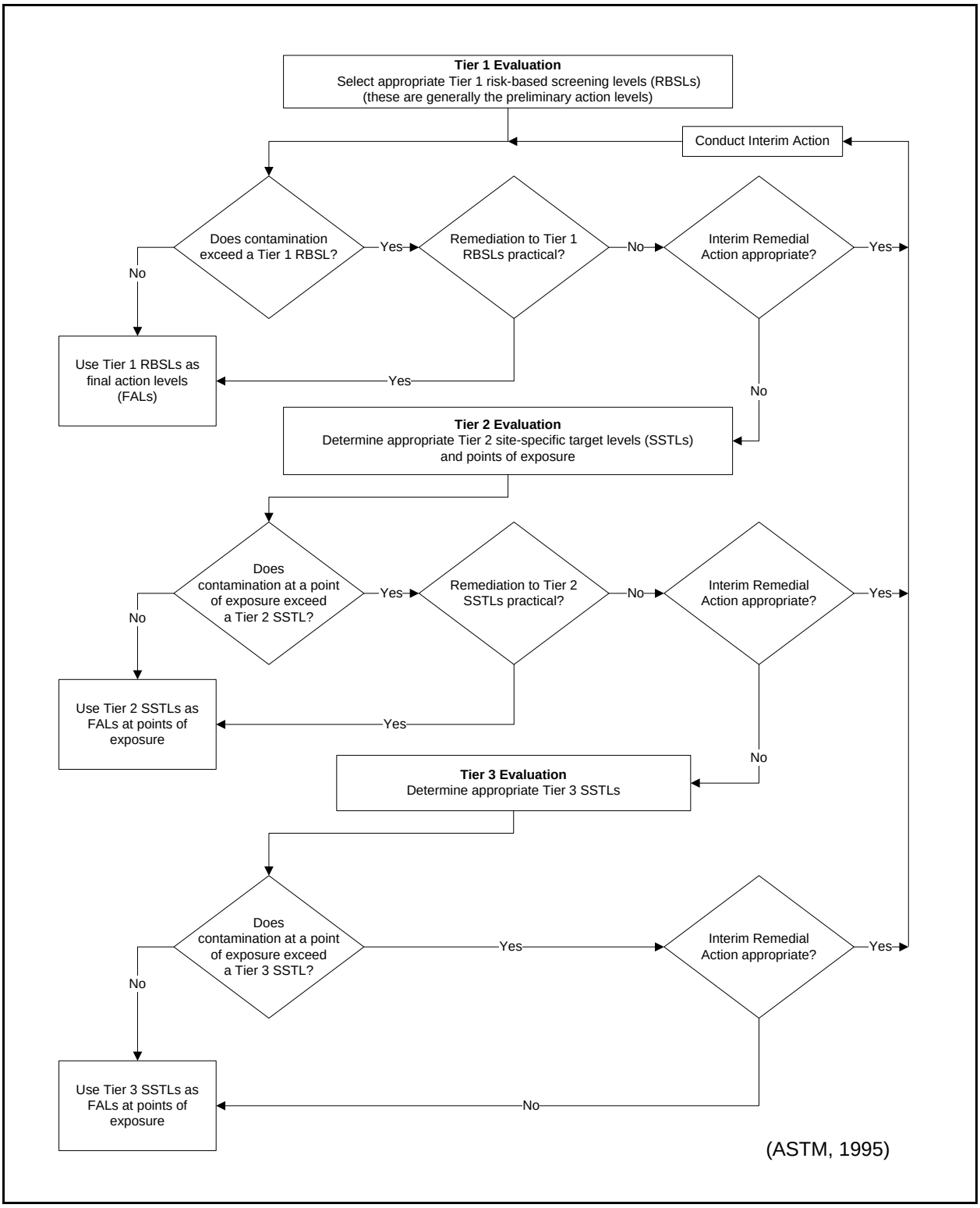

Figure C.1-1
Risk-Based Corrective Action Decision Process

their respective FALs; therefore, no COCs were identified. However, the subsurface soil at CAS 09-20-01 is assumed to be contaminated. No unexpected conditions or other indicators of contamination were encountered during the CAI. Table C.1-1 presents the maximum concentration of contaminants identified at each CAS and their corresponding PALs.

Table C.1-1
Maximum Reported Value for Tier 1 Comparison

CAS	Parameter	Preliminary Action Level	Units	Maximum Reported Value
06-23-02	Total Petroleum Hydrocarbons-Diesel-Range Organics	100	mg/kg	790
09-20-01	Plutonium-239/240	12.7	pCi/g	32.2 (J)

mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram

J = Estimated value.

C.1.3 C. 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 the environment; (2) short-term (0 to 2 years) threat to human health, safety, and the environment; (3) long-term (greater than 2 years) threat to human health, safety, or the environment; and (4) no demonstrated long-term threats.

Based on the CAI, none of the CASs present an immediate threat to human health, safety, and the environment; therefore, no interim response actions are necessary at these sites. Based on this information, CAS 06-23-02 is determined to be a Classification 4 site as defined by ASTM Method E 1739-95 (ASTM, 1995) and poses no demonstrated near- or long-term threats. At CAS 09-20-01, COCs are presumed to be present that may pose long-term threats to human health, safety, or the environment and has been determined to be a Classification 3 site as defined by ASTM Method E 1739-95.

C.1.4 D. Development of Tier 1 Lookup Table of Risk-Based Screening Levels

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 very conservative estimates of risk, are preliminary in nature, and 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 (i.e., PAL) value if individual contaminant analytical results are below the corresponding Tier 1 action level value. The FAL may also be established as the Tier 1 action level value if individual contaminant analytical results exceed the corresponding Tier 1 action level value and implementing a corrective action based on the FAL is practical. The PALs are defined as:

- The EPA Region 9 Risk-Based PRGs for Industrial Soils (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 the mean plus two times the standard deviation based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- The TPH concentrations above the action level of 100 mg/kg per NAC 445A.2272 (NAC, 2006c).
- For COPCs without established PRGs, a protocol similar to EPA Region 9 will be used to establish an action level; otherwise, an established PRG from another EPA region may be chosen.
- The PALs for radioactive contaminants are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) scaled to 25 millirem-per-year-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 the CAU 546 CASs in Areas 6 and 9 are not assigned work stations and are considered to be in remote or occasional use areas, the use of industrial re-use based PALs is conservative. The Tier 1 lookup table is defined as the PAL concentrations or activities defined in the CAIP (NNSA/NSO, 2008).

C.1.5 E. 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 no COCs are present at CAS 06-23-02 and that COCs are

presumed to be present in subsurface soils near the injection well and can only be exposed through excavation. Groundwater is not considered to be a significant exposure pathway.

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

All analytical results from CAU 546 samples were less than corresponding Tier 1 action levels (i.e., PALs) except for those listed in Table C.1-2. A lead brick, lead battery, and lead slag were determined to be PSM based on the presence of elemental lead.

Table C.1-2
Contaminants of Potential Concern Detected above Preliminary Action Levels

CAS	TPH-DRO	Pu-239/240
06-23-02	X	--
09-20-01	--	X

DRO = Diesel-range organics
Pu = Plutonium
TPH = Total petroleum hydrocarbons
-- = Not detected

C.1.7 G. Evaluation of Tier 1 Results

For all contaminants at all CASs not listed in Table C.1-2, the FALs were established as the Tier 1 RBSLs. It was determined that corrective actions were not required for these contaminants at these CASs. However, TPH-DRO contamination and the PSM identified at CAS 06-23-02 as well as the Pu-239/240 contamination at CAS 09-20-01 exceeded the Tier 1 criterion.

C.1.8 H. Tier 1 Remedial Action Evaluation

The evaluation for remediating the contaminants that exceed Tier 1 criteria are discussed below.

TPH-DRO Evaluation

No action to remediate CAS 06-23-02 to Tier 1 action levels for TPH-DRO are proposed; therefore, TPH-DRO was moved to a Tier 2 evaluation.

Radionuclide Evaluation

No actions to remediate Pu-239/240 at CAS 09-20-01 to Tier 1 action levels are proposed; therefore, Pu-239/240 was moved to a Tier 2 evaluation.

Potential Source Material Evaluation

The lead brick, lead battery, and lead slag; along with soil in direct contact with the debris, were feasible to remove. The debris and soil was placed in a drum for disposal.

C.1.9 I. Tier 1 Evaluation

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

C.1.10J. Development of Tier 2 Site-Specific Target Levels

Evaluation of TPH-DRO SSTLs

Method E 1739-95 stipulates that risk evaluations for TPH-DRO contamination be calculated and evaluated based on the risk posed by the potentially hazardous constituents of TPH-DRO. Section 6.4.3 ("Use of Total Petroleum Hydrocarbon Measurements") of ASTM Method E 1739-95 states: "TPHs should not be used for risk assessment because the general measure of TPH-DRO provides insufficient information about the amounts of individual chemical(s) of concern present" (see also Sections X1.5.4 and X1.42 of Method E 1739-95 in ASTM [1995]). Therefore, the individual potentially hazardous constituents will be evaluated for risk in place of TPH-DRO. The SSTLs were established for the individual potentially hazardous constituents in TPH-DRO at the corresponding PAL concentrations.

Evaluation of Radiological Contaminant SSTLs

The Tier 2 evaluation consisted of evaluating Pu-239/240 detected at CAS 09-20-01 to the Tier 2 action level. The CAS-specific Tier 2 action level was calculated using the RESRAD code (version 6.4 [Yu et al., 2001]) and site-specific parameters. The RESRAD calculations were based on continued industrial use of the site assuming that a worker will be on the site for 250 days per year, 10 hours per day for a duration of 25 years. A more detailed discussion of the RESRAD code, site-specific parameters used, and the RESRAD printouts are provided in Attachment 1 of this appendix.

All the radionuclides detected at a CAS are used in the sum-of-fractions calculation, and a unique Tier 2 SSTL was developed. The FAL established for Pu-239/240 specific to CAS 09-20-01 is 1,890 pCi/g.

C.1.11 K. Comparison of Site Conditions with Tier 2 Site-Specific Target Levels

The Tier 2 action levels are typically compared to individual sample results from reasonable points of exposure (as opposed to the source areas as 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 546, the Tier 2 action levels were compared to maximum contaminant concentrations from each sample location.

The maximum concentration of Pu-239/240 at CAS 09-20-01 (32.2. pCi/g) is below the CAS-specific Tier 2-based FAL of 1,890 pCi/g. No potentially hazardous constituents of TPH-DRO were detected in samples collected from CAS 06-23-02 and, therefore, are below the Tier 2-based FALs.

C.1.12 L. Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation of the TPH-DRO hazardous constituents, the TPH-DRO at CAS 06-23-02 does not pose an unacceptable risk to human health and the environment. Therefore, no corrective actions concerning TPH-DRO are required at this CAS. Based on the Tier 2 evaluation of Pu-239/240 at CAS 09-20-01, this radionuclide does not pose an unacceptable risk to human health and the environment. Therefore, no corrective actions concerning Pu-239/240 are required at CAS 09-20-01.

As all contaminant FALs were established as Tier 1 or Tier 2 action levels, a Tier 3 evaluation was not necessary.

C.2.0 Recommendations

All of the site contaminant concentrations in soils from the analysis of CAU 546 samples were less than the corresponding FALs at all locations. However, PSM was present at CAS 06-23-02 and removed under a corrective action of clean closure. Based on the RBCA process, it was determined that remaining contamination at CAS 06-23-02 and in surface soils at CAS 09-20-01 does not pose a significant risk to human health or the environment. Based on this, CAS 06-23-02 does not require further corrective action. This does not preclude the consideration for other additional protective measures that may be implemented as BMPs. Because COCs are assumed to be present in the subsurface soil at CAS 09-20-01, a corrective action of close in place with a UR is required. The UR is included in Appendix D.

C.3.0 References

ASTM, see American Society for Testing and Materials.

American Society for Testing and Materials. 1995. *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites,* ASTM E 1739-95 (Reapproved 2002). Philadelphia, PA.

Appenzeller-Wing, J., U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2004. Letter to T.A. Maize (NDEP) entitled, "Submittal of Proposed Radiological Preliminary Action Levels (PALs) for the Industrial Sites Project," 15 January. Las Vegas, NV.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (SAIC), "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV.

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

NCRP, see National Council on Radiation Protection and Measurements.

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

National Council on Radiation Protection and Measurements. 1999. *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies/National Council on Radiation Protection and Measurements,* NCRP Report No. 129. Bethesda, MD.

Nevada Administrative Code. 2006a. NAC 445A.227, "Contamination of Soil: Order by Director for Corrective Action; Factors To Be Considered in Determining Whether Corrective Action Required." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 22 September 2008.

Nevada Administrative Code. 2006b. NAC 445A.22705, "Contamination of Soil: Evaluation of Site by Owner or Operator; Review of Evaluation by Division." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 22 September 2008.

Nevada Administrative Code. 2006c. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 22 September 2008.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

U.S. Department of Energy. 1993. *Radiation Protection of the Public and the Environment,* DOE Order 5400.5, Change 2. Washington, DC.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2008. *Corrective Action Investigation Plan for Corrective Action Unit* 546*: Injection Well and Surface Releases, Nevada Test Site, Nevada,* Rev. 0, DOE/NV--1010. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2006. *Industrial Sites Project Establishment of Final Action Levels,* Rev. 0, DOE/NV--1107. Las Vegas, NV.

U.S. Environmental Protection Agency. 2004. *Region 9 Preliminary Remediation Goals (PRGs)*. As accessed at www.epa.gov/region09/waste/sfund/prg/index.htm on 22 September 2008.

Yu, C., A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4, Argonne National Laboratory, Environmental Assessment Division, Argonne, IL.

Attachment 1

RESRAD Analysis

(26 Pages)

Summary : CAU 546 CAS 09-20-01 Industrial
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\CAU546INDUSTRIAL.RAD

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 13

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(1)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(2)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(3)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(4)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(5)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(6)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(7)
A-1	Eu-152 (Source: FGR 12)	7.006E+00	7.006E+00	DCF1(8)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(9)
A-1	Gd-152 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(10)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(11)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(12)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(13)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(14)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(15)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(16)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(17)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(18)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(19)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(20)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(21)
A-1	Pu-238 (Source: FGR 12)	1.513E-04	1.513E-04	DCF1(22)
A-1	Pu-239 (Source: FGR 12)	2.952E-04	2.952E-04	DCF1(23)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(24)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(25)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(26)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(27)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(28)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(29)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(30)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(31)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(32)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(33)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(34)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(35)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(36)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.724E+00	6.700E+00	DCF2(1)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(2)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(3)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(5)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(6)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(7)
B-1	Pu-238	3.920E-01	3.920E-01	DCF2(8)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(10)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(11)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(12)
B-1	U-234	1.320E-01	1.320E-01	DCF2(13)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 13

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(14)
B-1	U-238	1.180E-01	1.180E-01	DCF2(15)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(16)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.410E-02	DCF3(1)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(2)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(3)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(5)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(6)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(7)
D-1	Pu-238	3.200E-03	3.200E-03	DCF3(8)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(10)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(11)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(12)
D-1	U-234	2.830E-04	2.830E-04	DCF3(13)
D-1	U-235+D	2.673E-04	2.660E-04	DCF3(14)
D-1	U-238	2.550E-04	2.550E-04	DCF3(15)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(16)
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	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(2,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(3,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(3,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(6,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(6,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(7,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(7,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(7,3)
D-34				
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(8,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 13

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(11,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(11,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(11,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(12,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(13,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(13,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(14,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(14,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(14,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(15,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(15,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
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	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(2,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(3,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(5,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(6,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(7,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)
D-5				
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(8,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 13

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(11,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(11,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(12,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(12,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(13,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(13,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(14,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(14,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(15,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(15,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*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)	3.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+02	3.000E+01	---	T(5)
R011	Times for calculations (yr)	5.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+03	3.000E+02	---	T(7)
R011	Times for calculations (yr)	2.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.120E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.280E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Pu-238	4.900E-01	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Pu-239	3.220E+01	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): U-234	1.620E+00	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): U-235	7.300E-02	0.000E+00	---	S1(14)
R012	Initial principal radionuclide (pCi/g): U-238	1.110E+00	0.000E+00	---	S1(15)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(14)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(15)
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)	4.070E+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)	1.626E-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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.713E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.628E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.084E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.084E-04	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.320E-03	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.320E-03	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.320E-03	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
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	1.074E-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(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.628E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.320E-03	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.164E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.089E-03	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.613E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R017	Inhalation rate (m**3/yr)	8.400E+03	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)	8.550E-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)
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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	1.080E+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)
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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	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	1024	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
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

Summary : CAU 546 CAS 09-20-01 Industrial
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\CAU546INDUSTRIAL.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	100.00 square meters	Cs-137	1.120E+00
Thickness:	0.15 meters	Eu-152	1.280E+00
Cover Depth:	0.00 meters	Pu-238	4.900E-01
		Pu-239	3.220E+01
		U-234	1.620E+00
		U-235	7.300E-02
		U-238	1.110E+00

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	3.000E+01	1.000E+02	5.000E+02	1.000E+03	2.000E+03	3.000E+03
TDOSE(t):	1.195E+00	1.159E+00	8.917E-01	5.578E-01	1.608E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	4.781E-02	4.634E-02	3.567E-02	2.231E-02	6.433E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 1.195E+00 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	2.289E-01	0.1915	8.191E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.095E-05	0.0000
Eu-152	5.115E-01	0.4280	6.392E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.438E-06	0.0000
Pu-238	5.711E-06	0.0000	4.437E-03	0.0037	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.437E-03	0.0012
Pu-239	6.509E-04	0.0005	3.203E-01	0.2680	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.049E-01	0.0878
U-234	4.653E-05	0.0000	4.949E-03	0.0041	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.210E-04	0.0004
U-235	3.734E-03	0.0031	2.078E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.793E-05	0.0000
U-238	1.036E-02	0.0087	3.032E-03	0.0025	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.739E-04	0.0002
Total	7.552E-01	0.6318	3.330E-01	0.2786	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.071E-01	0.0896

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	2.290E-01	0.1915
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	5.116E-01	0.4280
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	5.880E-03	0.0049
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	4.259E-01	0.3563
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.416E-03	0.0045
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	3.959E-03	0.0033
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.366E-02	0.0114
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	1.195E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	2.230E-01	0.1925	7.950E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.945E-05	0.0000
Eu-152	4.838E-01	0.4176	6.026E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.012E-06	0.0000
Pu-238	5.665E-06	0.0000	4.372E-03	0.0038	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.416E-03	0.0012
Pu-239	6.497E-04	0.0006	3.182E-01	0.2746	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.042E-01	0.0899
U-234	4.629E-05	0.0000	4.894E-03	0.0042	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.164E-04	0.0004
U-235	3.710E-03	0.0032	2.056E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.775E-05	0.0000
U-238	1.028E-02	0.0089	2.999E-03	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.709E-04	0.0002
Total	7.215E-01	0.6228	3.306E-01	0.2854	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.064E-01	0.0918

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	2.230E-01	0.1925
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	4.839E-01	0.4177
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	5.794E-03	0.0050
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	4.230E-01	0.3651
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.357E-03	0.0046
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	3.934E-03	0.0034
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.355E-02	0.0117
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	1.159E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.758E-01	0.1972	6.063E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.771E-05	0.0000
Eu-152	2.927E-01	0.3283	3.537E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.115E-06	0.0000
Pu-238	5.266E-06	0.0000	3.821E-03	0.0043	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.238E-03	0.0014
Pu-239	6.381E-04	0.0007	2.985E-01	0.3348	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.775E-02	0.1096
U-234	4.440E-05	0.0000	4.423E-03	0.0050	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.763E-04	0.0004
U-235	3.505E-03	0.0039	1.865E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.619E-05	0.0000
U-238	9.635E-03	0.0108	2.710E-03	0.0030	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.448E-04	0.0003
Total	4.824E-01	0.5410	3.096E-01	0.3473	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.966E-02	0.1118

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	1.759E-01	0.1972
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	2.927E-01	0.3283
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	5.065E-03	0.0057
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	3.969E-01	0.4451
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.844E-03	0.0054
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	3.707E-03	0.0042
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.259E-02	0.0141
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	8.917E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.026E-01	0.1839	3.269E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.033E-05	0.0000
Eu-152	9.475E-02	0.1699	1.065E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.240E-06	0.0000
Pu-238	4.472E-06	0.0000	2.789E-03	0.0050	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.035E-04	0.0016
Pu-239	6.091E-04	0.0011	2.550E-01	0.4572	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.350E-02	0.1497
U-234	4.125E-05	0.0001	3.477E-03	0.0062	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.958E-04	0.0005
U-235	3.063E-03	0.0055	1.486E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.306E-05	0.0000
U-238	8.258E-03	0.0148	2.129E-03	0.0038	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.923E-04	0.0003
Total	2.093E-01	0.3752	2.635E-01	0.4725	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.493E-02	0.1523

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	1.026E-01	0.1839
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	9.475E-02	0.1699
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	3.697E-03	0.0066
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	3.391E-01	0.6080
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.814E-03	0.0068
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	3.225E-03	0.0058
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.058E-02	0.0190
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.578E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Cs-137	1.193E-02	0.0742	2.678E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.666E-06	0.0000
Eu-152	1.409E-03	0.0088	1.137E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.324E-08	0.0000
Pu-238	2.412E-06	0.0000	6.596E-04	0.0041	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.137E-04	0.0013
Pu-239	4.313E-04	0.0027	1.046E-01	0.6505	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.426E-02	0.2130
U-234	3.197E-05	0.0002	1.066E-03	0.0066	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.071E-05	0.0006
U-235	1.522E-03	0.0095	4.887E-05	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.458E-06	0.0000
U-238	3.818E-03	0.0237	6.519E-04	0.0041	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.889E-05	0.0004
Total	1.915E-02	0.1191	1.070E-01	0.6656	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.463E-02	0.2153

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	1.193E-02	0.0742
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	1.409E-03	0.0088
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	8.757E-04	0.0054
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	1.393E-01	0.8662
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.189E-03	0.0074
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.576E-03	0.0098
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.529E-03	0.0282
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	1.608E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+03 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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
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
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (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	3.000E+01	1.000E+02	5.000E+02	1.000E+03	2.000E+03	3.000E+03
Cs-137+D	Cs-137+D	1.000E+00	2.044E-01	1.991E-01	1.570E-01	9.159E-02	1.066E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Eu-152	7.208E-01	2.881E-01	2.725E-01	1.649E-01	5.336E-02	7.936E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Eu-152	2.792E-01	1.116E-01	1.055E-01	6.386E-02	2.067E-02	3.074E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Gd-152	2.792E-01	5.087E-18	1.482E-17	7.801E-17	1.257E-16	6.393E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	äDSR(j)		1.116E-01	1.055E-01	6.386E-02	2.067E-02	3.074E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	Pu-238	1.840E-09	2.208E-11	2.176E-11	1.902E-11	1.388E-11	3.288E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	Pu-238	1.000E+00	1.200E-02	1.182E-02	1.034E-02	7.545E-03	1.787E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	U-234	1.000E+00	4.725E-09	1.401E-08	8.727E-08	1.923E-07	1.731E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	Th-230	1.000E+00	3.450E-14	2.393E-13	1.026E-11	6.844E-11	2.362E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	Ra-226+D	1.000E+00	2.922E-16	4.355E-15	1.258E-12	2.607E-11	4.037E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	Pb-210+D	1.000E+00	2.169E-20	6.632E-19	1.131E-15	5.742E-14	1.642E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	äDSR(j)		1.200E-02	1.182E-02	1.034E-02	7.545E-03	1.787E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	Pu-239	1.000E+00	1.323E-02	1.314E-02	1.233E-02	1.053E-02	4.326E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	U-235+D	1.000E+00	2.672E-11	7.983E-11	5.366E-10	1.413E-09	2.638E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	Pa-231	1.000E+00	1.794E-16	1.247E-15	5.449E-14	3.802E-13	1.586E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	Ac-227+D	1.000E+00	8.212E-18	1.213E-16	3.214E-14	5.565E-13	5.205E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	äDSR(j)		1.323E-02	1.314E-02	1.233E-02	1.053E-02	4.326E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	3.343E-03	3.307E-03	2.989E-03	2.352E-03	7.271E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	3.659E-08	1.089E-07	7.030E-07	1.679E-06	2.005E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Ra-226+D	1.000E+00	4.129E-10	2.875E-09	1.284E-07	9.421E-07	4.849E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pb-210+D	1.000E+00	3.826E-14	5.659E-13	1.510E-10	2.633E-09	2.312E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	äDSR(j)		3.343E-03	3.307E-03	2.990E-03	2.354E-03	7.340E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235+D	U-235+D	1.000E+00	5.424E-02	5.388E-02	5.076E-02	4.410E-02	2.144E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235+D	Pa-231	1.000E+00	5.465E-07	1.625E-06	1.038E-05	2.424E-05	2.771E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235+D	Ac-227+D	1.000E+00	3.327E-08	2.286E-07	8.917E-06	4.932E-05	1.132E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235+D	äDSR(j)		5.424E-02	5.389E-02	5.078E-02	4.418E-02	2.158E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-238	5.400E-05	1.605E-07	1.588E-07	1.435E-07	1.128E-07	3.469E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238+D	U-238+D	9.999E-01	1.231E-02	1.221E-02	1.134E-02	9.530E-03	4.080E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238+D	U-234	9.999E-01	4.730E-09	1.405E-08	8.897E-08	2.033E-07	2.072E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238+D	Th-230	9.999E-01	3.453E-14	2.397E-13	1.039E-11	7.100E-11	2.650E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238+D	Ra-226+D	9.999E-01	2.924E-16	4.361E-15	1.270E-12	2.680E-11	4.407E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238+D	Pb-210+D	9.999E-01	2.171E-20	6.640E-19	1.139E-15	5.874E-14	1.772E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238+D	äDSR(j)		1.231E-02	1.221E-02	1.134E-02	9.531E-03	4.080E-03	0.000E+00	0.000E+00	0.000E+00	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	3.000E+01	1.000E+02	5.000E+02	1.000E+03	2.000E+03	3.000E+03
Cs-137	1.223E+02	1.255E+02	1.592E+02	2.730E+02	2.346E+03	*8.704E+13	*8.704E+13	*8.704E+13	*8.704E+13
Eu-152	6.255E+01	6.613E+01	1.093E+02	3.377E+02	2.271E+04	*1.765E+14	*1.765E+14	*1.765E+14	*1.765E+14
Pu-238	2.083E+03	2.114E+03	2.419E+03	3.313E+03	1.399E+04	*1.712E+13	*1.712E+13	*1.712E+13	*1.712E+13
Pu-239	1.890E+03	1.903E+03	2.028E+03	2.374E+03	5.778E+03	*6.214E+10	*6.214E+10	*6.214E+10	*6.214E+10
U-234	7.478E+03	7.560E+03	8.361E+03	1.062E+04	3.406E+04	*6.247E+09	*6.247E+09	*6.247E+09	*6.247E+09
U-235	4.609E+02	4.639E+02	4.923E+02	5.659E+02	1.158E+03	*2.161E+06	*2.161E+06	*2.161E+06	*2.161E+06
U-238	2.031E+03	2.047E+03	2.204E+03	2.623E+03	6.127E+03	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Cs-137	1.120E+00	0.000E+00	2.044E-01	1.223E+02	2.044E-01	1.223E+02
Eu-152	1.280E+00	0.000E+00	3.997E-01	6.255E+01	3.997E-01	6.255E+01
Pu-238	4.900E-01	0.000E+00	1.200E-02	2.083E+03	1.200E-02	2.083E+03
Pu-239	3.220E+01	0.000E+00	1.323E-02	1.890E+03	1.323E-02	1.890E+03
U-234	1.620E+00	0.000E+00	3.343E-03	7.478E+03	3.343E-03	7.478E+03
U-235	7.300E-02	0.000E+00	5.424E-02	4.609E+02	5.424E-02	4.609E+02
U-238	1.110E+00	0.000E+00	1.231E-02	2.031E+03	1.231E-02	2.031E+03

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	1.000E+01	3.000E+01	1.000E+02	5.000E+02	1.000E+03	2.000E+03	3.000E+03
Cs-137	Cs-137	1.000E+00	2.290E-01	2.230E-01	1.759E-01	1.026E-01	1.193E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Eu-152	7.208E-01	3.687E-01	3.488E-01	2.110E-01	6.830E-02	1.016E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	Eu-152	2.792E-01	1.428E-01	1.351E-01	8.174E-02	2.645E-02	3.935E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Eu-152	äDOSE(j)		5.116E-01	4.839E-01	2.927E-01	9.475E-02	1.409E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Gd-152	Eu-152	2.792E-01	6.511E-18	1.897E-17	9.986E-17	1.609E-16	8.183E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	Pu-238	1.840E-09	1.082E-11	1.066E-11	9.319E-12	6.803E-12	1.611E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	Pu-238	1.000E+00	5.880E-03	5.794E-03	5.065E-03	3.697E-03	8.756E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	äDOSE(j)		5.880E-03	5.794E-03	5.065E-03	3.697E-03	8.756E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	Pu-238	1.000E+00	2.315E-09	6.866E-09	4.276E-08	9.424E-08	8.483E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-234	1.000E+00	5.416E-03	5.357E-03	4.843E-03	3.810E-03	1.178E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	U-238	9.999E-01	5.250E-09	1.560E-08	9.876E-08	2.257E-07	2.300E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	äDOSE(j)		5.416E-03	5.357E-03	4.843E-03	3.810E-03	1.178E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	Pu-238	1.000E+00	1.690E-14	1.172E-13	5.027E-12	3.353E-11	1.157E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	U-234	1.000E+00	5.927E-08	1.764E-07	1.139E-06	2.720E-06	3.248E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	U-238	9.999E-01	3.833E-14	2.661E-13	1.153E-11	7.880E-11	2.942E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	äDOSE(j)		5.927E-08	1.764E-07	1.139E-06	2.720E-06	3.248E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	Pu-238	1.000E+00	1.432E-16	2.134E-15	6.164E-13	1.278E-11	1.978E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	U-234	1.000E+00	6.688E-10	4.657E-09	2.080E-07	1.526E-06	7.855E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	U-238	9.999E-01	3.246E-16	4.841E-15	1.410E-12	2.975E-11	4.891E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	äDOSE(j)		6.688E-10	4.657E-09	2.080E-07	1.526E-06	7.856E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	Pu-238	1.000E+00	1.063E-20	3.250E-19	5.540E-16	2.813E-14	8.047E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	U-234	1.000E+00	6.199E-14	9.167E-13	2.446E-10	4.265E-09	3.745E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	U-238	9.999E-01	2.409E-20	7.370E-19	1.265E-15	6.520E-14	1.967E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	äDOSE(j)		6.199E-14	9.167E-13	2.446E-10	4.265E-09	3.745E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	Pu-239	1.000E+00	4.259E-01	4.230E-01	3.969E-01	3.391E-01	1.393E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	Pu-239	1.000E+00	8.603E-10	2.571E-09	1.728E-08	4.550E-08	8.495E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	3.959E-03	3.934E-03	3.706E-03	3.220E-03	1.565E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-235	äDOSE(j)		3.959E-03	3.934E-03	3.706E-03	3.220E-03	1.565E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	Pu-239	1.000E+00	5.778E-15	4.015E-14	1.755E-12	1.224E-11	5.108E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	U-235	1.000E+00	3.989E-08	1.186E-07	7.576E-07	1.770E-06	2.023E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pa-231	äDOSE(j)		3.989E-08	1.186E-07	7.576E-07	1.770E-06	2.023E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ac-227	Pu-239	1.000E+00	2.644E-16	3.907E-15	1.035E-12	1.792E-11	1.676E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ac-227	U-235	1.000E+00	2.429E-09	1.669E-08	6.509E-07	3.600E-06	8.261E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ac-227	äDOSE(j)		2.429E-09	1.669E-08	6.509E-07	3.601E-06	8.261E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-238	5.400E-05	1.782E-07	1.762E-07	1.593E-07	1.252E-07	3.850E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	U-238	9.999E-01	1.366E-02	1.355E-02	1.259E-02	1.058E-02	4.529E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	äDOSE(j)		1.366E-02	1.355E-02	1.259E-02	1.058E-02	4.529E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration, Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	3.000E+01	1.000E+02	5.000E+02	1.000E+03	2.000E+03	3.000E+03
Cs-137	Cs-137	1.000E+00	1.120E+00	1.094E+00	8.885E-01	5.592E-01	1.106E-01	1.052E-05	9.872E-11	8.702E-21	7.670E-31
Eu-152	Eu-152	7.208E-01	9.226E-01	8.756E-01	5.471E-01	1.924E-01	4.958E-03	4.135E-12	1.854E-23	0.000E+00	0.000E+00
Eu-152	Eu-152	2.792E-01	3.574E-01	3.392E-01	2.119E-01	7.451E-02	1.921E-03	1.602E-12	7.180E-24	0.000E+00	0.000E+00
Eu-152	äS(j):		1.280E+00	1.215E+00	7.590E-01	2.669E-01	6.879E-03	5.737E-12	2.572E-23	0.000E+00	0.000E+00
Gd-152	Eu-152	2.792E-01	0.000E+00	2.234E-15	1.784E-14	3.457E-14	4.273E-14	3.868E-14	3.392E-14	2.608E-14	2.005E-14
Pu-238	Pu-238	1.840E-09	9.016E-10	8.944E-10	8.322E-10	7.090E-10	4.048E-10	1.644E-11	2.999E-13	9.977E-17	3.319E-20
Pu-238	Pu-238	1.000E+00	4.900E-01	4.861E-01	4.523E-01	3.854E-01	2.200E-01	8.937E-03	1.630E-04	5.422E-08	1.804E-11
Pu-238	äS(j):		4.900E-01	4.861E-01	4.523E-01	3.854E-01	2.200E-01	8.937E-03	1.630E-04	5.422E-08	1.804E-11
U-234	Pu-238	1.000E+00	0.000E+00	1.381E-06	1.306E-05	3.465E-05	7.541E-05	3.653E-05	4.872E-06	6.620E-08	8.782E-10
U-234	U-234	1.000E+00	1.620E+00	1.613E+00	1.551E+00	1.423E+00	1.051E+00	1.865E-01	2.148E-02	2.847E-04	3.774E-06
U-234	U-238	9.999E-01	0.000E+00	3.133E-06	3.014E-05	8.292E-05	2.042E-04	1.813E-04	4.177E-05	1.109E-06	2.209E-08
U-234	äS(j):		1.620E+00	1.613E+00	1.551E+00	1.423E+00	1.052E+00	1.867E-01	2.152E-02	2.859E-04	3.797E-06
Th-230	Pu-238	1.000E+00	0.000E+00	6.227E-12	6.001E-10	4.980E-09	4.199E-08	2.776E-07	3.480E-07	3.536E-07	3.493E-07
Th-230	U-234	1.000E+00	0.000E+00	1.455E-05	1.427E-04	4.102E-04	1.183E-03	2.972E-03	3.296E-03	3.298E-03	3.257E-03
Th-230	U-238	9.999E-01	0.000E+00	1.412E-11	1.376E-09	1.170E-08	1.067E-07	9.614E-07	1.399E-06	1.485E-06	1.469E-06
Th-230	äS(j):		0.000E+00	1.455E-05	1.427E-04	4.102E-04	1.183E-03	2.973E-03	3.298E-03	3.300E-03	3.259E-03
Ra-226	Pu-238	1.000E+00	0.000E+00	8.993E-16	8.678E-13	2.166E-11	6.122E-10	1.896E-08	3.717E-08	4.337E-08	4.311E-08
Ra-226	U-234	1.000E+00	0.000E+00	3.151E-09	3.077E-07	2.629E-06	2.442E-05	2.394E-04	3.702E-04	4.055E-04	4.020E-04
Ra-226	U-238	9.999E-01	0.000E+00	2.039E-15	1.984E-12	5.041E-11	1.513E-09	6.087E-08	1.418E-07	1.810E-07	1.812E-07
Ra-226	äS(j):		0.000E+00	3.151E-09	3.077E-07	2.629E-06	2.442E-05	2.395E-04	3.704E-04	4.058E-04	4.022E-04
Pb-210	Pu-238	1.000E+00	0.000E+00	6.948E-18	6.367E-14	4.276E-12	2.912E-10	1.619E-08	3.414E-08	4.053E-08	4.032E-08
Pb-210	U-234	1.000E+00	0.000E+00	3.239E-11	2.958E-08	6.592E-07	1.362E-05	2.106E-04	3.423E-04	3.791E-04	3.760E-04
Pb-210	U-238	9.999E-01	0.000E+00	1.575E-17	1.453E-13	9.906E-12	7.116E-10	5.126E-08	1.294E-07	1.690E-07	1.694E-07
Pb-210	äS(j):		0.000E+00	3.239E-11	2.958E-08	6.592E-07	1.362E-05	2.107E-04	3.425E-04	3.793E-04	3.762E-04
Pu-239	Pu-239	1.000E+00	3.220E+01	3.220E+01	3.216E+01	3.207E+01	3.176E+01	3.007E+01	2.807E+01	2.447E+01	2.134E+01
U-235	Pu-239	1.000E+00	0.000E+00	3.164E-08	3.102E-07	8.904E-07	2.556E-06	6.204E-06	6.508E-06	5.760E-06	5.023E-06
U-235	U-235	1.000E+00	7.300E-02	7.269E-02	6.991E-02	6.413E-02	4.739E-02	8.417E-03	9.705E-04	1.290E-05	1.715E-07
U-235	äS(j):		7.300E-02	7.269E-02	6.991E-02	6.413E-02	4.739E-02	8.423E-03	9.770E-04	1.866E-05	5.195E-06
Pa-231	Pu-239	1.000E+00	0.000E+00	3.345E-13	3.258E-11	2.766E-10	2.515E-09	2.207E-08	3.065E-08	2.893E-08	2.528E-08
Pa-231	U-235	1.000E+00	0.000E+00	1.538E-06	1.479E-05	4.069E-05	1.002E-04	8.858E-05	2.032E-05	5.346E-07	1.055E-08
Pa-231	äS(j):		0.000E+00	1.538E-06	1.479E-05	4.069E-05	1.002E-04	8.860E-05	2.035E-05	5.635E-07	3.583E-08
Ac-227	Pu-239	1.000E+00	0.000E+00	3.515E-15	3.140E-12	6.705E-11	1.251E-09	1.584E-08	2.282E-08	2.170E-08	1.896E-08
Ac-227	U-235	1.000E+00	0.000E+00	2.417E-08	2.081E-06	1.372E-05	6.205E-05	6.987E-05	1.647E-05	4.391E-07	8.704E-09
Ac-227	äS(j):		0.000E+00	2.417E-08	2.081E-06	1.372E-05	6.205E-05	6.989E-05	1.649E-05	4.608E-07	2.766E-08
U-238	U-238	5.400E-05	5.994E-05	5.968E-05	5.741E-05	5.265E-05	3.891E-05	6.911E-06	7.969E-07	1.059E-08	1.408E-10
U-238	U-238	9.999E-01	1.110E+00	1.105E+00	1.063E+00	9.750E-01	7.206E-01	1.280E-01	1.476E-02	1.962E-04	2.608E-06
U-238	äS(j):		1.110E+00	1.105E+00	1.063E+00	9.751E-01	7.206E-01	1.280E-01	1.476E-02	1.962E-04	2.608E-06

THF(i) is the thread fraction of the parent nuclide.
RESCALC.EXE execution time = 23.14 seconds

Appendix D

Closure Activity Summary
(Use Restriction)

D.1.0 Closure Activity Summary

The following sections document closure activities completed for CAU 546 at CASs 06-23-02 and 09-20-01. The closure activities were based on recommendations and decisions made at the CAU 546 Corrective Action Alternatives meeting on August 20, 2008.

D.1.1 CAS 06-23-02 Closure Activities

A lead brick, lead battery, and lead slag were removed as PSM; the debris and the soil that was in contact with the debris were placed in a drum and disposed of as waste. The vent line and pipe assemblies throughout the test area were cut to the ground surface and grouted as a BMP.

D.1.2 CAS 09-20-01 Closure Activities

The closure activities performed at CAS 09-20-01 consisted of backfilling the void space surrounding the injection well and posting a UR around the injection well. The corners of the UR were surveyed to support the UR form and Figure D.1-1 included in this appendix. The work was conducted on September 23, 2008.

CAU Use Restriction Information

CAU Number/Description: CAU 546, Injection Well and Surface Releases

Applicable CAS Number(s)/Description(s): CAS 09-20-01, Injection Well

Contact (organization/project): NNSA/NSO Industrial Sites Federal Sub-Project Director

Surveyed Area (UTM, Zone 11, NAD 27, meters):

Northwest Corner: E = 584858.72; N = 4109539.13
Northeast Corner E = 584864.85; N = 4109538.34
Southwest Corner E = 584858.47; N = 4109533.91
Southeast Corner: E = 584865.15; N = 4109530.99

Survey Date: September 2008 **Survey Method (GPS, etc.):** GPS
Site Monitoring Requirements: Inspection of postings

Required Frequency (quarterly, annually?): Annually

If Monitoring Has Started, Indicate last Completion Date: Not Applicable

Use Restrictions

The future use of any land related to this 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 546 documentation, unless appropriate concurrence is obtained in advance.

Comments: This UR is for subsurface disturbances greater than 2 ft bgs. The restricted area is identified with signs located at the northwest, northeast, southwest, and southeast corners of the injection well (no fencing). Annual post-closure inspections will be conducted to ensure postings are in place, intact, and readable. See the CAU 546 CADD/CR for additional information on the condition of the site.

Submitted By: /s/ Tiffany Lantow **Date:** 04 Dec 2008

cc with copy of survey map (paper and digital (.dgn) formats):
CAU Files (2 copies)

The UR signs state the following information:

WARNING
Underground Radiological
Contamination Below 2 ft bgs
FFACO Site CAU 546/CAS 09-20-01
Injection Well
No activities that may alter or modify the containment control are
permitted without U.S. Government permission.
Before working in this area,
Contact Real Estate Services at 295-2528

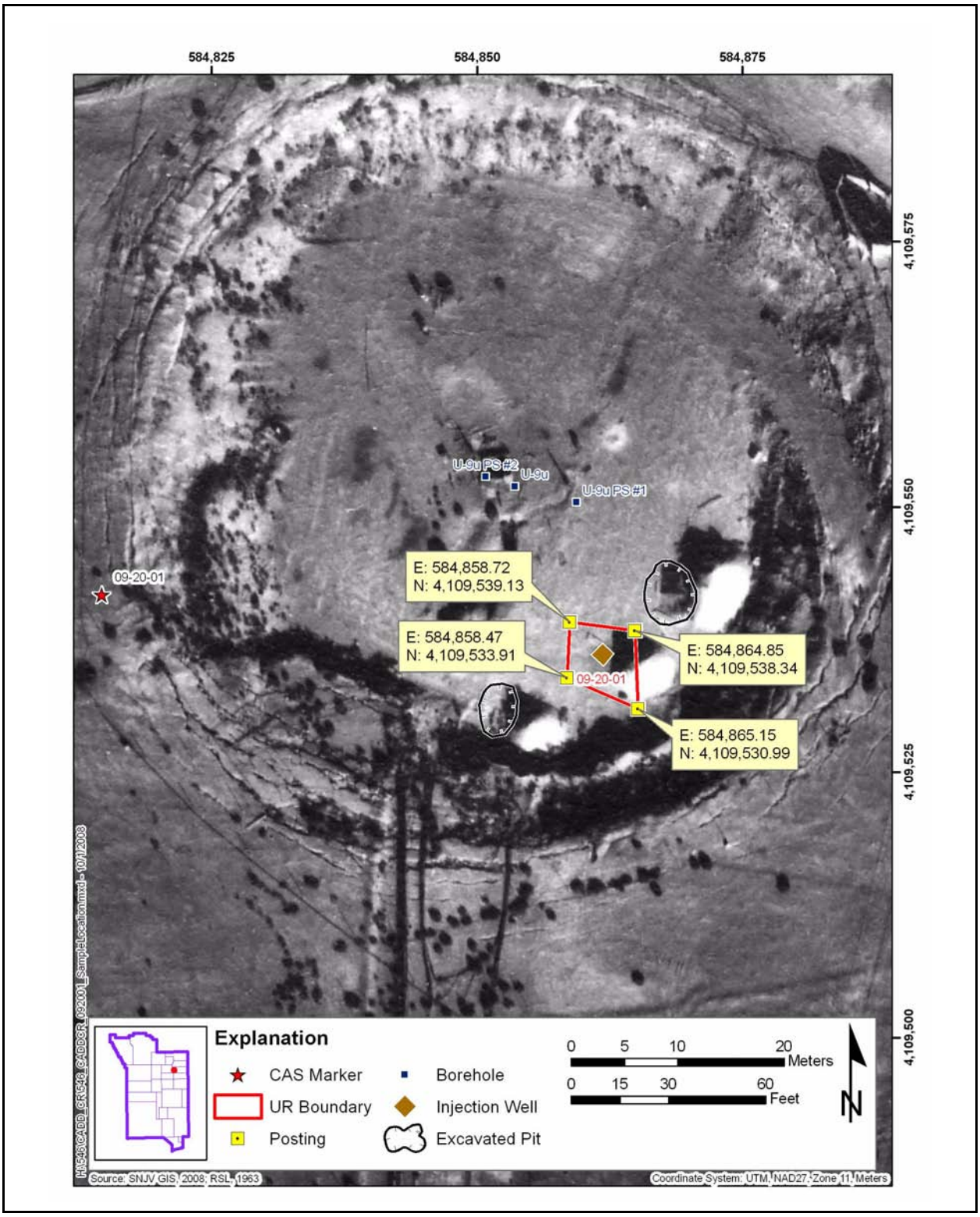

Figure D.1-1
Corrective Action Unit 546, CAS 09-20-01
Land Use Restriction Boundary

D.2.0 References

RSL, see Remote Sensing Laboratory.

Remote Sensing Laboratory. 1963. Aerial photograph "U9 AU Pre T-1," 11 December. Las Vegas, NV: EG&G Energy Measurements, Inc.

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

Stoller-Navarro Joint Venture Geographic Information Systems. 2008. ESRI ArcGIS Software.

Appendix E

Sample Location Coordinates

E.1.0 Sample Location Coordinates

Sample location coordinates for the CAI sampling were collected using a Trimble 5800 GPS Unit with centimeter-level accuracy. These coordinates identify the Decision I sampling locations (easting and northing positions) at CAU 546 and are shown in Figures A.3-1 and A.4-1. The corresponding coordinates for CASs 06-23-02 and 09-20-01 locations are listed in Table E.1-1.

Table E.1-1
Sample Location Coordinates[a] CASs 06-23-02 and 09-20-01
(Page 1 of 2)

Easting	Northing	Location
CAS 06-23-02		
584079.74	4091721.22	A01
584084.76	4091695.57	A02
584112.32	4091712.27	A03
584109.09	4091726.25	A04
584130.53	4091727.21	A05
584108.00	4091662.50	A06
584108.42	4091650.67	A07
584129.45	4091671.54	A08
584135.35	4091695.71	A09
583975.75	4091859.81	A10
583979.13	4091847.00	A11
583989.01	4091854.14	A12
583999.26	4091860.44	A13
584053.41	4091801.90	A14
584013.53	4091784.15	A15
584006.83	4091784.46	A16
584135.60	4091777.24	A17
584129.36	4091775.68	A18
584127.40	4091773.05	A19
584127.79	4091777.96	A20
584018.85	4091860.29	A21

Table E.1-1
Sample Location Coordinates[a] CASs 06-23-02 and 09-20-01
(Page 2 of 2)

Easting	Northing	Location
583985.77	4091869.98	A22
583964.24	4091853.87	A23
583980.73	4091836.21	A24
584135.90	4091735.00	A25
584119.80	4091730.00	A26
583968.60	4091773.00	A27
583963.00	4091800.00	A28
584096.46	4091661.96	A29
584122.04	4091654.60	A30
584136.87	4061673.95	A31
584140.17	4091696.70	A32
584117.11	4091650.35	A33
583947.92	4091667.69	A34
583946.90	4091666.58	A35
583946.67	4091667.91	A36
CAS 09-20-01		
584860.88	4109536.99	B01
584860.87	4109535.18	B02
584862.74	4109536.28	B03
584867.23	4109543.86	B04

[a]Universal Transverse Mercator Zone 11, North American Datum 1927 (U.S. Western)

Appendix F

Waste Disposal Documentation

(4 Pages)

NSTec Form FRM-0266

ONSITE WASTE TRANSPORT MANIFEST

04/10/08 Rev. 01

Manifest Document No.: 0 9 N 0 4

Page 1 of 1

Generation/Out-of-Service Date: 11/10/08

1. Generator's Name, Organization, and Location: (Please Print)
Joe Molter, SNJV Waste Ops
NTS Area-6 CAU 546, CAS 06-23-02
5B1B 69BG

Generator's Phone : (702) 295-1578

2. Receiving Facility, Organization, Location: (Please Print)
NSTec/Hazardous Waste Operations
Hazardous Waste Storage Unit
NTS Area 5 Bldg. 5-20

Contact Phone: (702) 295-4263

3a. Transporter Name: (Please Print)
Brett Bushnell

Transport Date: 11/10/08

3b. Vehicle I.D. Number: G63-1104D

	4. U.S. D.O.T. Description, Include: EPA Waste Code and Package Tracking Numbers.	HM		5. Containers No.	5. Containers Type	6. Total Quantity	7. Unit Wt./Vol.
a	NA3077, Hazardous waste, solid, n.o.s. (lead), 9, III D008 #NS-NTS-09-0014	X		1	DM	25	P
b							
c							
d							
e							
f							
g							

Use continuation pages for additional items, as necessary.

8. Special Handling Instructions/Additional Information: 24-Hour emergency contact: 702 - 295-0311 / Secondary: Carlos 630-0235 (Name & phone no.)

a) ERG# 171. 10-Gallon DM. Lead slag & lead contaminated soil, PPE. SNJV # 546A01 gm

/s/ Joe Molter

9. Released by: (Signature) Date: 11/10/08

10. Received for Transport by: (Signature)
/s/ Brett Bushnell
Date: 11/10/08

11. Discrepancy Indication: Actual qty is 62#. 10-G IA2/X100/S. ccj 11/10/08

12. Disposal/Accumulation Site Signature: *(Acknowledges acceptance of waste)*
/s/ Cirilo C. Gonzales
Date: 11/10/08

NSTec Form FRM-0918

NTS LANDFILL LOAD VERIFICATION

11

Page

SWO USE (Select One) AREA ☐ 23 ☐ 6 ☒ 9 ☒ LANDFILL

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GERERATOR INFORMATION

(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: Joe Molter, SNJV Waste Ops CAU-546 Phone Number: X5-1578, c 630-0188

Location / Origin: Area 6, CAS 06-23-02 & Area 9, CAS 09-20-01; debris, track #s 546A05, 546B01, HC drum # 546A03

Waste Category: (check one)		☐ Commercial	☒ Industrial	
Waste Type: (check one)	☒ NTS	☐ Putrescrible	☒ FFACO-onsite	☐ WAC Exception
	☐ Non-Putrescible	☐ Asbestos Containing Material	☐ FFACO-offsite	☐ Historic DOE/NV
Pollution Prevention Category: (check one)		☒ Environmental management	☐ Defense Projects	☐ YMP
Pollution Prevention Category: (check one)		☒ Clean-Up	☐ Routine	
Method of Characterization: (check one)		☐ Sampling & Analysis	☒ Process Knowledge	☐ Contents

Prohibited Waste at all three NTS landfills: Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels, and Medical wastes (needles, sharps, bloody clothing).

Additional Prohibited Waste at the Area 9 U10C Landfill: Sewage Sludge, Animal carcasses, Wet garbage (food waste); and Friable asbestos

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

NOTE: Waste disposal at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants, such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NTS landfill:

☐ Asphalt ☒ Metal ☐ Wood ☒ Soil ☐ Paper ☐ Rocks / unaltered geologic materials ☒ Empty containers

☒ Plastic ☐ Wire ☐ Cable ☒ Cloth ☐ Rubber (excluding tires) ☐ Demolition debris

☒ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.) ☐ Insulation (non-Asbestosform) ☐ Cement & concrete

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses

☐ Asbestos ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: _____

Additional waste accepted at the Area 9 U10c Landfill:

☐ Non-friable asbestos ☐ Drained automobiles and military vehicles ☐ Solid fractions from sand/oil/water

☐ Light ballasts (contact SWO) ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground Tanks

☒ Hydrocarbons (contact SWO) ☐ Other _____

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ _____

☐ Septic sludge ☐ Rags ☐ Drained fuel filters (gas & diesel) ☐ Crushed non-teme plated oil filters

☐ Plants ☐ Soil ☐ Sludge from sand/oil/water separators ☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: _____ **(if initialed, no radiological clearance is necessary.)**

The above mentioned waste was generated outside of a Controlled Waste Managemen knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those materials site. I have verified this through the waste characterization method identified above ar prohibited and allowable waste items. I have contacted Property Management and hav is approved for disposal in the landfill.

Print Name: Stacey Alderson

Signature: /s/ Stacey Alderson Date: 11-12-08

Note: "Food waste, office trash and animal carcasses do not require a radiological clearance. Freon-containing appliances must have signed removal certification statement with Load Verification."

Radiological Survey Release for Waste Disposal

RCT Initials

X **This container/load meets the criteria for no added man-made radioactive material**

_____ **This container/load meets the criteria for Radcon Manual Table 4.2 release limits.**

_____ **This container/load is exempt from survey due to process knowledge and origin.**

SIGNATURE: /s/ Chao-Hsiung Tung **DATE:** 11/12/08

BN-0646 (10/05)

SWO USE ONLY

Load Weight (net from scale or estimate): 1660 11/13/08 Signature of Certifier: /s/ Don Bickford

0

NSTec Form FRM-0918

NTS LANDFILL LOAD VERIFICATION

(1)

Page 1

SWO USE (Select One) AREA ☒ 23 ☐ 6 ☐ 9 ☒ **LANDFILL**

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GERERATOR INFORMATION

(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: Joe Molter, SNJV Waste Ops Phone Number: X5-1578, c 630-0188

Location / Origin: A23 Mercury, south side of Bldg 23-153; one 55-gallon drum of friable asbestos waste, Drum # 546A04

Waste Category: (check one)		☐ Commercial	☒ Industrial	
Waste Type: (check one)	☒ NTS	☐ Putrescrible	☒ FFACO-onsite	☐ WAC Exception
	☐ Non-Putrescible	☒ Asbestos Containing Material	☐ FFACO-offsite	☐ Historic DOE/NV
Pollution Prevention Category: (check one)		☒ Environmental management	☐ Defense Projects	☐ YMP
Pollution Prevention Category: (check one)		☒ Clean-Up	☐ Routine	
Method of Characterization: (check one)		☒ Sampling & Analysis	☒ Process Knowledge	☐ Contents

Prohibited Waste at all three NTS landfills: Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels, and Medical wastes (needles, sharps, bloody clothing).

Additional Prohibited Waste at the Area 9 U10C Landfill: Sewage Sludge, Animal carcasses, Wet garbage (food waste); and Friable asbestos

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

NOTE: Waste disposal at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants, such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NTS landfill:

☐ Asphalt	☒ Metal	☐ Wood	☒ Soil	☐ Rocks / unaltered geologic materials	☐ Paper	☐ Empty containers
☒ Plastic	☐ Wire	☐ Cable	☒ Cloth	☒ Insulation (non-Asbestosform)		☐ Demolition debris
☒ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)						☐ Cement & concrete

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses

☒ Asbestos ☒ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: 25 gallons (net)

Additional waste accepted at the Area 9 U10c Landfill:

☐ Non-friable asbestos	☐ Drained automobiles and military vehicles	☐ Solid fractions from sand/oil/water
☐ Light ballasts (contact SWO)	☐ Drained fuel filters (gas & diesel)	☐ Deconned Underground and Above Ground Tanks
☐ Hydrocarbons (contact SWO)	☐ Other _____	

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ _____

☐ Septic sludge	☐ Rags	☐ Drained fuel filters (gas & diesel)	☐ Crushed non-teme plated oil filters
☐ Plants	☐ Soil	☐ Sludge from sand/oil/water separators	☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: _____ (if initialed, no radiological clearance is necessary.)

The above mentioned waste was generated outside of a Controlled Waste Manag[illegible] Area (CWMA) and to the best of my knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those ma[illegible] site. I have verified this through the waste characterization method identified ab[illegible] prohibited and allowable waste items. I have contacted Property Management ar[illegible] is approved for disposal in the landfill.

Print Name: John M. Fowler

Signature: /s/ John M. Fowler Date: 10/29/08

Radiological Survey Release for Waste Disposal

RCT Initials

X — **This container/load meets the criteria for no added man-made radioactive material**

____ **This container/load meets the criteria for Radcon Manual Table 4-2 release limits.**

____ **This container/load is exempt from survey due to process knowledge and origin.**

SIGNATURE: /s/ Chao-Hsiung Tung **DATE:** 10/17/08

BN-0646 (10/05)

Note: "Food waste, office trash and animal carcasses do not require a radiological clearance. Freon-containing appliances must have signed removal certification statement with Load Verification."

SWO USE ONLY

Load Weight (net from scale or estimate): 120 Signature of Certifier: 11/13/08 /s/ Don Bickford

* * * * * OFFICIAL USE ONLY * * * * * *

NTS On-Site HazMat Transfer - Published

Tracking No: 20081112072647 **Mesa Number:**
Carrier: NSTEC
Vehicle: G820445D
Driver: WARREN MORRIS CDL: 3400170034 NV

Depart: 13-NOV-2008 Arrival: 13-NOV-2008

From: JOE MOLTER
STOLLER-NAVARRO
BASE CAMP
MERCURY, NV 89023
Area: 23
Bldg: 0153
Phone: 702-295-1578 1578
Mobile: 702-630-0188

To: GREG SCHMETT
NSTEC
BASE CAMP
MERCURY, NV 89023
Area: 23
Bldg: LANDFILL
Phone: 702-295-4870
Mobile:

Entered By: ROBERT MOLTER
Modified By: ROBERT MOLTER

Date Entered: 12-NOV-2008
Date Modified: 13-NOV-2008

Shipped Material(s)	Package(s)	Unit(s)	Guide No.
RQ, UN/NA 2212, ASBESTOS, 9, PG III SNJV CONTAINER # 546A04	1 DRUM, METAL	55.00 GALLON(S) (GROSS)	171

Emergency Response Number
702-295-0311

Secondary Emergency Response Contact And/Or Comments
JOE MOLTER, PHONE 702-295-1578 CELL 702-630-0188

EMERGENCY RESPONSE

By Phone
702-295-0311

By Radio
'MAYDAY - MAYDAY - MAYDAY'

In the event of an incident involving Hazardous Material:

1. Gather HazMat shipping papers and NAER Guidebook
2. Isolate the immediate area
3. Assess the situation:
   a. Fire, Spill, or Leak?
   b. People, Property, or the Environment at risk?
4. Contact On-site Emergency Response Personnel
5. Reference On-Site HazMat Transfer Tracking Number

This is to certify that the above-named materials are properly classified, described, packaged, marked, placarded, and labeled and are in proper condition for transportation according to the applicable regulations of the U.S Department of Transportation. As a signatory I cerfify that I have been trained and tested to the requirements of 49 CFR, Part 172-700 and is compliant with the NTS OTSD.

Authorized Signature: /s/ Joe Molter Date: 11/13/08 Time: 13:45

Received by: /s/ R. Everett Date: 11/13/08 Time: 15:02

Appendix G

Nevada Division of Environmental Protection Comments

(2 Pages)

ndep
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Jim Gibbons, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administr

November 3, 2008

Robert F. Boehlecke
Federal Project Director
Environmental Restoration Project
National Nuclear Security Administration
Nevada Site Office
P.O. Box 98518
Las Vegas, NV 89193-8518

RE: Review of the draft Corrective Action Decision Document / Closure Report (CADD/CR)
Corrective Action Unit (CAU) 546: Injection Well and Surface Releases
Federal Facility Agreement and Consent Order

Dear Mr. Boehlecke,

The Nevada Division of Environmental Protection, Bureau of Federal Facilities (NDEP) staff has received and reviewed the draft Corrective Action Decision Document / Closure Report (CADD/CR) for Corrective Action Unit (CAU) 546: Injection Well and Surface Releases. NDEP's review of this document did not indicate any deficiencies.

Address any questions regarding this matter to Ted Zaferatos at (702) 486-2850, ext. 234, or myself at (702) 486-2850, ext. 233.

Sincerely,

/s/ Jeff MacDougall

Jeff MacDougall, Ph.D.
Supervisor
Bureau of Federal Facilities

ACTION	
INFO	AMEM
NSO/MGR	
AMBCM	
AMEM	✓
AMNS	
AMSO	
AMSS	
COR-RAI-File Code	

JJM/TZ

cc: K. J. Cabble, ERP, NNSA/NSO, Las Vegas, NV
E.F. DiSanza, WMP, NNSA/NSO
FFACO Group, PSG, NNSA/NSO, Las Vegas, NV
Jeffrey Fraher, DTRA/CXTS, Kirtland AFB, NM
Wayne Griffin, SNJV, Las Vegas, NV
T. A. Thiele, NSTec, Las Vegas, NV

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