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

Corrective Action Unit (CAU) Number: 576
CAU Description: Miscellaneous Radiological Sites and Debris
CAU Owner: Soils - Environmental Restoration (ER)

ROTC No. DOE/EMNV--0001-ROTC 1 **Page** 1 of 31

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 11/07/2019

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

Tiffany Gamero
Requestor Name

Long-Term Monitoring Activity Lead
Requestor Title

Description of Change:

1. The use restriction (UR) forms for Corrective Action Sites (CASs) 02-99-12, 03-99-20, 05-19-04, 09-99-08, and 09-99-09 were updated with minor editorial corrections, to be consistent with current standards. These changes are not technical in nature.
2. Remove "final" from the Administrative UR summary statement on the CAS 05-19-04 UR form.

Justification:

1. These minor editorial corrections were made in order to make all UR forms have standard verbiage.
2. Per FFACO agreement, Administrative URs are emplaced when contamination is present at levels below final actions levels but above an industrial action level.

Schedule Impacts:

No impacts to schedule.

ROTC applies to the following document(s):

- U.S. Department of Energy, Environmental Management Nevada Program. 2019. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

UNCONTROLLED

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

Corrective Action Unit (CAU) Number: 576
CAU Description: Miscellaneous Radiological Sites and Debris
CAU Owner: Soils - Environmental Restoration (ER)

ROTC No. DOE/EMNV--0001-ROTC 1 **Page** 2 of 31

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 11/07/2019

Approvals:

/s/ Kevin Cabble Date 11/13/19

Kevin Cabble
Activity Lead
Environmental Management (EM) Nevada Program

/s/ Wilhelm R. Wilborn Date 11/18/2019

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

/s/ Mark McLane Date 11/26/2019

Christine Andres FOR
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: 576 - Miscellaneous Radiological Sites and Debris

Corrective Action Site (CAS) Number & Description: 02-99-12 - U-2af (Kennebec) Surface Rad-Chem Piping

CAU/CAS Owner: Soils - 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 Occasional Use Area (80 hours per year) exposure scenario.

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	582,397	4,109,767
	2	582,396	4,109,771
	3	582,703	4,109,850
	4	582,704	4,109,846
	5	582,397	4,109,767

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

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

Boundary Applies to: Both Surface and Subsurface

Starting Depth: 0 **Ending Depth:** 5

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

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Fence	Present and provides barrier.
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: N/A

Section II. Administrative UR

An Administrative UR is not identified for this site.

Section III. Supporting Documentation

UR Source Document(s)

ROTC 1 for CAU 576 CADD/CR (DOE/EMNV--0001), dated 11/07/2019.

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. 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

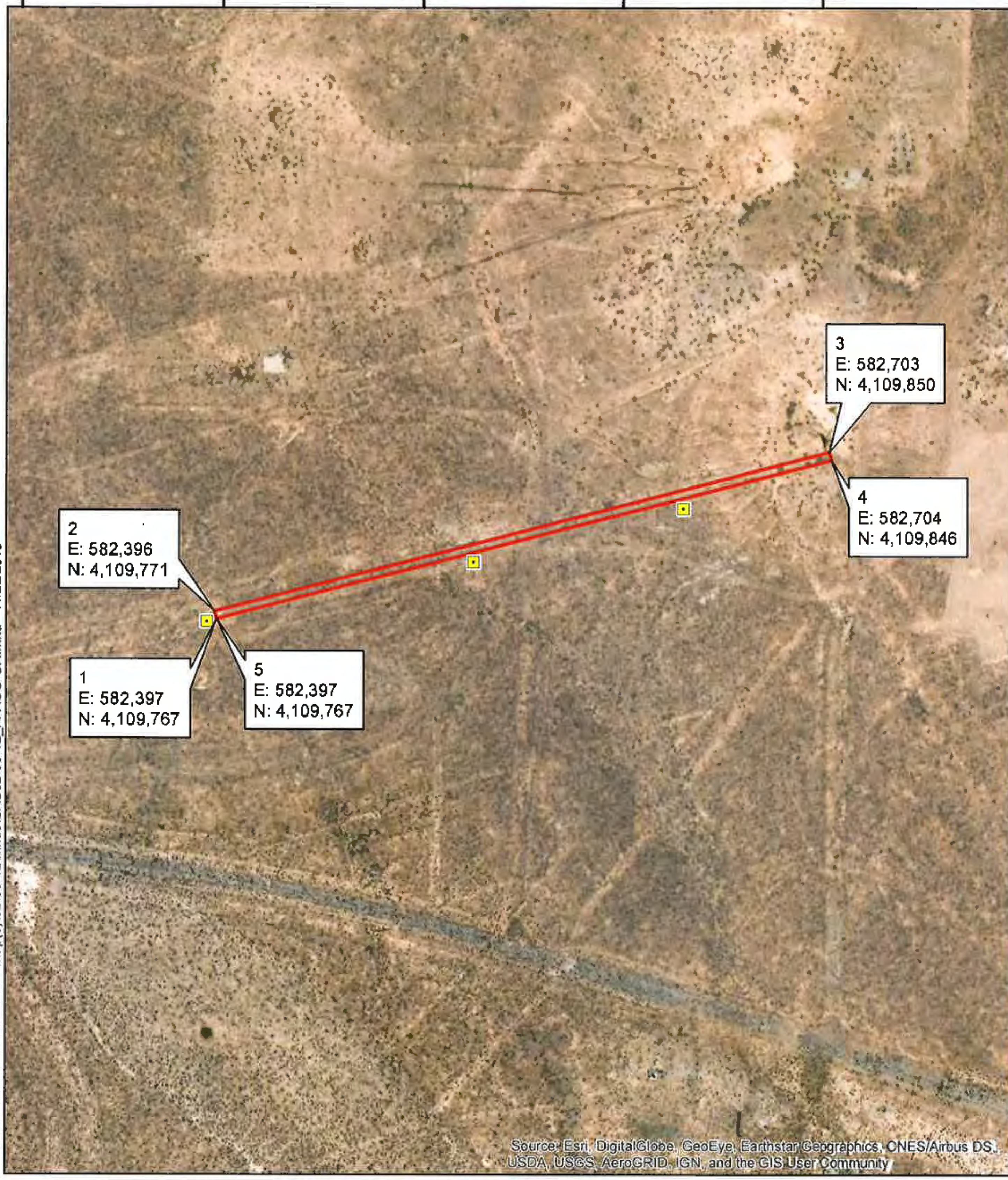
/s/ Kevin Cabble

Date: 11/13/19

Kevin Cabble

Activity Lead

EM Nevada Program



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CAU 576, CAS 02-99-12
U-2af (Kennebec) Surface
Rad-Chem Piping
FFACO UR Boundary

Explanation

FFACO UR

Approximate Location of UR Sign

0 20 40 80 Meters

0 50 100 200 Feet

N

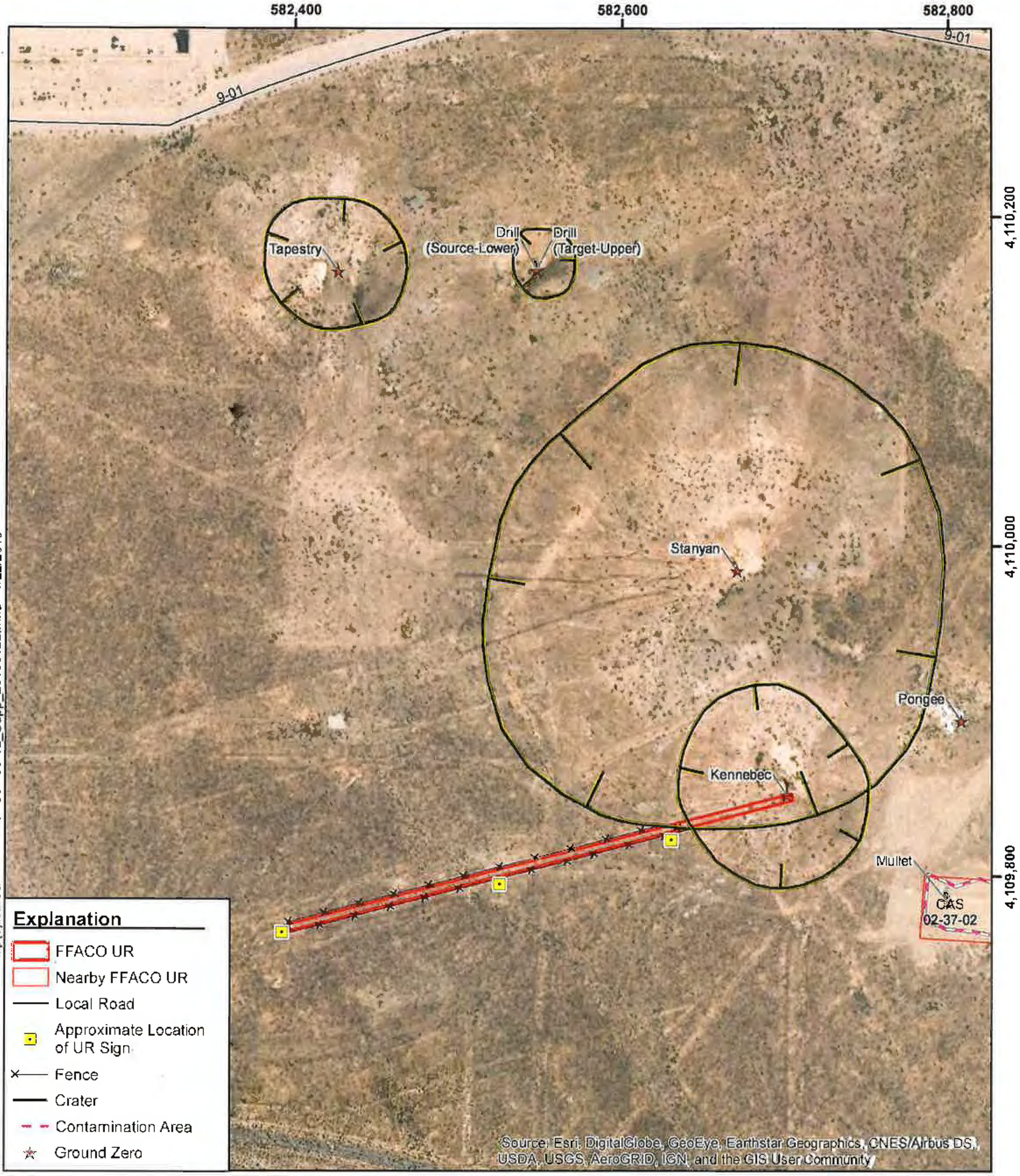
NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2018

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.



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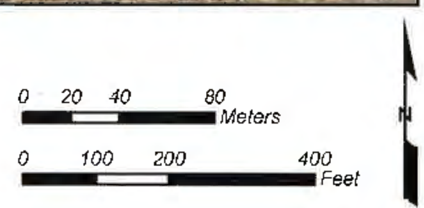
Source: Navarro GIS, 2019

CAU 576, CAS 02-99-12
U-2af (Kennebec) Surface Rad-Chem Piping
Supplemental Information
General Location of Site Features



NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

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:	576 - Miscellaneous Radiological Sites and Debris
Corrective Action Site (CAS) Number & Description:	03-99-20 - Area 3 Subsurface Rad-Chem Piping
CAU/CAS Owner:	Soils - 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 contaminants that were released at this site. Radiological contaminants are assumed to be present that exceed final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

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

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary 1	1	586,169	4,100,765
	2	585,890	4,100,799
	3	585,892	4,100,804
	4	586,170	4,100,769
	5	586,169	4,100,765
FFACO Boundary 2	1	586,008	4,100,665
	2	585,803	4,100,718
	3	585,804	4,100,724
	4	586,011	4,100,670
	5	586,008	4,100,665

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

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

Boundary Applies to: Subsurface

Starting Depth: 0 **Ending Depth:** 5

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Signage	Present and legible.

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

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: The basis for this UR is the assumed presence of subsurface contamination. No surface contamination is present exceeding background levels.

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 576 CADD/CR (DOE/EMNV--0001), dated 11/07/2019.

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

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

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

Section V. EM Nevada Program Approval

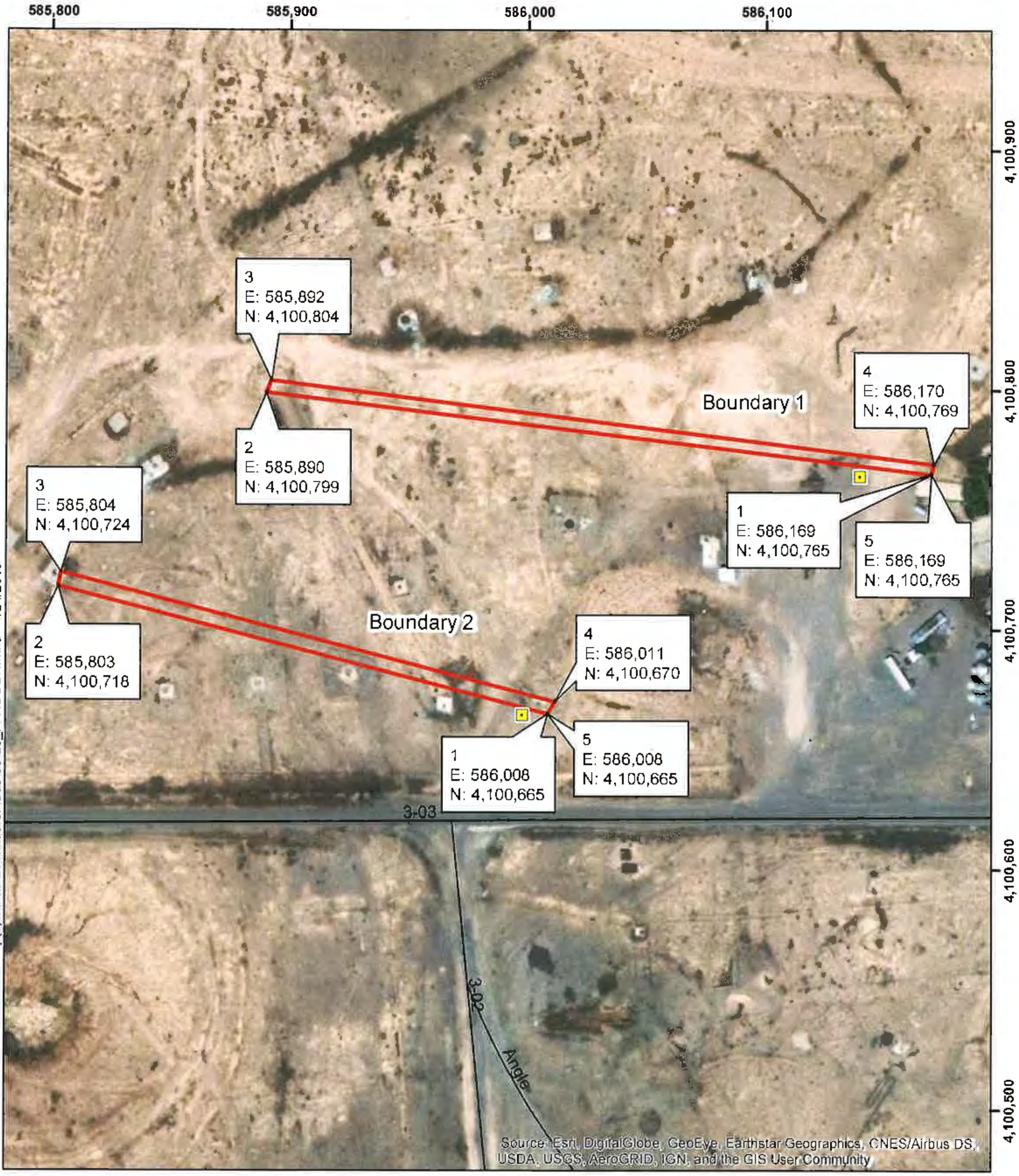
/s/ Kevin Cabble

Date: 11/13/19

Kevin Cabble

Activity Lead

EM Nevada Program



Source: Navarro GIS, 2019

CAU 576, CAS 03-99-20
Area 3 Subsurface
Rad-Chem Piping
FFACO UR Boundary

Explanation

- FFACO UR
- Local Road
- Approximate Location of UR Sign

0 15 30 60 Meters

0 50 100 200 Feet

N

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

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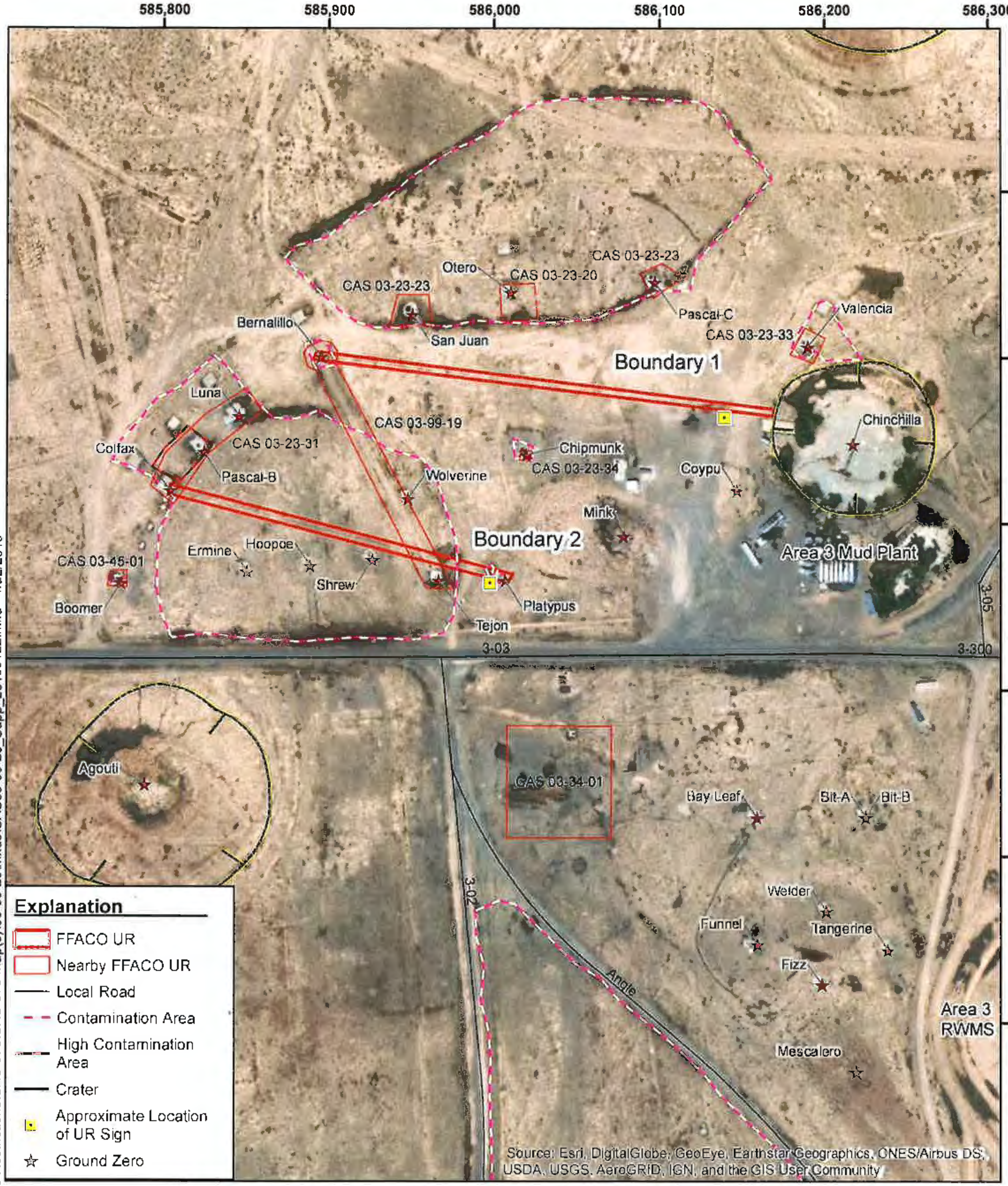
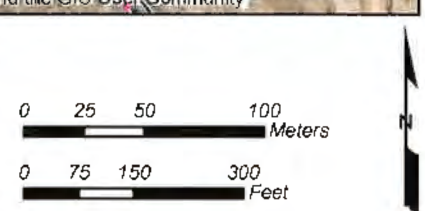
Supplemental Information Figure

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.



CAU 576, CAS 03-99-20
Area 3 Subsurface Rad-Chem Piping
Supplemental Information
General Location of Site Features



NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2019

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

General Information

Use Restriction (UR) Type(s):	Administrative Only
Corrective Action Unit (CAU) Number & Description:	576 - Miscellaneous Radiological Sites and Debris
Corrective Action Site (CAS) Number & Description:	05-19-04 - Frenchman Flat Rad Waste Dump
CAU/CAS Owner:	Soils - ER
Note:	N/A

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

An FFACO UR is not identified for this site.

Section II. Administrative UR

Basis for Administrative UR

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

Administrative UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
Admin Boundary	1	594,598	4,075,387
	2	594,573	4,075,394
	3	594,579	4,075,421
	4	594,607	4,075,408
	5	594,598	4,075,387

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

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

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

Boundary Applies to: Surface

Starting Depth: 0 **Ending Depth:** 5

Depth Unit: Centimeters

Survey Source: GIS

Administrative UR Requirements

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

Site Controls:

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

Section III. Supporting Documentation

UR Source Document(s)

ROTC 1 for CAU 576 CADD/CR (DOE/EMNV--0001), dated 11/07/2019.

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

Attachments

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

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

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

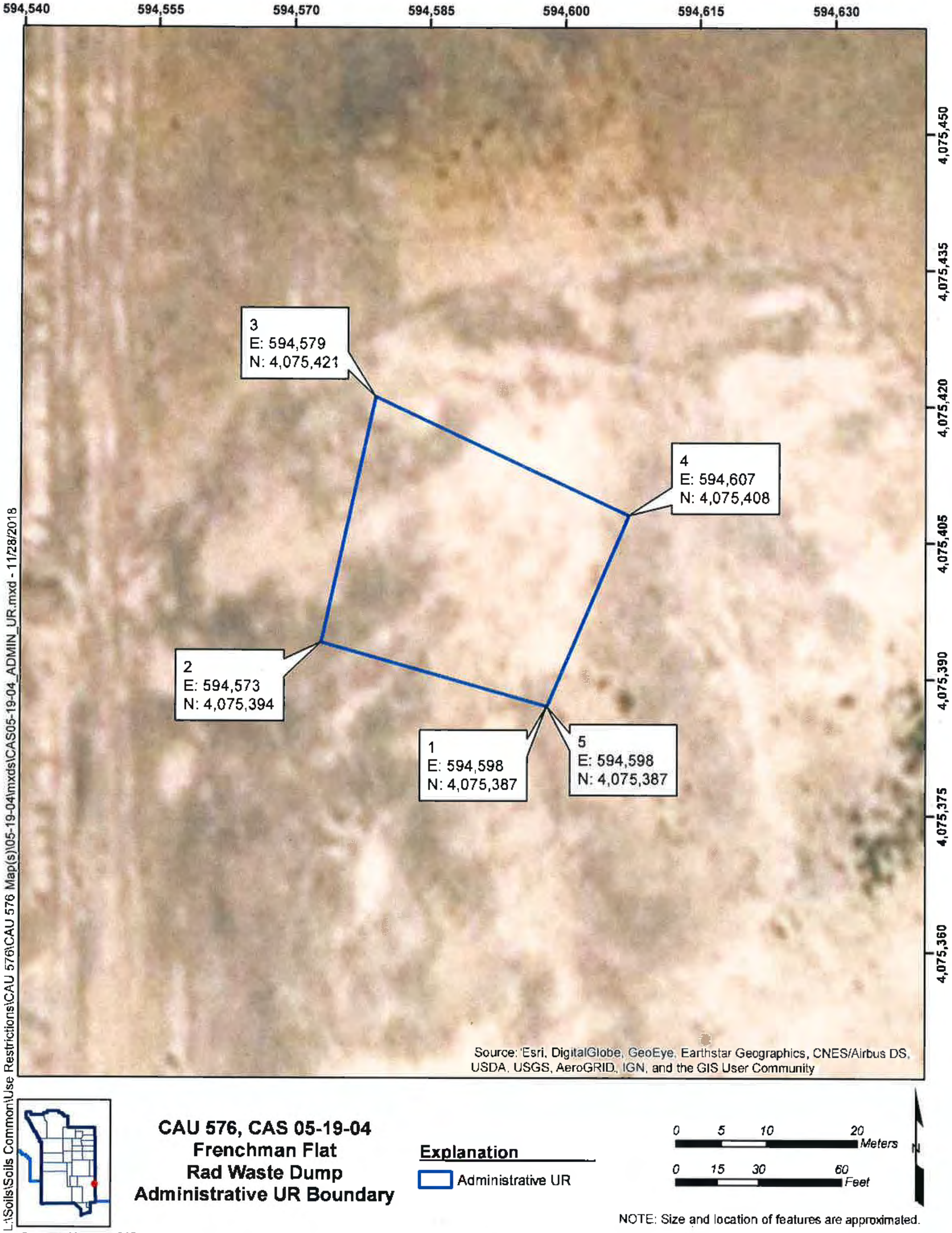
/s/ Kevin Cabble

Date: 11/13/19

Kevin Cabble

Activity Lead

EM Nevada Program



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CAU 576, CAS 05-19-04
Frenchman Flat
Rad Waste Dump
Administrative UR Boundary

Source: Navarro GIS, 2018

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

Supplemental Information Figure

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

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: 576 - Miscellaneous Radiological Sites and Debris

Corrective Action Site (CAS) Number & Description: 09-99-08 - U-9x (Allegheny) Subsurface Rad-Chem Piping

CAU/CAS Owner: Soils - 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 contaminants that were released at this site. Radiological contaminants are assumed to be present that exceed final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	586,088	4,108,255
	2	585,846	4,108,254
	3	585,846	4,108,260
	4	586,088	4,108,262
	5	586,088	4,108,255

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

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

Boundary Applies to: Subsurface

Starting Depth: 0 **Ending Depth:** 5

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

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: The basis for this UR is the assumed presence of subsurface contamination. No surface contamination is present exceeding background.

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 576 CADD/CR (DOE/EMNV--0001), dated 11/07/2019.

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. 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)

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

/s/ Kevin Cabble

Date: 11/13/19

Kevin Cabble

Activity Lead

EM Nevada Program

CAU 576, CAS 09-99-08
U-9x (Allegheny) Subsurface
Rad-Chem Piping
FFACO UR Boundary

Explanation

FFACO UR

Approximate Location of UR Sign

0 20 40 80 Meters

0 60 120 240 Feet

N

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2018

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Supplemental Information Figure

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

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

General Information

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

Corrective Action Unit (CAU) Number & Description: 576 - Miscellaneous Radiological Sites and Debris

Corrective Action Site (CAS) Number & Description: 09-99-09 - U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line

CAU/CAS Owner: Soils - 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 contaminants that were released at this site. Radiological contaminants are assumed to be present that exceed final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	585,352	4,110,542
	2	585,348	4,110,542
	3	585,347	4,110,547
	4	585,348	4,110,557
	5	585,361	4,110,569
	6	585,372	4,110,560
	7	585,355	4,110,553
	8	585,353	4,110,547
	9	585,352	4,110,542

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

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

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

Boundary Applies to: Both Surface and Subsurface

Starting Depth: 0 **Ending Depth:** 5

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: Depth of contamination is limited to the surface except at the wellhead.

Section II. Administrative UR

An Administrative UR is not identified for this site.

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

Section III. Supporting Documentation

UR Source Document(s)

ROTC 1 for CAU 576 CADD/CR (DOE/EMNV--0001), dated 11/07/2019.

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

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

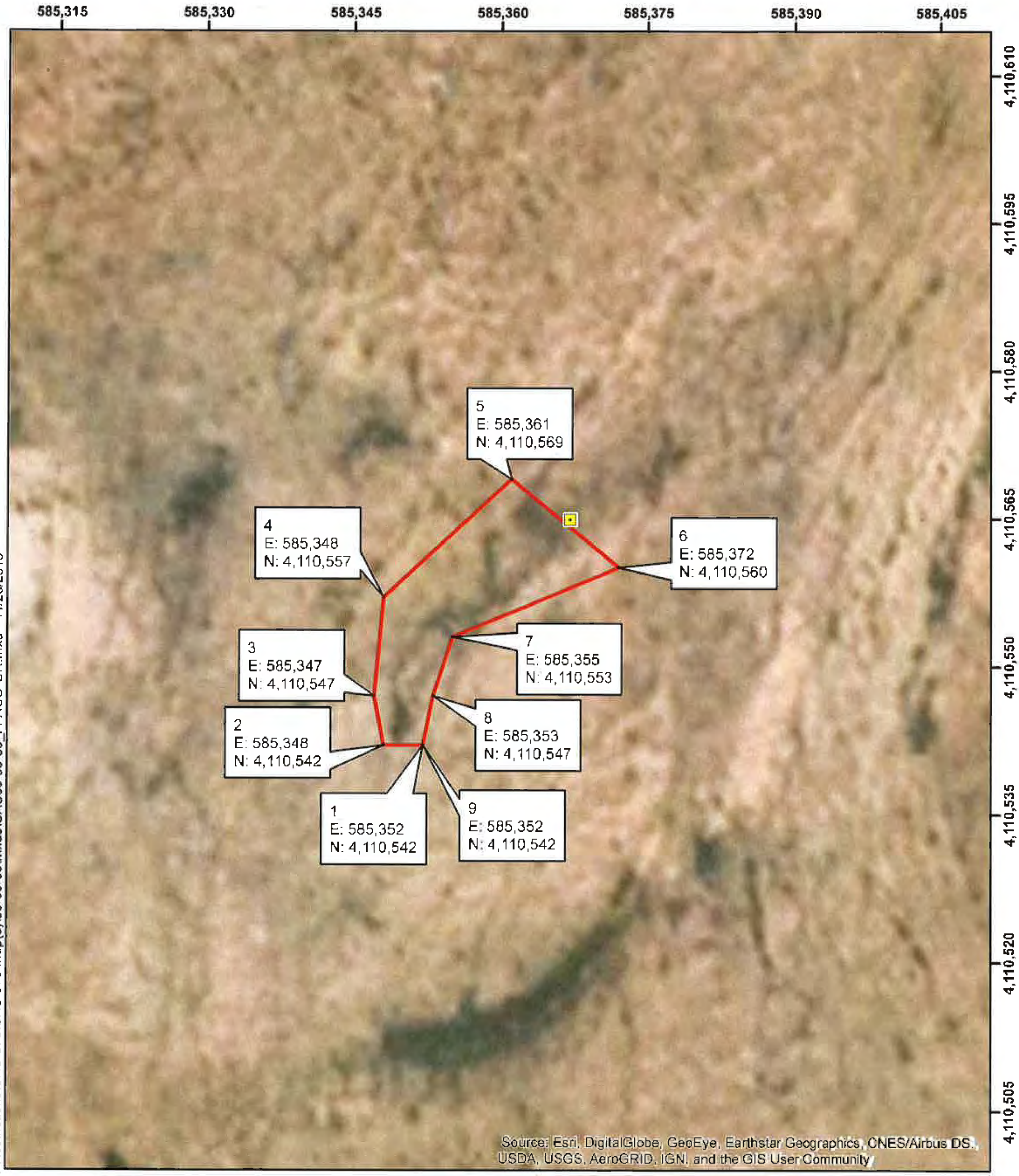
/s/ Kevin Cabble

Date: 11/13/19

Kevin Cabble

Activity Lead

EM Nevada Program



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CAU 576, CAS 09-99-09
U-9its u24 (Avens-Alkermes)
Surface Contaminated Flex Line
FFACO UR Boundary

Explanation

FFACO UR

Approximate Location of UR Sign

0 5 10 20 Meters

0 15 30 60 Feet

N

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2018

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.

Source: Navarro GIS, 2018

CAU 576, CAS 09-99-09
U-9its u24 (Avens-Alkermes)
Surface Contaminated Flex Line
Supplemental Information
General Location of Site Features

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

Environmental
Management
Nevada Program

DOE/EMNV--0001

Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris Nevada National Security Site, Nevada

Controlled Copy No.: UNCONTROLLED
Revision No.: 0

February 2019

U.S. Department of Energy
Environmental Management Nevada Program

Available for sale to the public from:

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National Technical Information Service
5301 Shawnee Road
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Phone: 865.576.8401
Fax: 865.576.5728
Email: *reports@adonis.osti.gov*

CORRECTIVE ACTION DECISION DOCUMENT/ CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 576: MISCELLANEOUS RADIOLOGICAL SITES AND DEBRIS NEVADA NATIONAL SECURITY SITE, NEVADA

U.S. Department of Energy,
Environmental Management Nevada Program
Las Vegas, Nevada

Controlled Copy No.: UNCONTROLLED

Revision No.: 0

February 2019

**CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT
FOR CORRECTIVE ACTION UNIT 576:
MISCELLANEOUS RADIOLOGICAL SITES AND DEBRIS
NEVADA NATIONAL SECURITY SITE, NEVADA**

Approved by: /s/ Kevin J. Cabble Date: 02/04/2019

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Table of Contents

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents *(Continued)*

List of Figures

List of Figures (Continued)

List of Tables

List of Tables (Continued)

List of Tables (Continued)

List of Acronyms and Abbreviations

Ac	Actinium
Ag	Silver
ags	Above ground surface
ALARA	As low as reasonably achievable
ALM	Adult Lead Methodology
Am	Americium
ANPR	Advance Notice of Proposed Rulemaking
ASTM	ASTM International
bgs	Below ground surface
BMP	Best management practice
CA	Contamination area
CAA	Corrective action alternative
CADD	Corrective action decision document
CAI	Corrective action investigation
CAIP	Corrective action investigation plan
CAS	Corrective action site
CAU	Corrective action unit
CFR	*Code of Federal Regulations*
cm	Centimeter
Cm	Curium
COC	Contaminant of concern
COPC	Contaminant of potential concern
cpm	Counts per minute
CR	Closure report
Cs	Cesium
CSM	Conceptual site model

List of Acronyms and Abbreviations *(Continued)*

day/yr	Days per year
DOE	U.S. Department of Energy
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
Eu	Europium
FAL	Final action level
FFACO	*Federal Facility Agreement and Consent Order*
FIDLER	Field instrument for the detection of low-energy radiation
ft	Foot
gal	Gallon
GIS	Geographic Information Systems
GPS	Global Positioning System
GZ	Ground zero
hr/day	Hours per day
IA	Industrial Area
ISOCS	In situ object counting system
LLW	Low-level waste
m	Meter
m^2	Square meter
MDC	Minimum detectable concentration
MEI	Most exposed individual
MLLW	Mixed low-level waste
M&O	Management and operating

List of Acronyms and Abbreviations *(Continued)*

MOB	Multiples of background
mrem/IA-yr	Millirem per Industrial Area year
mrem/OU-yr	Millirem per Occasional Use Area year
mrem/yr	Millirem per year
N/A	Not applicable
NAC	*Nevada Administrative Code*
NAD	North American Datum
NDEP	Nevada Division of Environmental Protection
NNSS	Nevada National Security Site
OU	Occasional Use Area
PAL	Preliminary action level
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
PIRDY	Public Involvement Resource Database
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAP	Quality Assurance Plan
QC	Quality control
Rad	Radiological
Rad-chem	Radiochemistry
RBCA	Risk-based corrective action
RCRA	*Resource Conservation and Recovery Act*
RRMG	Residual radioactive material guideline
RSL	Regional Screening Level
RWMC	Radioactive waste management complex

List of Acronyms and Abbreviations *(Continued)*

SG	Study Group
SHPO	Site Historic Preservation Office
Sr	Strontium
TED	Total effective dose
Th	Thorium
TLD	Thermoluminescent dosimeter
U	Uranium
UCL	Upper confidence limit
UR	Use restriction
UTM	Universal Transverse Mercator

Executive Summary

This Corrective Action Decision Document/Closure Report presents information supporting the closure of Corrective Action Unit (CAU) 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada. This document complies with the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management (EM); U.S. Department of Defense; and DOE, Legacy Management. CAU 576 comprises the six corrective action sites (CASs) listed in Table ES-1.

Table ES-1
CASs, Releases, Study Groups, and Corrective Actions

<table>
<tr><th>SG</th><th>CAS</th><th>CAS Name</th><th>Release Name</th><th>Release Component</th><th>CAA</th></tr>
<tr><td>1 (Surface Rad-Chem Piping)</td><td>09-99-09</td><td>U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line</td><td>Flex Line</td><td>Rad-Chem Piping</td><td>Closure in Place</td></tr>
<tr><td rowspan="4">2 (Subsurface Rad-Chem Piping)</td><td rowspan="2">02-99-12</td><td rowspan="2">U-2af (Kennebec) Surface Rad-Chem Piping</td><td rowspan="2">Kennebec</td><td>Rad-Chem Piping</td><td rowspan="2">Closure in Place</td></tr>
<tr><td>Lead Bricks</td></tr>
<tr><td>03-99-20</td><td>Area 3 Subsurface Rad-Chem Piping</td><td>Area 3 Piping</td><td>Rad-Chem Piping</td><td>Closure in Place</td></tr>
<tr><td>09-99-08</td><td>U-9x (Allegheny) Subsurface Rad-Chem Piping</td><td>Allegheny</td><td>Rad-Chem Piping</td><td>Closure in Place</td></tr>
<tr><td>3 (Rad Waste Dump)</td><td>05-19-04</td><td>Frenchman Flat Rad Waste Dump</td><td>Waste Dump</td><td>Potential Spills/Debris/Buried Debris</td><td>No Further Action</td></tr>
<tr><td rowspan="2">4 (Debris)</td><td rowspan="2">00-99-01</td><td rowspan="2">Potential Source Material</td><td rowspan="2">Debris</td><td>Lead Items</td><td rowspan="2">Clean Closure[a]</td></tr>
<tr><td>Two areas with elevated radiological readings</td></tr>
</table>

[a] After completion of corrective action removal activities.

CAA = Corrective action alternative
SG = Study group

The purpose of this Corrective Action Decision Document/Closure Report is to provide justification and documentation supporting the recommendation that no further corrective action is needed for CAU 576 based on the implementation of the corrective actions listed in Table ES-1.

Corrective action investigation (CAI) activities were performed from March through October 2017, as set forth in the *Corrective Action Investigation Plan for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada*; and in accordance with the *Soils Activity Quality Assurance Plan*, which establishes requirements, technical planning, and general quality practices.

The approach for the CAI was to investigate and make data quality objective (DQO) decisions based on the types of releases present. To facilitate site investigation and the evaluation of DQO decisions, the releases at CAU 576 were divided into four study groups, as shown in Table ES-1.

The reporting of investigation results and the evaluation of DQO decisions are at the release level. The CAAs were evaluated at the release level, and corrective actions were assigned at the FFACO CAS level.

The purpose of the CAI was to fulfill data needs as defined during the DQO process. The CAU 576 dataset of investigation results was evaluated based on a data quality assessment. This assessment demonstrated the dataset is complete and acceptable for use in fulfilling the DQO data needs.

The results of the CAI and the assumptions made in the DQOs resulted in the following conclusions:

- The radiological final action level (FAL) is assumed to be exceeded in SG1, Surface Rad-Chem Piping, in the portions located within the potential crater area at Avens-Alkermes.

- The radiological FAL is assumed to be exceeded in SG2, Subsurface Rad-Chem Piping, within the subsurface rad-chem piping (Kennebec, Chinchilla, Platypus, and Allegheny), and the portions of the rad-chem piping within the crater at Kennebec. The chemical FAL for lead is also assumed to be exceeded at the Kennebec site based on the presence of metallic lead bricks. The lead bricks on the ground surface were removed. The lead bricks within the subsurface vaults remain.

- No FALs are exceeded at SG3, Rad Waste Dump.

- The FAL for lead was assumed to be exceeded at SG4, Debris, based on the presence of metallic lead debris items. During the CAI, a corrective action consisting of the removal of the metallic lead debris was implemented at SG4. After removal of the lead debris, verification samples confirmed that no contamination exceeding the lead FAL remains, and no further corrective actions are necessary.

The corrective actions implemented at CAU 576 were developed based on an evaluation of analytical data from the CAI, the assumed presence of COCs at specific locations, and the detailed and comparative analysis of the CAAs. The CAAs were selected on technical merit focusing on performance, reliability, feasibility, safety, and cost. The implemented corrective actions meet all requirements for the technical components evaluated and meet all applicable federal and state regulations for closure of the site. Based on the implementation of these corrective actions, the EM Nevada Program provides the following recommendations:

- No further corrective actions are necessary for CAU 576.
- The Nevada Division of Environmental Protection should issue a Notice of Completion to the EM Nevada Program for closure of CAU 576.
- CAU 576 should be moved from Appendix III to Appendix IV of the FFACO.

1.0 Introduction

This Corrective Action Decision Document (CADD)/Closure Report (CR) provides the rationale and supporting information for the selection and implementation of corrective actions at Corrective Action Unit (CAU) 576, Miscellaneous Radiological Sites and Debris. This document has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996, as amended) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management (EM); U.S. Department of Defense; and DOE, Legacy Management.

CAU 576 is located in Areas 2, 3, 5, 8, and 9 of the Nevada National Security Site (NNSS), which is approximately 65 miles northwest of Las Vegas, Nevada. CAU 576 comprises six corrective action sites (CASs). A detailed discussion of the history of this CAU is presented in the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada* (NNSA/NFO, 2016). The locations of the releases associated with CAU 576 as described in Table 1-1 are shown on Figures 1-1 and 1-2.

Table 1-1
Summary of CAI Results
(Page 1 of 2)

SG	CAS	CAS Name	Release Name	Release Component	COC	CAA
1 (Surface Rad-Chem Piping)	09-99-09	U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line	Flex Line	Rad-Chem Piping	Assumed TED above FALs within potential crater area	Closure in Place
2 (Subsurface Rad-Chem Piping)	02-99-12	U-2af (Kennebec) Surface Rad-Chem Piping	Kennebec	Rad-Chem Piping	Assumed TED above FALs in subsurface piping	Closure in Place
				Lead Bricks	Lead	
	03-99-20	Area 3 Subsurface Rad-Chem Piping	Area 3 Piping	Rad-Chem Piping	Assumed TED above FALs in subsurface piping	Closure in Place
	09-99-08	U-9x (Allegheny) Subsurface Rad-Chem Piping	Allegheny	Rad-Chem Piping	Assumed TED above FALs in subsurface piping	Closure in Place

Table 1-1
Summary of CAI Results
(Page 2 of 2)

SG	CAS	CAS Name	Release Name	Release Component	COC	CAA
3 (Rad Waste Dump)	05-19-04	Frenchman Flat Rad Waste Dump	Waste Dump	Potential Spills/Debris/Buried Debris	None	No Further Action
4 (Debris)	00-99-01	Potential Source Material	Debris	Lead Items	None[a]	Clean Closure[a]
				Two areas with elevated radiological readings		

[a] After completion of corrective action removal activities.

CAA = Corrective action alternative
CAI = Corrective action investigation
COC = Contaminant of concern
FAL = Final action level
SG = Study group
TED = Total effective dose

The six CASs at CAU 576 are as follows:

- *00-99-01, Potential Source Material,* consists of debris associated with legacy testing activities in multiple areas of the NNSS. This debris includes lead items, lead-acid batteries, metallic tower debris, small drums containing a white powdery substance, and soil with elevated radiological readings.

- *02-99-12, U-2af (Kennebec) Surface Rad-Chem Piping,* consists of predominantly subsurface rad-chem piping associated with the Kennebec weapons-related test, which was conducted on June 25, 1963, as part of Operation Storax. Lead bricks are present adjacent to some of the rad-chem piping.

- *03-99-20, Area 3 Subsurface Rad-Chem Piping,* consists of two subsurface piping systems in Area 3. The first piping system was constructed as part of Chinchilla, a weapons-related shaft test conducted February 19, 1962, as part of Operation Nougat. The subsurface rad-chem piping system ran from the Chinchilla (U3ag) emplacement hole to the existing Bernalillo (U3n) emplacement hole. The second piping system was constructed as part of Platypus, a weapons-related shaft test, conducted on February 24, 1962, as part of Operation Nougat. The subsurface rad-chem piping system ran from the Platypus (U3ad) emplacement hole to the existing Colfax (U3k) emplacement hole.

- *05-19-04, Frenchman Flat Rad Waste Dump,* consists of a waste dump identified on a historical map, located on the northern edge of Frenchman Flat. A 30-by-30-foot (ft) area exhibited elevated radiological readings, and swipe samples identified removable contamination in levels exceeding contamination area (CA) conditions. It is unknown what was stored at this location.

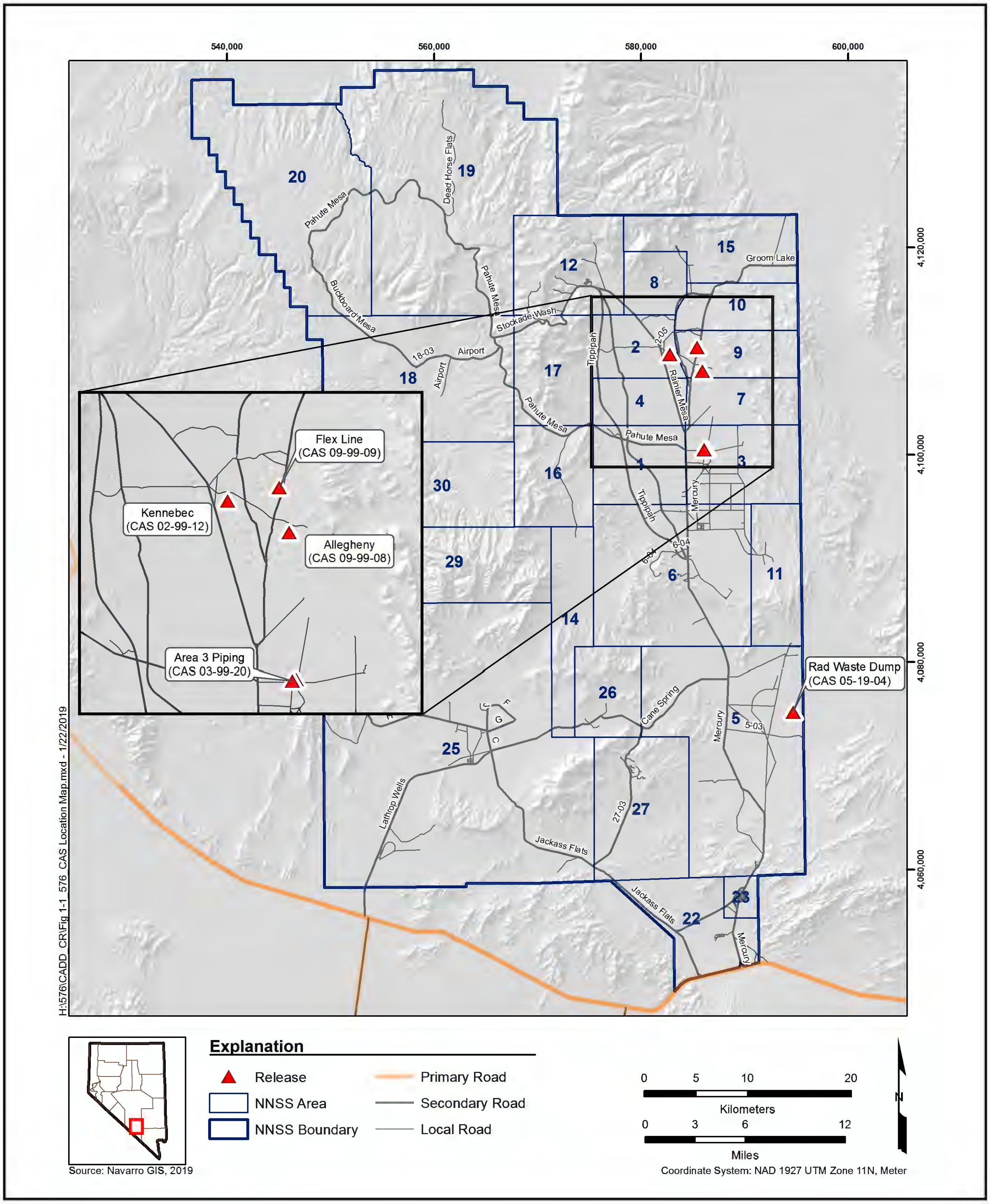


Figure 1-1
SG1, SG2, and SG3 Release Location Map

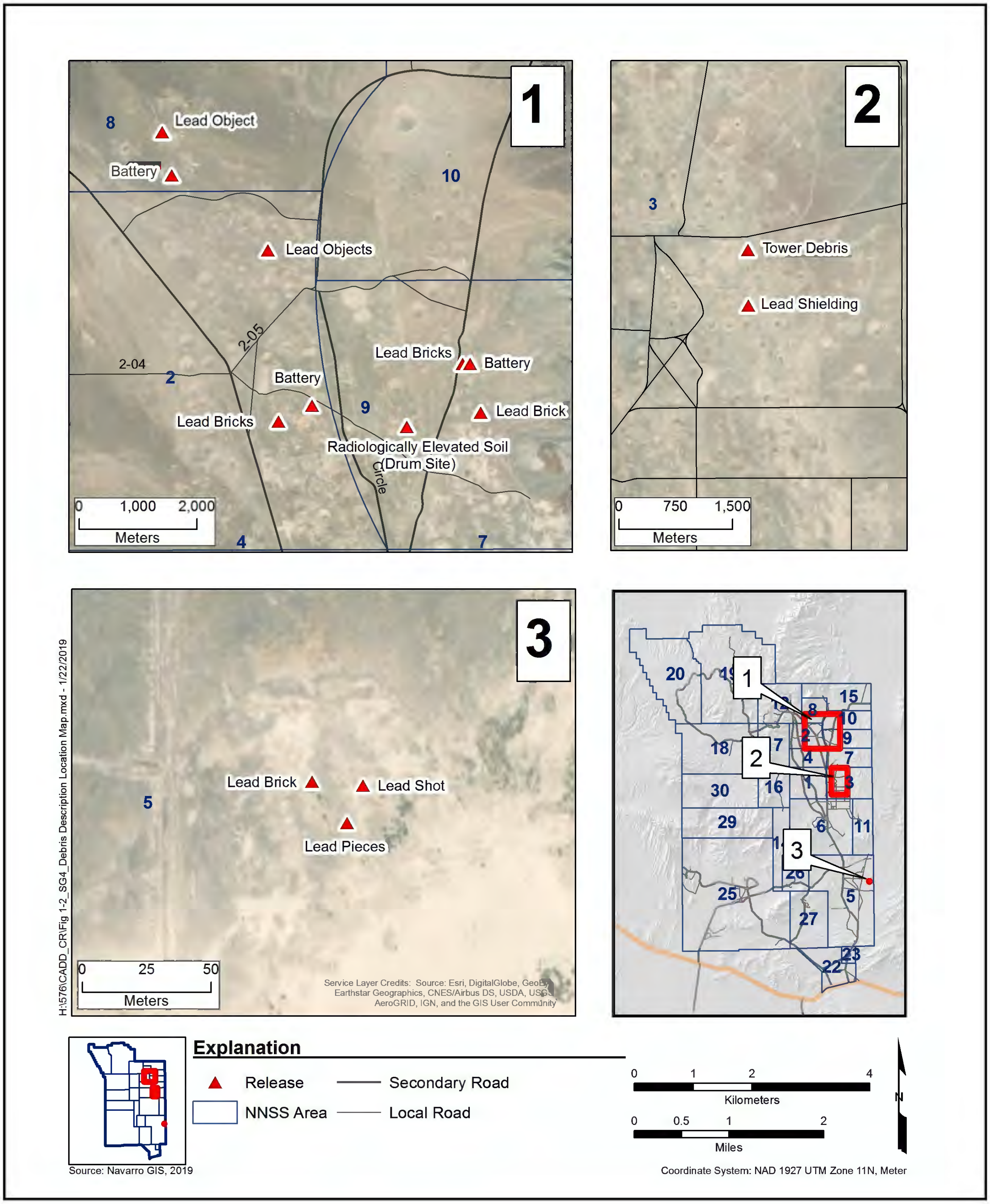


Figure 1-2
SG4 Release Location Map (CAS 00-99-01)

- *09-99-08, U-9x (Allegheny) Subsurface Rad-Chem Piping,* consists of the subsurface rad-chem piping associated with the Allegheny weapons-related test, which was conducted on September 29, 1962, as part of Operation Storax.

- *09-99-09, U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line,* consists of surface rad-chem piping, associated with the Avens-Alkermes weapons-related test, which was conducted on December 16, 1970, as part of Operation Emery. Test samples were captured through a gas-sampling flex line pipe (more than 65 meters [m] long).

To facilitate site investigation and the evaluation of data quality objective (DQO) decisions for different releases, the reporting of investigation results and the evaluation of DQO decisions for different releases were organized into study groups. The need for corrective action and the associated CAAs are evaluated separately for each release that requires corrective action. The study groups specific to the CAU 576 releases, as identified in the CAU 576 CAIP (NNSA/NFO, 2016), are described below.

- **SG1 (Surface Rad-Chem Piping).** This study group (referred to as “Flex Line” throughout the document) is specific to radionuclide waste contained within a surface gas-sampling flex line pipe. The flex line pipe is associated with gas-sampling activities conducted during a weapons-related test (Avens-Alkermes). It is assumed that containment of the waste in the piping will fail and will release contaminants to the surrounding soil.

- **SG2 (Subsurface Rad-Chem Piping).** This study group is specific to chemical and radionuclide contamination from waste contained primarily within subsurface rad-chem piping associated with the Kennebec (referred to as “Kennebec” throughout the document); Chinchilla and Platypus (referred to as “Area 3 Piping” throughout the document); and Allegheny (referred to as “Allegheny” throughout the document) test sites. It is assumed that containment of the waste in the piping will fail and will release contaminants to the surrounding soil. In addition, releases may have occurred from gas-sampling components and venting of gases from the exhaust pipe at Kennebec and Allegheny. Lead bricks are also present in the area of the Kennebec rad-chem piping.

- **SG3 (Rad Waste Dump).** This study group (referred to as “Waste Dump” throughout the document) is specific to residual contamination from material that was stored on the surface and then removed or contaminated material that may be currently buried at the site. Removable radiological contamination from surface soil was detected, and an area of approximately 30 by 30 ft was posted as a CA. No subsurface debris was identified in this area.

- **SG4 (Debris).** This study group is specific to chemical and possibly radiological surface soil contamination from legacy debris associated with testing activities. The debris consists of, but is not limited to, lead (bricks, plates, pieces, shot, shielding, object), broken lead-acid batteries, metallic tower debris (referred to as the tower debris site), two small drums containing a white powdery substance and radiologically elevated soil between the two drums (referred to as the drum site). The debris is found within multiple areas of the NNSS. The debris has the potential to leach contaminants (chemical or radiological) into the environment (surface soil).

The study groups and CASs associated with each release, and the corrective actions associated with each CAS are described in Table 1-1. The corrective actions were implemented in accordance with the FFACO (1996, as amended).

1.1 Purpose

The purpose of this CADD/CR is to provide documentation and justification that no further corrective action is needed for the closure of CAU 576 after implementation of corrective actions. This includes a description of investigation activities, an evaluation of the data, and a description of corrective actions that were performed.

1.2 Scope

The CAI for CAU 576 was completed by demonstrating through environmental soil and thermoluminescent dosimeter (TLD) sample analytical results the nature and extent of COCs. For radiological releases, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding a FAL of 25 millirem per year (mrem/yr). For chemical releases, a COC is defined as the presence of a contaminant above its corresponding FAL. The FALs are presented in Appendix C. The presence of a COC requires a corrective action. A corrective action is also required if a waste present within a release site contains a contaminant that, if released to soil, would cause the soil to contain a COC. Such a waste is considered to be potential source material (PSM) as defined in the *Soils Risk-Based Corrective Action* (RBCA) *Evaluation Process* (NNSA/NFO, 2014), hereafter referred to as the "Soils RBCA document."

The scope of the activities used to identify, evaluate, and recommend preferred CAAs for CAU 576 included the following:

- Performed visual surveys to identify biasing factors for selecting soil sample locations.
- Performed radiological surveys to identify biasing factors for selecting sample locations.

- Conducted a geophysical survey
- Conducted in situ object counting system (ISOCS) measurements.
- Collected grab and sample plot soil samples at biased locations.
- Submitted soil samples for analysis.
- Staged TLDs at biased locations.
- Collected and submitted TLDs for analysis.
- Collected Global Positioning System (GPS) coordinates of sample locations and points of interest.
- Implemented interim corrective actions of PSM removal.
- Conducted waste management activities (e.g., sampling, disposal).
- Evaluated corrective action objectives based on the results of the CAI and the CAA screening criteria.
- Recommended preferred CAAs.

The CAI activities were completed in accordance with the CAIP (NNSA/NFO, 2016), except as noted in Appendix A; and in accordance with the *Soils Activity Quality Assurance Plan* (QAP) (NNSA/NSO, 2012), which establishes requirements, technical planning, and general quality practices. The investigation results and the risk associated with the site contamination were evaluated in accordance with the Soils RBCA document (NNSA/NFO, 2014).

1.3 CADD/CR 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 Summary,” summarizes the investigation field activities, the results of the CAI, and the justification for no further action.
- Section 3.0, “Recommendation,” provides a recommendation that no further corrective action is required and requests a Notice of Completion for this CAU.

- 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, CAI results and data evaluation, waste management, and quality assessment (QA).

- Appendix B, *Data Assessment*, provides a data quality assessment (DQA) that reconciles DQO assumptions and requirements to the CAI results.

- Appendix C, *Risk Assessment*, provides documentation of the RBCA process as applied to CAU 576.

- Appendix D, *Closure Activity Summary,* provides concise details on the completed closure activities, verification activities, and supporting documentation.

- Appendix E, *Evaluation of Alternatives,* describes, identifies, and evaluates the steps taken to determine the preferred CAA.

- Appendix F, *Sample Location Coordinates,* provides CAI sample location coordinates.

- Appendix G, *Analytical Test Results*, presents the analytical results for the soil samples collected at CAU 576.

- Appendix H, *Evaluation of Hot Spots,* summarizes the process for evaluation of isolated areas of soil with elevated radioactivity.

- Appendix I, *Geophysical Survey Report,* presents the results and interpretation of the geophysical surveys conducted at CAU 576.

- Appendix J, *Nevada Division of Environmental Protection* (NDEP) *Comments*, contains responses to NDEP comments on the draft version of this document.

All CAI activities were performed in accordance with the following documents:

- CAIP for CAU 576, Miscellaneous Radiological Sites and Debris (NNSA/NFO, 2016)
- Soils RBCA document (NNSA/NFO, 2014)
- Soils QAP (NNSA/NSO, 2012)
- FFACO (1996, as amended)

2.0 Corrective Action Investigation Summary

The following subsections summarize the CAI activities and results, and identify the need for corrective action at CAU 576. Detailed CAI activities and results are presented in Appendix A. The field investigation was completed as specified in the CAIP (NNSA/NFO, 2016) except as noted in this document.

All results are reported using the following protocol:

- Numbers were rounded to three significant digits for reporting purposes to avoid inferring more confidence in the numbers than is justified; however, the entire (unrounded) numbers were used in calculations.
- Radionuclide activities are limited to one decimal place. (i.e., there is no confidence in, or significance to, hundredths of a picocurie per gram [pCi/g]).
- Dose results are limited to whole digits (i.e., there is no confidence in, or significance to, tenths of a millirem per year [mrem/yr]).

2.1 Investigation Activities

CAI activities at CAU 576 were conducted from March through October 2017. The purpose of the CAI was to provide the additional information needed to resolve the CAU 576 DQOs and evaluate CAAs. Investigation activities included visual surveys, radiological surveys, a geophysical survey, ISOCS measurements, and soil and TLD sampling. A corrective action involving the removal of PSM was also completed during the CAI. Investigation activities were completed in accordance with the CAIP (NNSA/NFO, 2016) and in accordance with the Soils Activity QAP (NNSA/NSO, 2012). The investigation results and the risks associated with site contamination were evaluated in accordance with the Soils RBCA document (NNSA/NFO, 2014).

To facilitate site investigation and the evaluation of DQO decisions, the releases at CAU 576 were divided into four study groups, as discussed in Section 1.0. Sampling was conducted from 10-by-10-m sample plots as prescribed in the CAIP (NNSA/NFO, 2016) and the Soils RBCA document (NNSA/NFO, 2014) except for verification samples described in Section 2.1.4. The CAI activities are summarized in the study-group-specific sections below; the dose calculation results of the CAI are summarized in Section 2.2 and discussed in detail in Appendix A. The ISOCS measurements were used as informational data per the Soils Activity QAP (NNSA/NSO, 2012). Informational data do not directly affect DQOs, but provide information to support conceptual models and guide investigations. ISOCS estimates are highly dependent upon the modeled geometry of the contaminated material and the piping containing the contamination. As such, the dose estimates are approximations that are useful for providing information but will not be used to make corrective action decisions.

2.1.1 SG1, Surface Rad-Chem Piping

This study group is composed of the potential release from the surface rad-chem piping (flex line pipe) at Avens-Alkermes as defined in the CAU 576 DQOs and documented in the CAU 576 CAIP (NNSA/NFO, 2016). The DQO Decision I was to determine whether the waste has the potential to cause soil contamination exceeding a FAL when the containment afforded by the flex line pipe fails and if the waste currently has the potential to cause a dose exceeding a FAL. The general location of SG1 and sample locations at SG1 are shown on Figure A.3-2.

All of the CAI activities for SG1 were completed as specified in the CAU 576 CAIP (except as noted in Section A.3.4), including radiological surveys, ISOCS measurement, and the collection of a soil and TLD sample.

To determine whether the waste currently has the potential to cause a dose exceeding a FAL, one soil grab sample (0 to 5 centimeters [cm] below ground surface [bgs]) was collected at the pipe termination (location A09) (beneath the nozzle of the flex line pipe) and analyzed for gamma spectroscopy, isotopic plutonium (Pu), isotopic uranium (U), and isotopic americium (Am). To determine whether the contained waste currently has the potential to provide an external dose exceeding the radiological FAL, one TLD was placed at a height of 1 m above the flex line pipe at the nearest accessible location to the ground zero (GZ) (location A09).

To determine whether the waste currently contained by the rad-chem piping may have the potential to cause a dose exceeding a FAL when the containment afforded by the flex line pipe fails, an ISOCS measurement was collected at the nearest accessible location to the GZ (location A34).

The resolution of DQO Decision I on the presence of COCs for this study group is based on the assumption that the wellhead and flex line pipe exceed the FAL. This was agreed to in the CAA meeting with the CAU 576 stakeholders (DOE and NDEP) held on September 5, 2017. Therefore, all CAI data are considered informational data. The sample locations for ISOCS and TLD placement were modified from that described in the CAU 576 CAIP. This deviation is described in Section A.3.4. The sample locations are shown on Figure A.3-2. The resolution of the DQO decision on extent of COC contamination is assumed to be limited to physical extent of the wellhead and the flex line pipe.

2.1.2 SG2, Subsurface Rad-Chem Piping

This study group is composed of three release sites consisting of the potential release from the subsurface rad-chem piping at each of three locations (Kennebec, Area 3 Piping, and Allegheny) as defined in the CAU 576 DQOs and documented in the CAU 576 CAIP (NNSA/NFO, 2016). The DQO Decision I was to determine whether the waste currently has the potential to cause a dose exceeding a FAL. As noted in the DQOs, it was assumed that the all subsurface piping exceed radiological FALs. The general locations of the releases in SG2, geophysical and ISOCS locations, and sample locations at each SG2 release site are shown on Figures A.4-5, A.4-6, and A.4-7.

The CAI activities for each release site within this study group will be described separately. All CAI activities were completed as specified in the CAU 576 CAIP (except as noted in this document), including radiological surveys, and the collection of soil and TLD samples.

Kennebec

The Kennebec release consists of exposed and subsurface rad-chem piping components and lead bricks adjacent to the rad-chem piping. The CAI activities to resolve the DQO Decision I question included radiological surveys and the collection of a soil and TLD sample (see Appendix A for CAI details).

To determine whether the waste currently has the potential to cause a dose exceeding a FAL, one soil grab sample was collected at the pipe termination (from the soil mound) (location A10) and analyzed for gamma spectroscopy, isotopic Pu, isotopic U, and isotopic Am. To determine whether the contained waste in the exposed piping currently has the potential to provide an external dose exceeding the radiological FAL, one TLD was placed at a height of 1 m above the cyclone (the accessible location with the highest radiological survey value) (location A22). The sample locations are shown on Figure A.4-6.

Although not specified in the CAIP, to determine whether the waste in the piping may have the potential to cause a dose exceeding a FAL when the containment afforded by the piping fails, ISOCS measurements were collected at the cyclone (location A22), at a pipe elbow in the vault area (location A35), and at a large pipe flange near the pipe termination (location A10).

The resolution of DQO Decision I on the presence of COCs for the Kennebec site was based on the assumption that the subsurface rad-chem piping and wellhead exceed the radiological FAL and the lead bricks will cause soil contamination that will exceed the chemical FAL for lead. This was agreed to in the DQO meeting with the CAU 576 stakeholders. Therefore, the TLD and analytical data are considered informational data.

The resolution of the DQO decision on extent of COC contamination is assumed to be limited to physical extent of the rad-chem piping system.

Area 3 Piping

The Area 3 Piping site consists of subsurface rad-chem piping originating from U-3ag (Chinchilla) to U-3n (Bernalillo), and from U-3ad (Platypus) to U-3k (Colfax). The CAI activities to resolve the DQO Decision I question included the collection of a TLD sample (see Appendix A for CAI details).

To determine whether the contained waste in the exposed piping currently has the potential to provide an external dose exceeding the radiological FAL, one TLD was placed at a height of 1 m above the Platypus wellhead (the only exposed location) at location A36. The sample location for the TLD is shown on Figure A.4-7. An additional TLD was placed at an area of elevated radiological readings discovered during the CAI (location A21) to verify that radiological contamination at this location did not exceed the radiological FAL.

The resolution of DQO Decision I on the presence of COCs for the Area 3 Piping site was based on the assumption that the subsurface rad-chem piping exceed the radiological FAL. This was agreed to in the DQO meeting with the CAU 576 stakeholders. The TLD data at the only exposed portion of the rad-chem piping system show that the exposed piping (i.e., the Platypus wellhead) does not produce sufficient external dose to exceed the radiological FAL. The dose results from the additional TLD at location A21 were not distinguishable from local background. Therefore, the TLD data are considered decisional data.

The resolution of the DQO decision on extent of COC contamination is assumed to be limited to physical extent of the rad-chem piping system.

Allegheny

The Allegheny site consists of subsurface rad-chem piping. The CAI activities to resolve the DQO Decision I question included a geophysical survey to determine the location of the rad-chem piping and the collection of a soil and TLD sample (see Appendix A for CAI details).

The geophysical survey identified the rad-chem piping system extending from U-9x #1 R/C eastward approximately 800 ft and terminating within a visually identifiable soil mound (see Section A.4.1.4).

To determine whether the waste currently has the potential to cause a dose exceeding a FAL, one soil grab sample was collected at the pipe termination (from the soil mound) (location A33) and analyzed for gamma spectroscopy, isotopic Pu, isotopic U, and isotopic Am. To determine whether the contained waste in the exposed piping currently has the potential to provide an external dose exceeding the radiological FAL, one TLD was placed at a height of 1 m above the Allegheny wellhead (the only exposed location) at location A18. The sample locations are shown on Figure A.4-5.

Although not specified in the CAIP, to determine whether the waste in the piping may have the potential to cause a dose exceeding a FAL when the containment afforded by the piping fails, an ISOCS measurement was collected at the U-9x #1 R/C wellhead.

The resolution of DQO Decision I on the presence of COCs for the Allegheny site was based on the assumption that the subsurface rad-chem piping and wellhead exceed the radiological FAL. This was agreed to in the DQO meeting with the CAU 576 stakeholders. Therefore, the TLD and analytical data are considered informational data.

The resolution of the DQO decision on extent of COC contamination is assumed to be limited to physical extent of the rad-chem piping system.

2.1.3 SG3, Rad Waste Dump

This study group was defined in the CAU 576 CAIP (NNSA/NFO, 2016) as a possible radioactive waste dump. CAI activities generated information to resolve the DQO Decision I questions on whether the site contains buried waste and whether surface contamination exceeds FALs. All of the CAI activities were completed as specified in the CAU 576 CAIP for SG3, including a radiological survey, geophysical survey, and the collection of four composite soil samples from each of two sample plots (locations A26 and A27) biased to the locations of the highest radiological survey readings (see Appendix A for CAI details). Each sample was analyzed for gamma spectroscopy; isotopic Pu; isotopic U, and isotopic Am analyses. To estimate the maximum potential external dose, a TLD was placed in the center of each sample plot at a height of 1 m.

The resolution of DQO Decision I for this study group is based on the absence of COCs in surface soil and the absence of buried debris. This was agreed to in the DQO meeting with the CAU 576 stakeholders. Therefore, the TLD, analytical data, and geophysical survey are considered decisional data. As outlined in CAU 576 CAIP, the radiological survey determined the locations for the sample plots and TLD placement. The sample locations are shown on Figure A.5-1.

Resolution of the DQO decision on the extent of COC contamination for this study group did not need to be resolved as no COCs were identified.

2.1.4 SG4, Debris

This study group was defined in the CAU 576 CAIP (NNSA/NFO, 2016) as material present at a site that contains radiological and/or chemical contaminants that, if released, could cause the surrounding environmental media to contain a COC (NNSA/NFO, 2014). Debris was identified at eight locations throughout the NNSS during the preliminary investigation and 5 additional locations were identified during CAI activities. The debris consists of lead items (bricks, plates, pieces, shot, shielding, objects, and broken lead-acid batteries) as well as tower debris and drums. CAI activities were completed as specified in the CAU 576 CAIP (except as noted in this document), and CAI details are discussed in Appendix A.

The DQO Decision I was resolved for the metallic lead debris by assuming that the debris met the definition of PSM and requires corrective action. The DQO Decision I was resolved for the tower debris and drum site by soil and TLD sample results from each release. At the tower debris (location A11) and drum site (location A12), one soil grab sample (0 to 5 cm bgs) was collected and analyzed for gamma spectroscopy; isotopic Pu; isotopic U, and isotopic Am analyses. To estimate the maximum potential external dose, one TLD was placed at a height of 1 m at the locations of the highest radiological survey readings at each site. The SG4 sample locations are shown on Figure A.6-3.

All metallic lead debris were removed under a corrective action during the CAI. Verification of the completion of this corrective action included the collection of verification plot samples beneath each lead item (locations A01 through A07, A25, and A28 through A30) (aside from location A08, which was located on a concrete pad). Verification samples at the two lead-acid battery locations were from 3-by-3-ft plots, and all other verification samples were collected from 2-by-2-ft plots. The verification plot samples were collected from a depth of 0 to 5 cm bgs and analyzed for *Resource Conservation and Recovery Act* (RCRA) metals. The verification sample plot locations are shown on Figure A.6-3.

The TLD and analytical data are considered decisional data. Because no COCs are present at SG4 after removal of the lead items, the DQO decision on the extent of COC contamination for SG4 did not need to be resolved.

2.2 Results

The following subsections summarize the results of the CAI for each release. Additional detail may be found in the study-group-specific sections of Appendix A. For all releases, the dose a receptor would receive from radiological site contamination was compared to the radiological FAL (defined in Appendix C) to determine whether corrective action is necessary. As stated in the CAIP (NNSA/NFO, 2016), it is assumed that the radiological FAL is exceeded for all subsurface rad-chem piping.

As detailed in Appendix C, the radiological FAL of 25 mrem/yr is based on the Occasional Use Area (OU) exposure scenario (as specified in the CAU 576 DQOs), which assumes that a site worker would be exposed to site contamination 8 hours per day (hr/day) for 10 days per year (day/yr). In the DQO meeting on June 14, 2016, the most exposed individual (MEI) (based on current and future land use at the NNSS) was defined as a worker who could occupy these locations on an occasional and temporary basis, such as a military exercise. Release locations in CAU 576 are remote locations without any site improvements and where no regular work is performed. Therefore, the potential exposure to the MEI who uses locations within CASs in CAU 576 is conservatively represented by the OU exposure scenario. Additional discussion on the selection of the exposure scenario is provided in Appendix C. Although DQO decisions are resolved based on this scenario, dose is also presented in this document based on the Industrial Area (IA) scenario for informational purposes only.

Radiological doses calculated for SG1, SG2, SG3, and at the tower debris and drum sites for SG4 are a conservative estimate of maximum potential dose for FFACO decision-making purposes only. These estimated doses were compared to the radiological FAL based on an area of contamination of 1,000 square meters (m^2).

For the PSM in SG4, the chemical preliminary action levels (PALs) are based on the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels (RSLs) for chemical contaminants in industrial soils (EPA, 2017) except where natural background concentrations of a RCRA metal exceed the screening level (e.g., arsenic on the NNSS). The chemical FALs were established in Appendix C at the PAL concentrations.

2.2.1 Data Summary

The following subsections present a summary of the computational results for soil and TLD samples from each study group. Analytical results from soil samples and results from TLDs are presented in Appendix G.

2.2.1.1 SG1, Surface Rad-Chem Piping

For the calculation of internal dose, a single judgmental soil grab sample was taken (0 to 5 cm bgs) at the termination of the flex line pipe (location A09) at Avens-Alkermes. To estimate the maximum potential external dose, one TLD was placed at a height of 1 m at the same location. See Figure A.3-2 for the sample location at SG1. Based on the results of the TLD and soil sample collected at SG1 (Table 2-1), radiological contamination does not exceed the FAL (25 millirem per Occasional Use Area year [mrem/OU-yr]). However, because the portion of the flex line pipe within the potential crater area could not be surveyed or sampled, the sampling plan for this site was modified as discussed in Section A.3.4. Therefore, it is assumed that contamination in the flex line pipe within the potential crater area and the wellhead at Avens-Alkermes exceeds the radiological FAL.

Table 2-1
TED at Sample Location in SG1

Release	Location	Type of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
			Average TED	95% UCL of TED	Average TED	95% UCL of TED
Flex Line	A09	Grab and TLD	13	17	1	1

mrem/IA-yr = Millirem per Industrial Area year
UCL = Upper confidence limit

An ISOCS measurement of the flex line pipe at the nearest accessible location to the GZ (location A34) was collected to determine whether contamination currently contained in the flex line pipe is present that has the potential to provide a dose exceeding the radiological FAL when the containment afforded by the piping fails. Based on the results of the ISOCS measurement (see Section A.3.1.2), there is no potential for future dose at levels exceeding the FAL from contamination in the flex line pipe at this location.

The conceptual site model (CSM) and associated discussion for this study group are provided in the CAIP (NNSA/NFO, 2016). Information gathered during the CAI supports the CSM as presented in the CAIP. No modification to the CSM was needed.

2.2.1.2 SG2, Subsurface Rad-Chem Piping

At Kennebec, to calculate internal dose, two judgmental surface soil grab samples (one sample and a duplicate) were collected at the pipe termination (exhaust pipe) (location A10). To estimate the maximum potential external dose, one TLD was placed at a height of 1 m at the location of highest radiological readings (cyclone area) (location A22). See Figure A.4-6 for the sample locations at Kennebec. Results of the TLD and soil samples collected at Kennebec (Table 2-2) did not identify radiological contamination that exceeds the FAL. However, it is assumed that the subsurface piping at Kennebec, the wellhead, and piping within the crater area exceed the radiological FAL. It is also assumed that the lead bricks present at Kennebec meet the definition of PSM and exceed the FAL for lead.

Table 2-2
TED at SG2 Sample Locations

Release Name	Location	Type of Samples	IA (mrem/IA-yr)	OU (mrem/OU-yr)
			Average TED	
Kennebec	A10	Grab Only	2	0
Allegheny	A33	Grab Only	0	0

At the Area 3 Piping site, one TLD was placed at the only location (location A36) where the rad-chem piping system was exposed (the wellhead at Platypus). A second TLD was placed in a location of elevated radioactivity near the CA boundary surrounding the Platypus GZ (location A21). See Figure A.4-7 for the sample locations at the Area 3 Piping site. Results of the TLD samples collected at Platypus did not identify any dose that was distinguishable from background dose. However, it is assumed that the subsurface piping from Bernalillo to Chinchilla, and from Colfax to Platypus exceed the radiological FAL.

At the Allegheny site, one soil grab sample was collected from the termination of the rad-chem pipe within a soil mound (location A33). Also, one TLD was placed at the only location where the rad-chem piping system was exposed (the U-9x #1 R/C wellhead) (location A18). See Figure A.4-5 for the sample locations at Allegheny. Results of the TLD and soil samples collected at Allegheny (Table 2-2) did not identify radiological contamination that exceeds the FAL. However, it is assumed that the subsurface piping at Allegheny exceeds the radiological FAL.

Although not specified by the CAIP (NNSA/NFO, 2016), ISOCS measurements were collected at the Kennebec and Allegheny release sites (locations A10, A18, A22, and A35) to determine whether contamination currently contained in exposed piping is present that has the potential to provide a dose exceeding the radiological FAL when the containment afforded by the piping fails. Based on the results of the ISOCS measurement (see Section A.4.1.3), there is no potential for future dose at levels exceeding the FAL from contamination in exposed piping at the Kennebec or Allegheny release sites.

The CSM and associated discussion for this study group are provided in the CAIP. Information gathered during the CAI supports the CSM as presented in the CAIP. No modification to the CSM was needed.

2.2.1.3 SG3, Rad Waste Dump

Four composite soil samples (0 to 5 cm bgs) were collected from each of two sample plots biased to the locations of highest radiological readings at the rad waste dump. Sample plots as defined in the Soils RBCA document include the collection of a TLD placed at a height of 1 m at the approximate center of each sample plot. See Figure A.5-1 for the sample locations at the Waste Dump. Results of the TLD and soil samples collected at the Waste Dump (Table 2-3) did not identify radiological contamination that exceeds the radiological FAL.

Table 2-3
TED at Sample Locations in SG3

Release Name	Sample Location	Type of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
			Average	95% UCL	Average	95% UCL
Rad Waste Dump	A26	Sample Plot	2	6	0	0
	A27	Sample Plot	18	**26**	1	1

Bold indicates the values exceeding 25 mrem/yr.

A geophysical survey was conducted at the Waste Dump to determine whether this location contains buried debris. The results of the survey (presented in Appendix I) did not indicate the potential for debris to be present.

The CSM and associated discussion for this study group are provided in the CAIP (NNSA/NFO, 2016). Information gathered during the CAI supports the CSM as presented in the CAIP. No modification to the CSM was needed.

2.2.1.4 SG4, Debris

A total of 12 locations were identified as containing metallic lead debris that meets the definition of PSM within SG4. The PSM from the 12 lead locations was removed as a corrective action. Grab soil samples (0 to 5 cm bgs) were collected from beneath each removed item at 11 of 12 locations (a soil sample could not be collected at location A08, as it was situated on a concrete pad) and analyzed for RCRA metals.

Location A11 was identified as soil with elevated radiological readings at the tower debris site. A grab soil sample and TLD sample were collected from this location.

Location A12 was identified as two small drums containing an unknown white powdery substance, with elevated radiological readings between the drums, located at the drum site. A grab soil sample and TLD sample were collected from the area of elevated radiological readings, and one composite grab sample was collected from the white powdery substance within the small drums. See Figure A.6-3 for the sample locations in SG4. Results of the TLD and soil samples (Tables 2-4 and 2-5) collected at SG4 did not identify radiological or chemical contamination that exceeds the FALs.

Table 2-4
TED at Sample Locations in SG4

Release Name	Sample Location	Type of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
			Average	95% UCL	Average	95% UCL
Tower Debris	A11	Grab and TLD	2	5	0	0
Drum Site	A12	Grab and TLD	21	23	1	1

The CSM and associated discussion for this study group are provided in the CAIP. Information gathered during the CAI supports and validates the CSM; therefore, no modification to the CSM was needed.

Table 2-5
SG4 Sample Results for Metals Detected above MDCs

Sample Location	Sample Number	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury
	FAL (mg/kg)	22.5	220,000	980	44.1	5,740	350
A01	AB7A001	3.7	140	0.18	6.4	36	0.027
A02	AB7A002	3.2	120	0.17	7	630	0.035
A03	AB7A003	3.1	150	0.3	4	24	0.042
A04	AB7A004	3.5	230	0.33	4.7	230	0.033
A05	AB7A005	3.9	150	0.47	4.9	250	0.024
A06	AB7A006	4.2	300	0.68	5	31	0.019
A07	AB7A007	4	140	0.22	8	730	0.034
A12	AB7A501	3.4	28	--	2.5	3.6	0.0047
A25	AB7A013	4.1	140	0.2	9.1	280	0.036
A28	AB7A022	5	170	2.3	9	890	0.028
A29	AB7A023	5.6	210	1.9	9.3	27	0.036
A30	AB7A024	5.5	170	0.48	8.1	95	0.018
A30	AB7A025	4.9	180	0.79	9.5	23	0.02

MDC = Minimum detectable concentration
mg/kg = Milligrams per kilogram

-- = Not detected above MDC.

2.2.2 Data Quality Assessment

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 is composed of the following five steps:

1. Review DQOs and Sampling Design.
2. Conduct a Preliminary Data Review.

3. Select the Test.
4. Verify the Assumptions.
5. Draw Conclusions from the Data.

The results of the DQI evaluation in Appendix B show that all DQI criteria were met and that the CAU 576 dataset supports the intended use in the decision-making process. Based on the results of the DQA, the nature and extent of COCs at CAU 576 have been adequately identified to develop and evaluate CAAs. The DQA also determined that information generated during the investigation supports the CSM assumptions, and the data collected met the DQOs.

2.3 Justification for No Further Action

For CAU 576, there are two considerations for determining whether COCs are present and the FAL is exceeded: (1) area-based residual radioactive material guideline (RRMGs) based on 1,000 m^2 and (2) hot spot RRMGs based on 1 m^2 (see Appendix H). The presence of a COC requires a corrective action. Although no CAI sample results indicated the presence of contamination exceeding FALs, the subsurface and inaccessible rad-chem piping at SG1 and SG2 were assumed to exceed the radiological FAL, and lead bricks and debris identified at the Kennebec site in SG2 and SG4 were assumed to meet the definition of PSM and require corrective action.

As no contamination exceeding a FAL was identified in SG3, no corrective actions are required.

The PSM in SG4 was removed as a corrective action during the CAI and verification samples collected after removal demonstrate that no contamination remains at SG4 at levels exceeding the FAL for lead. Therefore, no further corrective action is required for SG4.

FFACO use restrictions (URs) were implemented for each release site in SG1 and SG2. The UR boundaries were established as the corrective action boundaries determined from the physical extent of the rad-chem piping systems (including the vaults with lead bricks at Kennebec). The corrective action boundaries for SG1 and SG2 are shown in Figures 2-1 through 2-4.

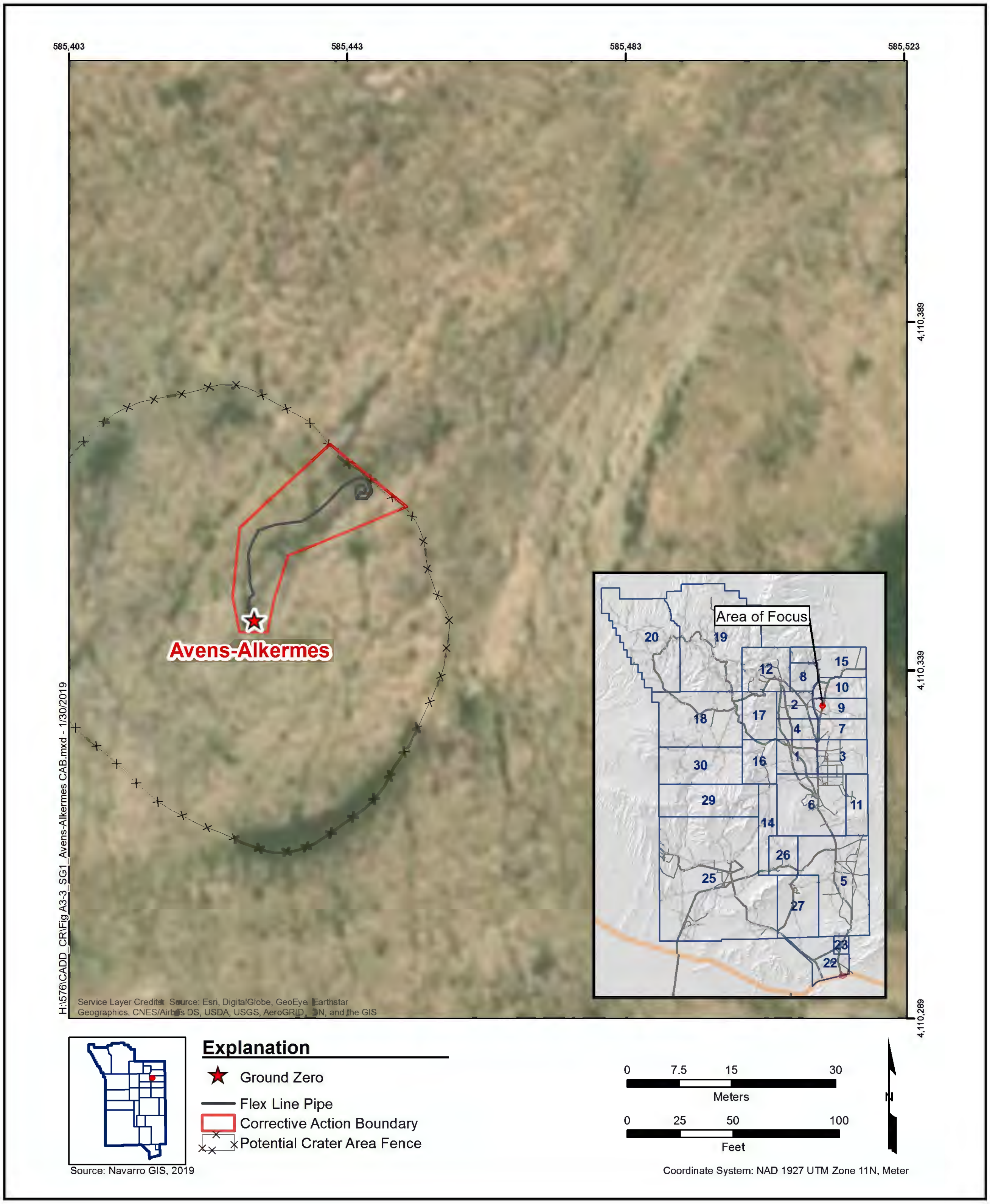


Figure 2-1
Corrective Action Boundary for Flex Line (CAS 09-99-09)

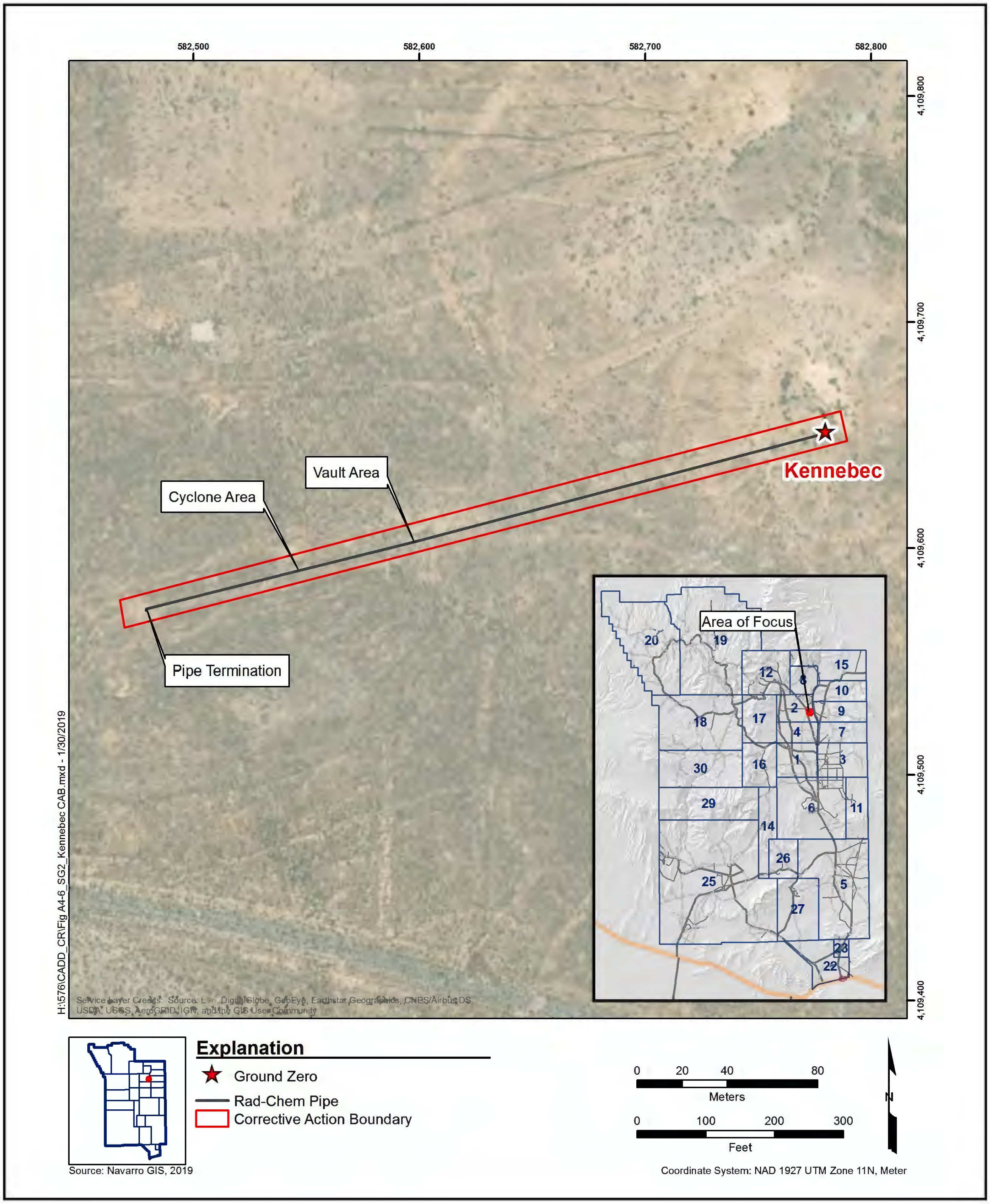


Figure 2-2
Corrective Action Boundary for Kennebec (CAS 02-99-12)

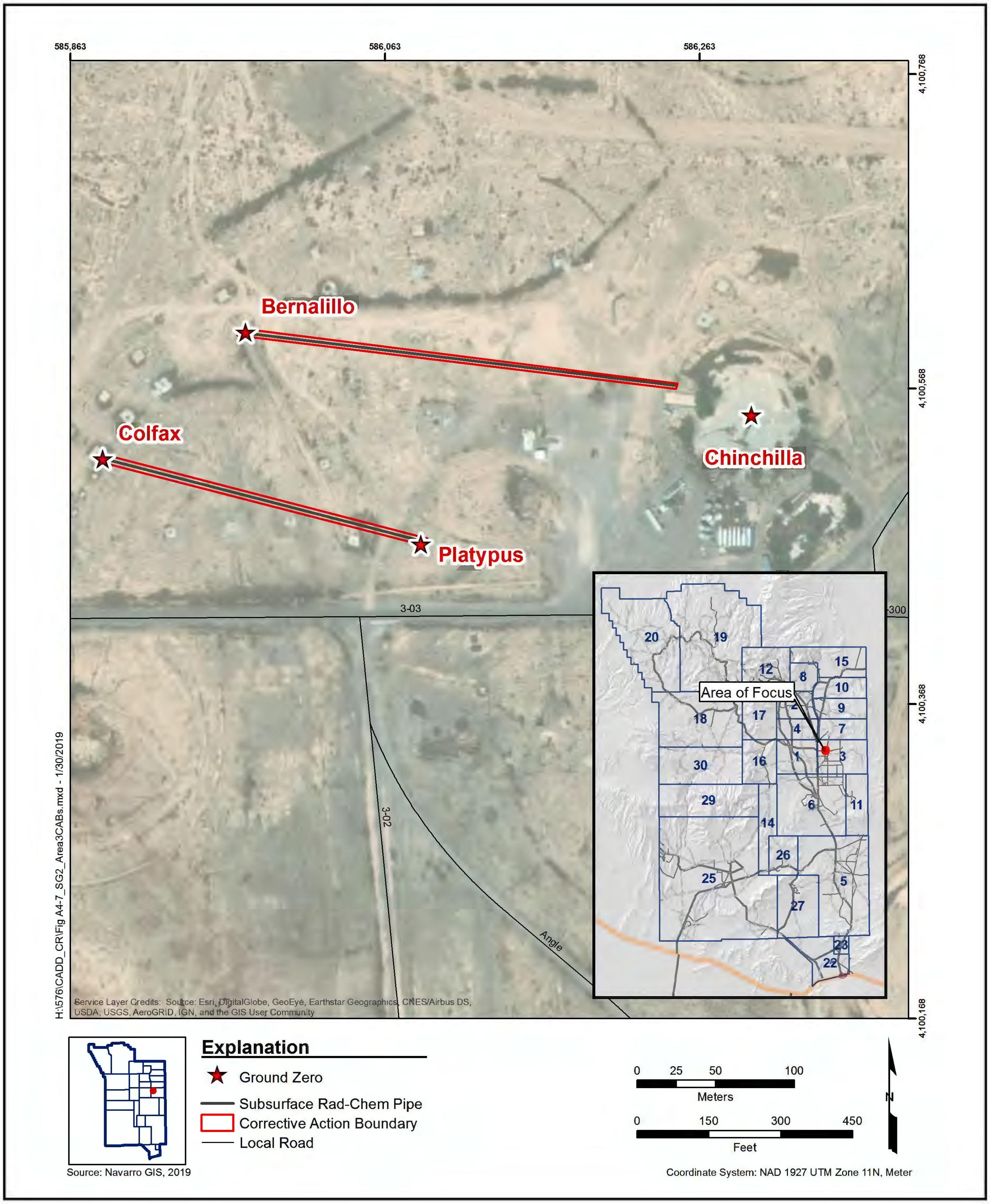


Figure 2-3
Corrective Action Boundary for Area 3 Piping (CAS 03-99-20)

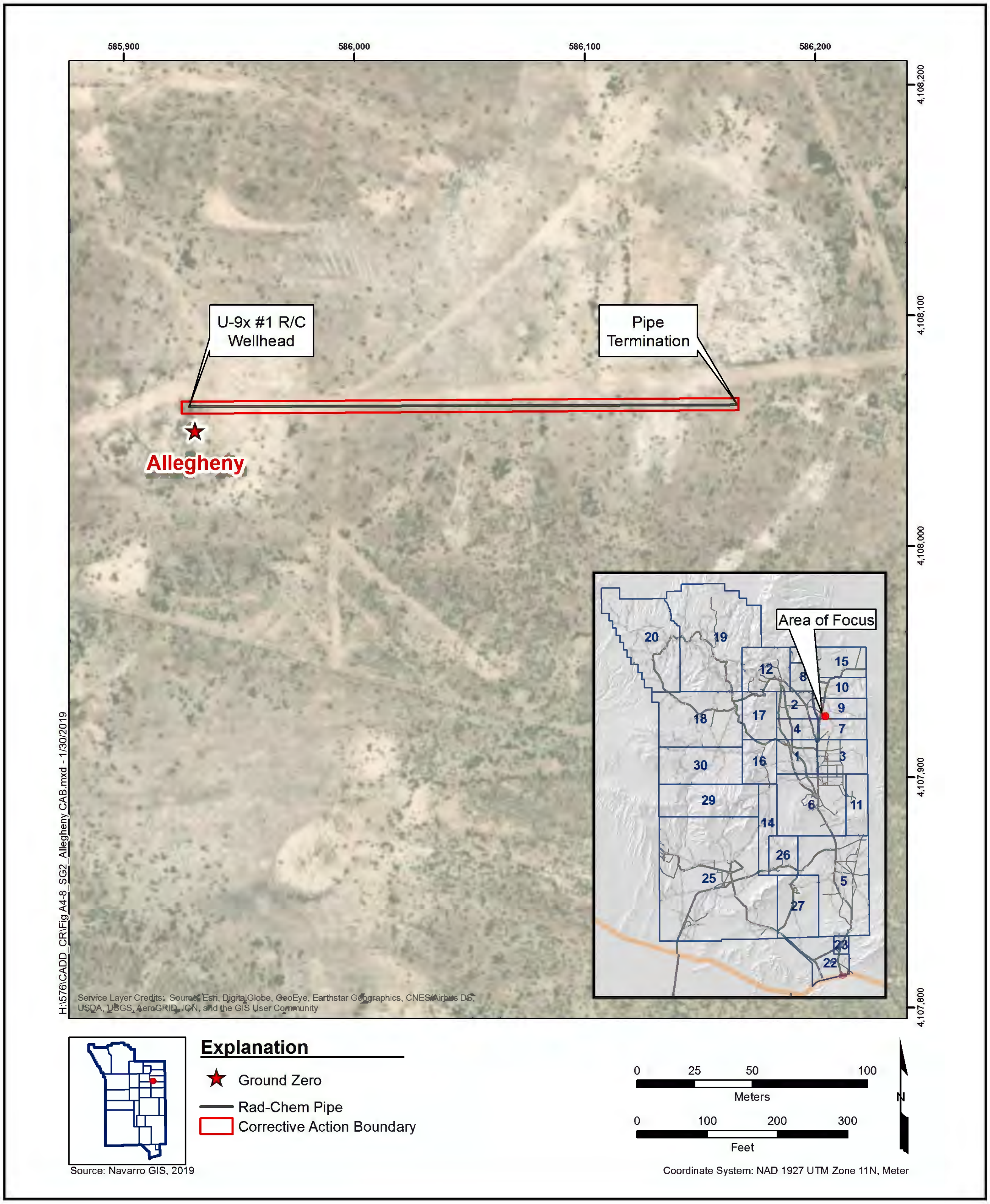


Figure 2-4
Corrective Action Boundary for Allegheny (CAS 09-99-08)

3.0 Recommendation

As presented in Appendix E, the CAA of closure in place with URs was selected as the recommended CAA for the Flex Line, Kennebec, Allegheny, and Area 3 Piping releases in the CAA meetings held on September 5, 2017, and July 31, 2018. The closure in place alternative for the Flex Line release site, and the alternatives of clean closure and closure in place for the Kennebec, Allegheny, and Area 3 Piping release sites were evaluated.

The selected CAA for the Flex Line release site consists of the moving of the flex line pipe to within the potential crater area, and implementing an FFACO UR for the area surrounding the relocated flex line pipe and the wellhead. The selected CAA for the Kennebec, Allegheny, and Area 3 Piping release sites consists of implementing FFACO URs for the area surrounding the physical extent of the rad-chem piping systems. At Kennebec, a fence was erected around the portion of the rad-chem piping system outside the crater area. These FFACO URs are presented in Appendix D.

Based on CAI results, no buried debris or contamination levels exceeding FALs were identified at the Waste Dump, and no corrective action is required for SG3. A corrective action of clean closure was implemented during the CAI for PSM identified in SG4. Based on the results of verification samples collected after removal, no contamination remains at SG4 that exceeds the FALs, and no further corrective action is required at this site.

The corrective actions implemented for CAU 576 are based on the assumption that activities on the NNSS will be limited to those that are industrial in nature and that the NNSS will maintain controlled access (i.e., restrict public access and residential use). Should the future land use of the NNSS change such that these assumptions are no longer valid, additional evaluation will be required.

The EM Nevada Program requests that NDEP issue a Notice of Completion for CAU 576 and approve transferring the CAU from Appendix III to Appendix IV of the FFACO. The DOE, under its regulatory authority for management of radioactive waste materials associated with environmental remediation activities, approves this request (USC, 2012).

4.0 References

EPA, see U.S. Environmental Protection Agency.

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

Federal Facility Agreement and Consent Order. 1996 (as amended March 2010). 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. Appendix VI, which contains the Soils Sites Strategy, was last modified June 2014, Revision No. 5.

Navarro GIS, see Navarro Geographic Information Systems.

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

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

Navarro Geographic Information Systems. 2018. ESRI ArcGIS Software.

USC, see *United States Code*.

United States Code. 2012. Title 42 USC 2011 et seq., "Atomic Energy Act of 1954," as amended. Washington, DC: U.S. Government Printing Office.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2016. *Corrective Action Investigation Plan for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada*, Rev. 0, DOE/NV--1551. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012. *Soils Activity Quality Assurance Plan,* Rev. 0, DOE/NV--1478. Las Vegas, NV.

U.S. Environmental Protection Agency. 2017. *Pacific Southwest, Region 9: Regional Screening Levels (Formerly PRGs), Screening Levels for Chemical Contaminants.* As accessed at http://www.epa.gov/region9/superfund/prg on 18 September. Prepared by EPA Office of Superfund and Oak Ridge National Laboratory.

Appendix A

Corrective Action Investigation Results

A.1.0 Introduction

This appendix presents the CAI activities and dose estimates for the six CASs at CAU 576, Miscellaneous Radiological Sites and Debris. To facilitate site investigation and the evaluation of DQO decisions, the reporting of investigation results and the evaluation of DQO decisions, the CAU 576 releases were organized into four study groups (Table A.1-1). Although the need for corrective action is evaluated separately for each release, CAAs are applied to the FFACO CAS. Additional information regarding the history of the site, planning, and scope of the investigation is presented in the CAU 576 CAIP (NNSA/NFO, 2016).

Table A.1-1
Release Sites

<table>
<tr><th>Study Group</th><th>CAS</th><th>CAS Name</th><th>Release Name</th><th>Release Component</th></tr>
<tr><td>1</td><td>09-99-09</td><td>U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line</td><td>Flex Line</td><td>Rad-Chem Piping</td></tr>
<tr><td rowspan="4">2</td><td rowspan="2">02-99-12</td><td rowspan="2">U-2af (Kennebec) Surface Rad-Chem Piping</td><td rowspan="2">Kennebec</td><td>Rad-Chem Piping</td></tr>
<tr><td>PSM (Lead Bricks)</td></tr>
<tr><td>03-99-20</td><td>Area 3 Subsurface Rad-Chem Piping</td><td>Area 3 Piping</td><td>Rad-Chem Piping</td></tr>
<tr><td>09-99-08</td><td>U-9x (Allegheny) Subsurface Rad-Chem Piping</td><td>Allegheny</td><td>Rad-Chem Piping</td></tr>
<tr><td>3</td><td>05-19-04</td><td>Frenchman Flat Rad Waste Dump</td><td>Waste Dump</td><td>Potential Spills/Debris/Buried Debris</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">00-99-01</td><td rowspan="2">Potential Source Material</td><td rowspan="2">Debris</td><td>PSM (Lead Items)</td></tr>
<tr><td>Two areas with elevated radiological readings</td></tr>
</table>

A.1.1 Investigation Objectives

The objective of the CAI was to provide sufficient information to evaluate and select CAAs and implement corrective actions as necessary to support the closure of CAU 576. This objective was achieved by identifying the nature and extent of COCs, evaluating and selecting CAAs, and implementing corrective actions.

For radiological contamination, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding the FAL of 25 mrem/yr. For chemical contamination, a COC is defined as the presence of a contaminant at a concentration exceeding its corresponding FAL (see Section A.2.4).

A.1.2 Contents

This appendix describes CAI activities and dose estimates. The contents of this appendix are as follows:

- Section A.1.0 describes the investigation background, objectives, and the contents of this document.
- Section A.2.0 provides an investigation overview.
- Sections A.3.0 through A.6.0 provide study-group-specific information regarding CAI field activities, sampling methods, and dose estimates.
- Section A.7.0 summarizes waste management activities.
- Section A.8.0 discusses the QA and QC processes followed and the results of QA/QC activities.
- Section A.9.0 provides a summary of the CAI results.
- Section A.10.0 lists the cited references.

The complete field documentation and laboratory data—including field activity daily logs, sample collection logs, analysis request/chain-of-custody forms, laboratory certificates of analyses, and analytical results—are retained in CAU 576 files as hard copy documents or electronic media.

A.2.0 Investigation Overview

Field investigation and sampling activities for the CAU 576 CAI were conducted between March and October 2017. Investigation activities included visual surveys, radiological surveys, geophysical surveys, ISOCS measurements, surface and subsurface soil sampling, and TLD sampling.

The investigation and sampling program adhered to the requirements set forth in the CAIP (NNSA/NFO, 2016) and in accordance with the Soils Activity QAP (NNSA/NSO, 2012), which establishes requirements, technical planning, and general quality practices. The investigation results and the risk associated with site contamination were evaluated in accordance with the Soils RBCA document (NNSA/NFO, 2014).

In accordance with the graded approach described in the Soils Activity QAP (NNSA/NSO, 2012), the quality required of a dataset will be determined by its use in decision making. Data used to define the presence of COCs are classified as decisional and will be used to make corrective action decisions. Survey data are generally classified as decision supporting when they are not used to resolve corrective action decisions.

The study groups were investigated by collecting TLD samples for external radiological dose calculations and collecting soil samples for the calculation of internal or total radiological dose. Data to evaluate chemical risk were provided by analytical results of soil samples. The field investigation was completed as specified in the CAIP (NNSA/NFO, 2016) except as noted in this document.

A.2.1 Sample Locations

All sample locations for CAU 576 were selected judgmentally, using biasing factors such as radiological survey results and/or the presence of debris. Soil samples were collected from the locations presented in the CAIP (NNSA/NFO, 2016) as planned except as noted in Sections A.3.4 and A.4.4. At the biased locations where soil sample plots were established, four composite samples were collected from unbiased locations within each sample plot, and TLDs were located at the center of each sample plot. The subsample aliquot locations for each sample were identified using a predetermined random-start, triangular grid pattern.

All sample locations and points of interest were surveyed with a GPS instrument. Appendix F presents these GPS data in a tabular format. Additional information on the selection of sample locations is found in the study-group-specific sections (see Sections A.3.0 through A.6.0).

A.2.2 Investigation Activities

The investigation activities conducted at CAU 576 completed all of the field investigation activities specified in the CAIP (NNSA/NFO, 2016) Sampling activities were conducted as planned except as noted in Sections A.3.4 and A.4.4. The investigation strategy provided the necessary information to establish the nature and extent of contamination associated with each study group.

A.2.2.1 ISOCS Sampling

ISOCS measurements were collected at selected releases in SG1 and SG2 to determine whether the waste currently contained by the rad-chem piping may have the potential to cause a dose exceeding a FAL when the containment afforded by the piping fails. The ISOCS measurements were used as informational data per the Soils Activity QAP (NNSA/NSO, 2012). Informational data do not directly affect DQOs, but provide information to support conceptual models and guide investigations. ISOCS estimates are highly dependent upon the modeled geometry of the contaminated material and the piping containing the contamination. As such, the dose estimates are approximations that are useful for providing information but will not be used to make corrective action decisions The ISOCS technology uses gamma spectroscopy to identify and quantify radionuclide content on surfaces, piping, containers, and various sample matrices. This allows for the measurement of specific radionuclide activities within surface piping without having to breach the piping. The ISOCS data were used to evaluate the potential for future dose to exceed the radiological FAL at each point measured. The results of these evaluations are discussed in Sections A.3.1.2 and A.4.1.3.

The results of the ISOCS measurements only identified the radionuclide cesium (Cs)-137 as present at any of the measurement locations in significant activities. The ISOCS measurement results were reported in terms of activity within a defined geometry. The estimation of the potential volume of impacted soil was estimated by projecting the measured geometry onto the ground surface, accounting for dispersion by doubling the resulting area, and using an estimated depth of contamination of 5 cm. The resulting volume was then converted to grams of soil using the conversion factor of 1.64 grams of soil per cubic centimeter. The Cs-137 activity estimated by the ISOCS measurement was then divided by the mass of the potentially impacted soil resulting in an estimate of activity per gram of soil (pCi/g). The potential dose at that location was then estimated using the methods described in Section A.2.3 except the hot spot RRMG for Cs-137 was used instead of the area-based RRMG (see Appendix H). Finally, the potential future dose was estimated at the time of failure of the piping containment as 25 percent of the current estimate by assuming the piping would fail after two additional half-lives of Cs-137 (i.e., 60 years).

A.2.2.2 TLD Sampling

TLDs (Panasonic UD-814) were staged at select CAU 576 sample locations with the objective of collecting in situ measurements to determine the external radiological dose as specified in the CAIP (NNSA/NFO, 2016). Two TLDs were also placed within each of four NNSS areas for the measurement of background radiation (Table A.2-1 and Figure A.2-1) representative of the CAU 576 release sites. The background TLDs are deployed to measure dose from natural sources in areas unaffected by the CAU-related releases. The background TLDs were placed in locations with the same geomorphological properties as the CAU 576 release sites but outside the influence of the releases. Therefore, they were determined to be representative of each general area and were used as a good estimate of true average background doses for TLDs placed at CAU 576 releases. See the study-group-specific sections for further discussion on the placement of TLDs.

Table A.2-1
Background TLD Sample Locations

Location Area	Location Number	Applicable Releases
Area 2	A23	Kennebec
	A24	
Area 3	A13	Area 3 Piping, Debris
	A14	
Area 5	A31	Waste Dump
	A32	
Area 9	A17	Flex Line, Allegheny, Debris
	A19	
Total Background TLDs	**8**	

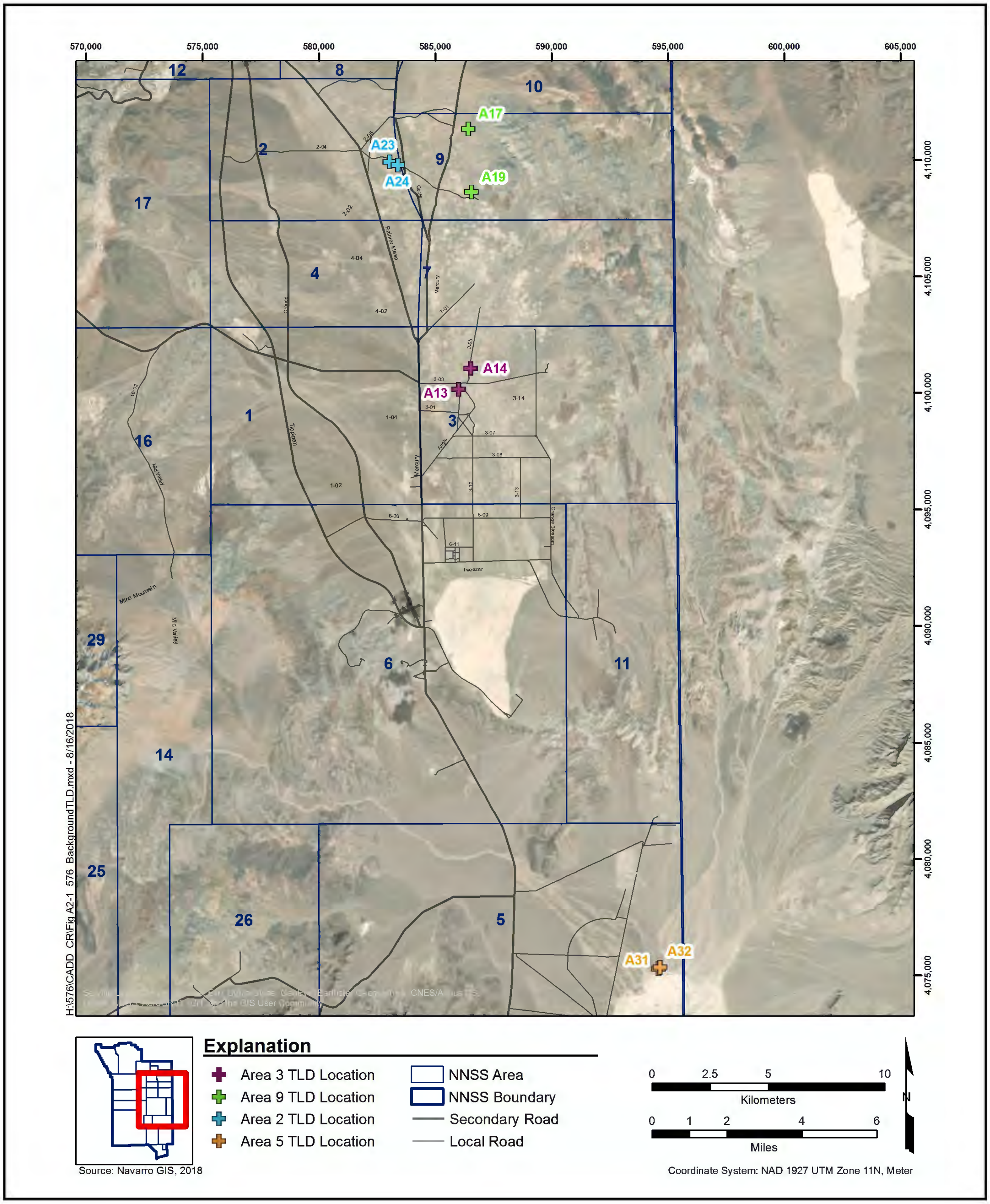


Figure A.2-1
Background TLD Locations

Each TLD was placed at a height of 1 m (3.3 ft) above ground surface (ags), which is consistent with standard practice in the NNSS environmental monitoring programs and is based on DOE guidance (BN, 2003). Once retrieved from the field locations, the TLDs were analyzed by automated TLD readers that are calibrated and maintained by the NNSS management and operating (M&O) contractor. This approach allowed for the use of existing quality control (QC) procedures for TLD processing. Details of the environmental monitoring TLD program and TLD QC are presented in Section A.8.0. All readings conformed to the approved QC program and are considered representative of the external radiological dose at each location.

A.2.3 Dose Calculations

Soil and TLD data are used to estimate a maximum potential TED that could be received by a human receptor at the site. The following subsections discuss the process for estimating dose from the soil and TLD data.

A.2.3.1 Internal Dose Calculations

Estimated internal dose was calculated using the radionuclide analytical results from soil samples and the corresponding RRMG (NNSA/NFO, 2014). The internal dose RRMG concentration for a particular radionuclide is that concentration in surface soil that would cause an internal dose to a receptor of 25 mrem/yr (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The internal dose RRMG for each detected radionuclide (in picocuries per gram [pCi/g] of soil) was derived using RESRAD computer code (Yu et al., 2001) under specified exposure scenarios (NNSA/NFO, 2014).

The total internal dose corresponding to each surface soil sample was calculated by adding the dose contribution from each radionuclide. For each sample, the radionuclide-specific analytical result was divided by its corresponding internal RRMG (NNSA/NFO, 2014) to yield a fraction of the 25-mrem/yr dose and then multiplied by 25 to yield an internal dose estimate (in mrem/yr) at that sample location. Soil concentrations of Pu isotopes are inferred from gamma spectroscopy results as described in the representativeness discussion of Section B.1.1.3.4. The internal doses for all radionuclides detected in a soil sample were then summed to yield an internal dose for that sample. For probabilistic samples, a 95 percent UCL was calculated for the internal dose in each sample plot using the estimated doses from each soil sample collected at that plot (NNSA/NFO, 2014). For judgmental sample locations where only one sample was collected, statistical inferences could not be calculated, and the estimated internal dose from the single sample was used.

A.2.3.2 External Dose Calculations

At CAI sample locations where TLDs were placed, external dose was calculated using direct TLD measurements in accordance with the Soils RBCA document (NNSA/NFO, 2014). The TLDs used at CAU 576 contain four individual elements. External dose at each TLD location is determined using the readings from TLD elements 2, 3, and 4. Each of these elements is considered a separate independent measurement of external dose. A 95 percent UCL of the average of these measurements was calculated for each TLD location. Element 1 is designed to measure dose to the skin and is not relevant to the determination of the external dose for the purpose of this investigation.TLD Element 1 is less sensitive to low-energy photons, is more variable, and is not replicated within the TLD badge. As the other three elements over-respond to low-energy photons, the predictions of external dose are conservatively high.

At soil sample locations where no TLD was placed, a TLD-equivalent external dose was estimated from radionuclide activities reported in soil sample analytical results and then adjusted by multiplying the RESRAD-derived external dose by a correction factor. This results in a more conservative (higher) estimate of external dose than if the RESRAD external dose was used without correction. This correction factor was developed to account for an observed difference between RESRAD-derived external dose and TLD readings as described in the Soils RBCA document (NNSA/NFO, 2014). The correction factor was derived by evaluating previous data from Soils Activity sites where both TLD and RESRAD-derived external dose data were available. The correlations were made using the Industrial Area (IA) scenario (as doses for this scenario were calculated for all Soils release sites). As external dose is directly related to exposure time, the correlation is the same for any period of exposure. Therefore, the IA scenario provides the most accurate results because it is the scenario that uses the longest exposure time. Evaluation of these data showed good correlation between these paired data, with a weighted average correction factor of 1.58 for average TLD values and 1.69 for 95 percent UCL TLD values. The correlation of TLD dose to RESRAD external dose is presented in Figure A.2-2. This evaluation also demonstrated that this

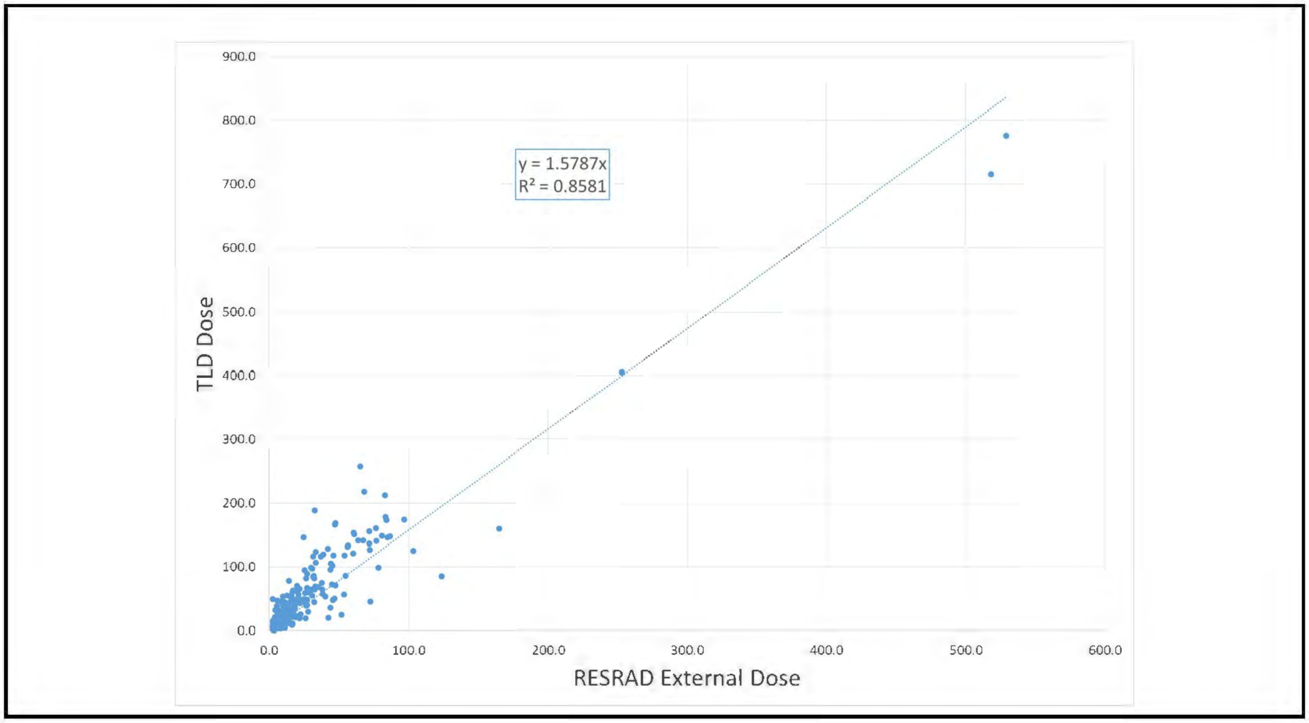


Figure A.2-2
Correlation of TLD Dose to RESRAD External Dose

correction factor was not influenced by the type of test (e.g., weapons test or safety experiment) as shown in Figure A.2-3, where the percent external dose represents different types of tests (i.e., weapons tests have a high percentage of external dose and safety experiments have a higher percentage of internal dose). The correction factor is also not influenced by the amount of activity present (Figure A.2-4). However, it demonstrated that at very low external dose levels (as external doses approached zero), the relationship between RESRAD-derived external dose and TLD external dose had no correlation. Therefore, attempting to use site-specific data to correct RESRAD-derived external dose at sites where external dose is low can result in erratic and erroneous results.

A.2.3.3 Total Effective Dose

The calculated TED represents the sum of the internal dose and the external dose for each sample location. The calculated TED is an estimate of the true (unknown) TED. It is uncertain how well the calculated TED represents the true TED. If a calculated TED were directly compared to the FAL, any significant difference between the true TED and the calculated TED could lead to decision errors.

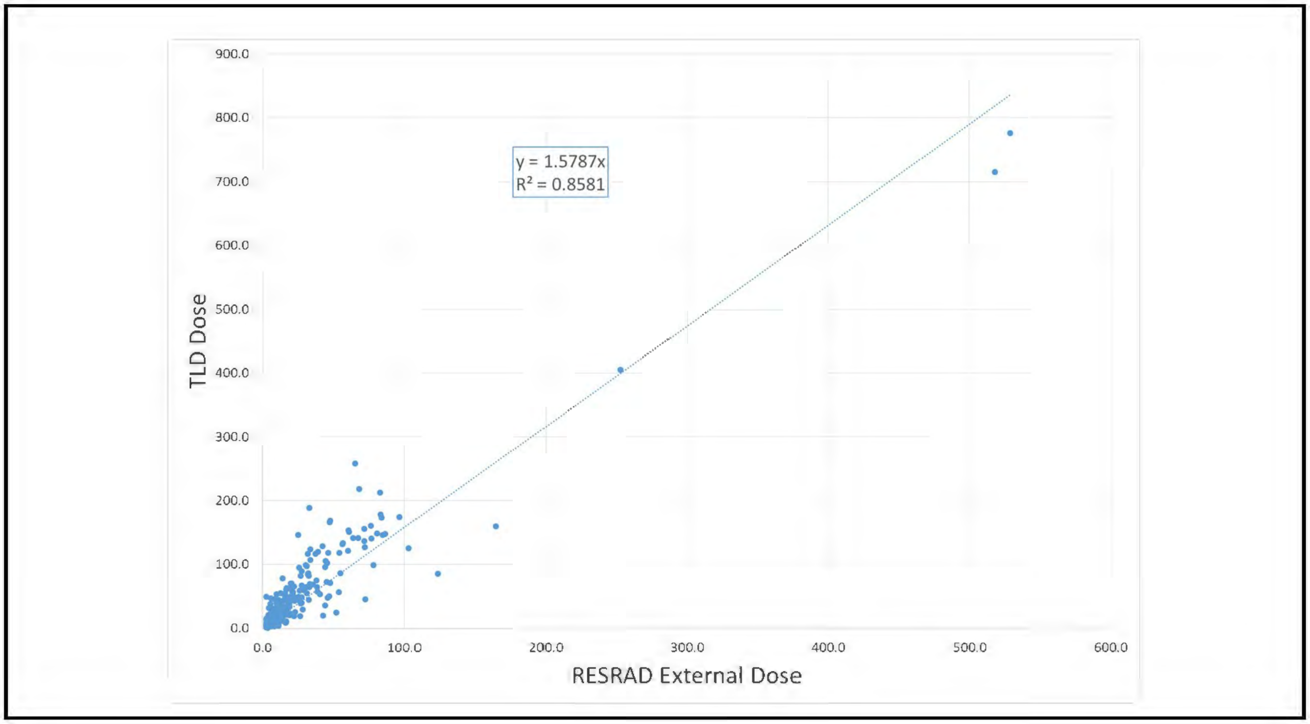


Figure A.2-3
Correlation of Correction Factor to Release Type
Note: Different release types are represented by different external dose percentages.

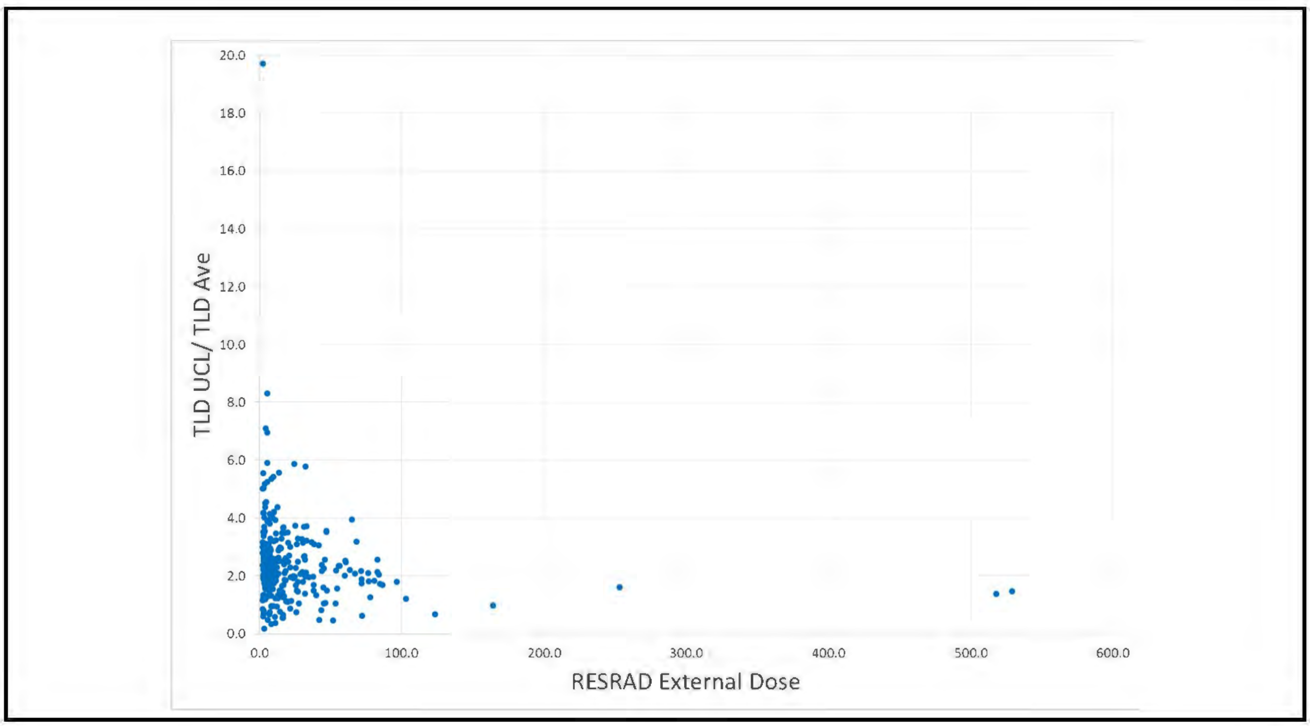


Figure A.2-4
Correlation of Correction Factor to External Dose

To reduce the probability of a false-negative decision error for probabilistic sampling results, a conservative estimate of the true TED (i.e., the 95 percent UCL) is used to compare to the FAL. By definition, there will be a 95 percent probability that the true TED is less than the 95 percent UCL of the calculated TED. The probabilistic sampling design as described in the CAIP (NNSA/NFO, 2016) conservatively prescribes using the 95 percent UCL of the TED for DQO decisions. The 95 percent UCL of the TED is also used for determining the presence or absence of COCs (DQO Decision I). For sample locations where a TLD and multiple soil samples are collected (i.e., sample plots), this is calculated as the sum of the 95 percent UCL of the internal and external doses. For grab sample locations where a TLD sample was collected or a TLD-equivalent is calculated, TED is calculated as the sum of the 95 percent UCL of the external dose and the single internal dose estimate.

A minimum number of samples is required to assure sufficient confidence in dose statistics for probabilistic sampling such as the average and 95 percent UCL (EPA, 2006). As stated in the CAIP, if the minimum sample size criterion cannot be met, it must be assumed that contamination exceeds the FAL. The calculation of the minimum sample size is described in Section B.1.1.3.2.

To reduce the probability of a false-negative decision error for judgmental sampling results, samples were biased to locations of higher radioactivity. Samples from these locations will produce TED results that are higher than from adjacent locations of lower radioactivity (within the exposure area that is being characterized for dose). This will conservatively overestimate the true TED of the exposure area and protect against false-negative decision errors.

A.2.4 Comparison to Action Levels

The radiological action level is based on an annual dose limit of 25 mrem/yr. This dose limit is specific to the potential cumulative annual hours of exposure to site contamination. The radiological PAL was established in the CAIP (NNSA/NFO, 2016) based on a dose limit of 25 mrem/yr over an annual exposure time of 2,000 hours (i.e., the IA exposure scenario, in which a site worker is exposed to site contamination for 8 hr/day and 250 day/yr). The radiological FAL is established in Appendix D using the OU exposure scenario with an annual exposure time of 80 hours in which a site worker is exposed to site contamination for 8 hr/day and 10 day/yr. Both the PALs and FALs were calculated using an exposure area of 1,000 m^2 (area-based).

Radiological doses calculated from soil sample and TLD results were compared to the area-based radiological FAL. To determine whether corrective action is necessary at small areas of anomalous elevated radioactivity (i.e., hot spots), the estimated dose from the ISOCS measurement at the single location of the Allegheny U-9x #1 R/C wellhead was estimated using the hot spot RRMGs defined in Appendix H.

A summary of the FAL basis and the assumptions for each study group is presented in Table A.2-2.

Table A.2-2
FAL Basis and Assumptions for Study Groups

Study Group	Release Name	Release Component	FAL	Basis/Assumption	Reference
1	Flex Line	Rad-Chem Piping	25 mrem/OU-yr	1,000-m^2 area of contamination for area contamination, 1-m^2 area of contamination for point contamination, or assumption of COCs for unsampled areas	Soils RBCA document (NNSA/NFO, 2014)
2	Kennebec	Rad-Chem Piping			
		PSM (Lead Bricks)	Lead FAL		
	Area 3 Piping	Rad-Chem Piping	25 mrem/OU-yr		
	Allegheny	Rad-Chem Piping			
3	Waste Dump	Potential Spills/Debris/Buried Debris	25 mrem/OU-yr		
4	Debris	PSM (Lead Items)	Lead FAL		
		Two areas with elevated radiological readings	25 mrem/OU-yr		

A.3.0 SG1, Surface Rad-Chem Piping

SG1 consists of a rad-chem gas sampling flex line pipe located within the southeastern portion of Area 9 of the NNSS. This flex line pipe is connected to the wellhead within a fenced potential crater area at the Averns-Alkermes weapons-related shaft test. The flex line pipe lies on the ground surface both inside and outside the potential crater area for approximately 65 m. Due to safety concerns, CAI activities were not conducted within the potential crater area. Additional detail on the history of SG1 is provided in the CAIP (NNSA/NFO, 2016).

A.3.1 CAI Activities

CAI activities specific to SG1 included a radiological survey, an ISOCS measurement on the flex line pipe, and the collection of a surface soil grab and TLD sample at the flex line pipe termination.

A.3.1.1 Radiological Surveys

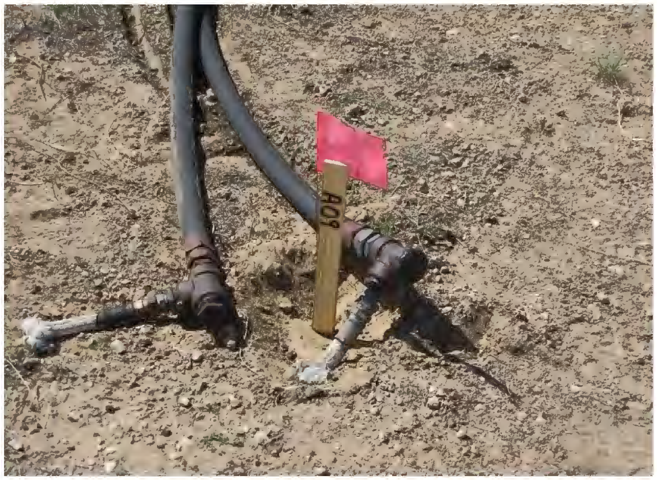
A radiological survey was completed along the flex line pipe outside the potential crater area using the Ludlum Model 4410 instrument. The purpose of the survey was to bias sample locations to the highest radiological readings along the flex line pipe for ISOCS measurements and TLD placement. No locations of elevated radioactivity were identified along the flex line pipe (i.e., none were distinguishable from the surrounding area).

A.3.1.2 ISOCS Measurements

An ISOCS measurement was collected in a location biased to physical features along the flex line pipe. The measurement was taken at the closest accessible location from the GZ along the flex line pipe (just outside the potential crater area at location A34. See Figure A.3-1 for photographs of the ISOCS measurement at the flex line pipe and Figure A.3-2 for the ISOCS sample location.

A.3.1.3 TLD Samples

One TLD (number 6268) was placed at a height of 1 m at the termination of the flex line pipe, near the nozzle (location A09). In addition, two background TLDs were staged in Area 9 of the NNSS



03/15/2017 (PIRDY-57-215611)

02/11/2016 (PIRDY-57-210953)

03/15/2017 (PIRDY-57-215616)

02/11/2016 (PIRDY-57-210956)

Figure A.3-1
Flex Line (CAS 09-99-09) ISOCS and Sample Location Photographs

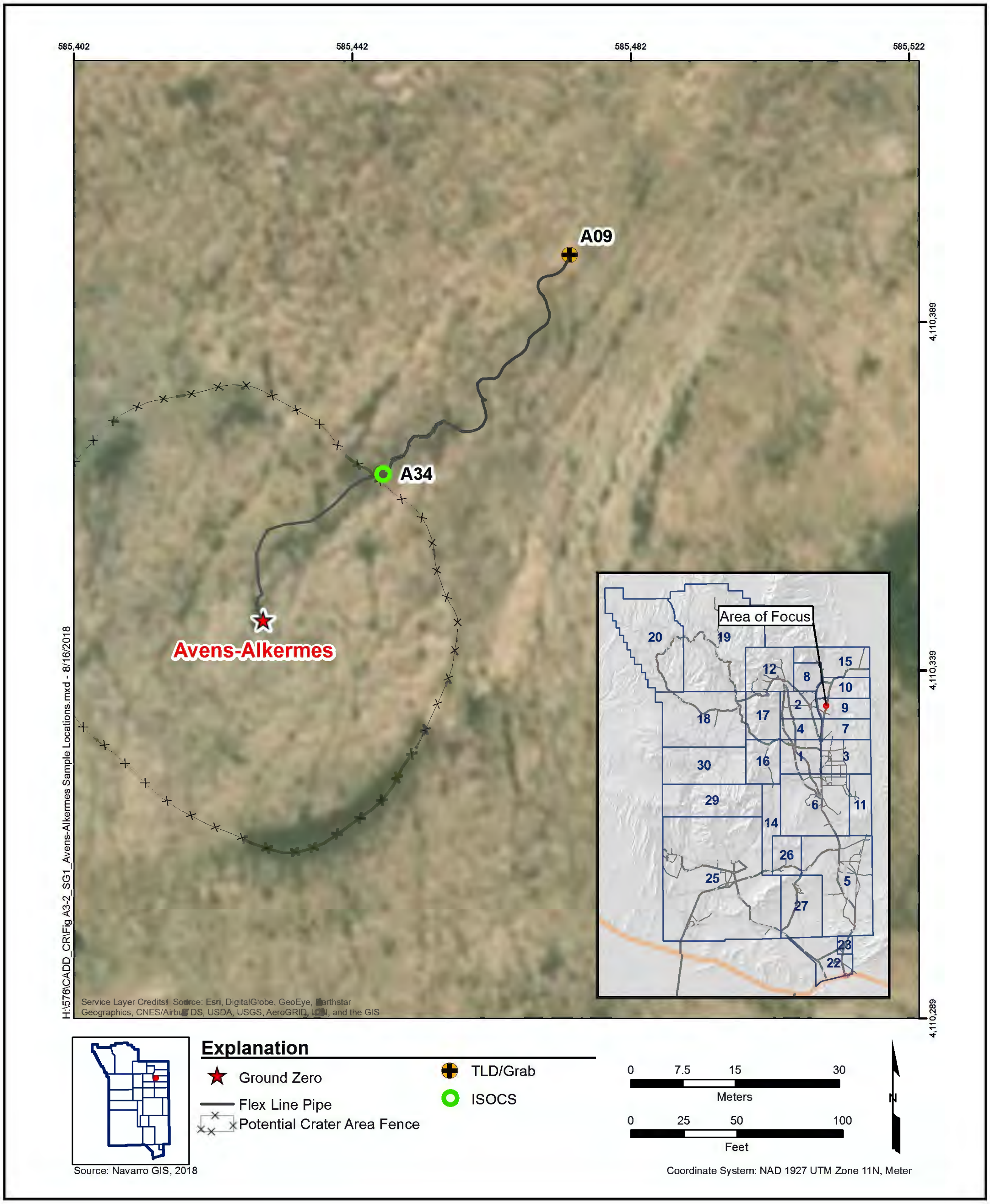


Figure A.3-2
Flex Line (CAS 09-99-09) Sample Locations

to measure background as discussed in Section A.2.2.2. See Figure A.3-2 for the TLD sample location at SG1.

A.3.1.4 Soil Samples

In accordance with the CAIP (NNSA/NFO, 2016), one judgmental surface grab soil sample was collected from the termination of the flex line pipe, near the nozzle (location A09, Sample Number AB7A008) at a depth of 0 to 5 cm bgs. This sample was submitted for gamma spectroscopy, isotopic Pu, isotopic U, and isotopic Am analyses. See Figure A.3-2 for the location of the soil sample collected at SG1.

A.3.2 Investigation Results

The following subsections present the internal, external, and TED results for the surface soil samples and ISOCS measurement collected at the flex line pipe. The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr.

A.3.2.1 ISOCS Radiological Dose Estimate

The ISOCS measurement taken at location A34 identified the presence of Cs-137 at an activity of 2,418 pCi/g. Using the hot spot RRMG for Cs-137 of 24,800 pCi/g, the projected future dose at the estimated time of containment failure is estimated to be 1 mrem/OU-yr. See Figure A.3-1 for photographs of the ISOCS sampling at the flex line pipe and Figure A.3-2 for the ISOCS sample location.

A.3.2.2 Internal Radiological Dose Calculations

The estimate for the internal dose that a receptor would receive at sample location A09 (nozzle at the termination of the flex line pipe) was determined as described in Section A.2.3.1. The internal doses for the IA and OU exposure scenarios are presented in Table A.3-1.

A.3.2.3 External Radiological Dose Calculations

The estimate for the external dose that a receptor would receive at sample location A09 was determined as described in Section A.2.3.2. External doses were calculated for the IA and OU

Table A.3-1
Internal Dose at Sample Location in SG1

Release Name	Sample Location	Sample Depth (cm bgs)	Number of Samples	IA (mrem/IA-yr)	OU (mrem/OU-yr)
Flex Line	A09	0-5	1	0	0

exposure scenarios for the sampled location. The external doses for each exposure scenario are presented in Table A.3-2. The minimum sample size requirement was met for the TLD sample.

Table A.3-2
External Dose at Sample Location in SG1

Release Name	Location	TLD	Number of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
				Average	95% UCL	Average	95% UCL
Flex Line	A09	Yes	3	13	17	1	1

A.3.2.4 Total Effective Dose

The TED for sample location A09 was calculated by adding the external dose value and the internal dose value. Values for both the average TED and the 95 percent UCL of the TED for the IA and OU exposure scenarios are presented in Table A.3-3. The 95 percent UCL of the TED at this location is estimated as the internal dose added to the 95 percent UCL of the external dose.

Table A.3-3
TED at Sample Location in SG1

Release	Location	Type of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
			Average TED	95% UCL of TED	Average TED	95% UCL of TED
Flex Line	A09	Grab and TLD	13	17	1	1

A.3.3 Nature and Extent of COCs

Based on the data evaluation and the proposed scenario, the 95 percent UCL of the average TED does not exceed the FAL of 25 mrem/OU-yr at location A09. Because access to the portion of the flex line pipe within the potential crater area was not permitted, it is assumed that contamination in the flex line pipe within the potential crater area and the wellhead exceeds FALs. Therefore corrective action is required for the Flex Line. The corrective action boundary is shown on Figure A.3-3. The selected corrective action is closure in place with a UR (see Appendix D). It was also determined during the CAA meeting held on September 5, 2017, that the portion of the flex line pipe outside the potential crater area would be moved to within the potential crater area fence line (see Appendix E).

A.3.4 Deviations/Revised CSM

The planned sampling activities for the Flex Line could not be implemented as described in the CAIP (NNSA/NFO, 2016). The CAIP stipulated that three Decision I bias ISOCS sample locations would be selected based on the highest radiological survey values along the length of the flex line pipe. It was also stated in the CAIP that one TLD would be placed in the area of the highest radiological survey value. However, biasing to the highest radiological survey value was not possible as there were no radiological survey results that could be distinguished from background readings in the area.

The sampling planned in the CAIP also assumed that there would be access to the Averns-Alkermes wellhead and the flex line pipe located inside the potential crater area. Access to these areas was not possible due to safety concerns.

Therefore, sampling at the Flex Line was modified by biasing an ISOCS measurement location to the nearest accessible location along the flex line pipe to the GZ. Also, one TLD was biased to the grab sample location at the termination of the flex line pipe near the nozzle.

The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions to the CSM were necessary.

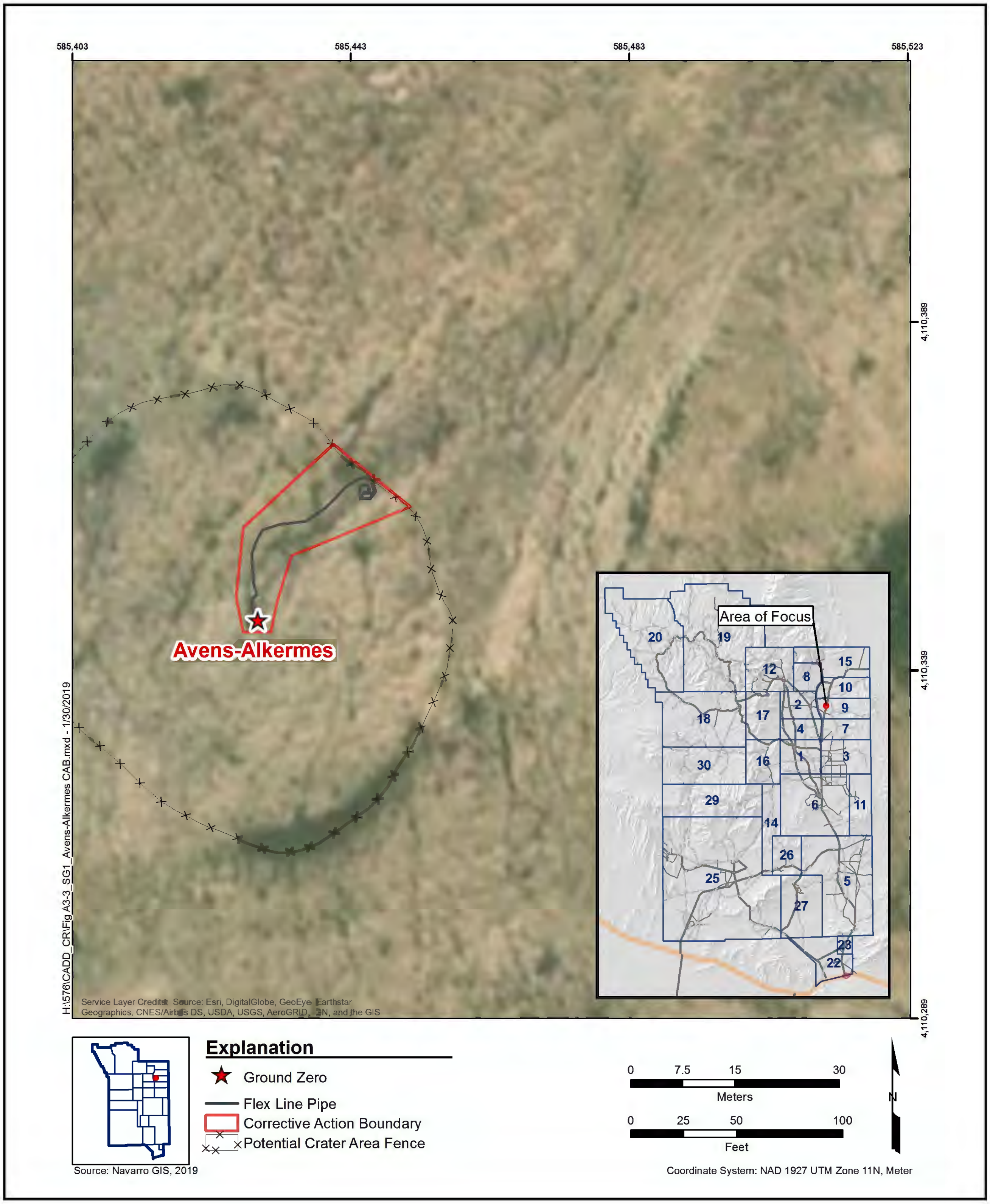


Figure A.3-3
Flex Line (CAS 09-99-09) Corrective Action Boundary

A.4.0 SG2, Subsurface Rad-Chem Piping

SG2 consists of three sites located in Areas 2 (Kennebec), 3 (Area 3 Piping), and 9 (Allegheny) of the NNSS. In general, SG2 is a mixture of the potential radionuclide releases to the surface and/or shallow subsurface from waste contained within surface and subsurface rad-chem piping, surface gas sampling components, and/or venting of gases from pipe termination. Additional detail on the history of SG2 is provided in the CAIP (NNSA/NFO, 2016).

A.4.1 CAI Activities

CAI activities specific to SG2 investigations included visual and radiological surveys, a geophysical survey (at Allegheny), ISOCS measurements (Kennebec and Allegheny), a surface soil grab sample (Kennebec), a subsurface soil grab sample (Allegheny), and TLD samples.

A.4.1.1 Visual Surveys

Visual inspections were conducted over the course of the field investigation. No drainage channels or staining were identified at any of the SG2 releases.

At Kennebec, lead bricks were identified on the ground surface. The lead bricks on the surface are included in SG4 (see Section A.6.0). According to an engineering drawing (see Figures 2-5 and 2-6 of the CAIP [NNSA/NFO, 2016]), lead bricks were placed subsurface within vaults. These vaults were observed during the visual survey. See Figures A.4-1 and A.4-2 for example photographs of the vaults containing lead bricks at Kennebec.

At the Area 3 Piping site, no surface rad-chem piping was identified. During CAU 568 closure activities sections of radioactively contaminated piping was identified on ground surface near the mud plant. It is likely that this piping is associated with removed portions of the rad-chem piping between Chinchilla and Bernalillo. This piping was removed during CAU 568 closure activities.

A.4.1.2 Radiological Surveys

At Kennebec, radiological surveys were completed with a Ludlum Model 4410 instrument to bias ISOCs and TLD sample locations along the length of the exposed piping at Kennebec. The radiation

03/02/2016 (PIRDY-57-210936)

Figure A.4-1
Kennebec (CAS 02-99-12) Vault Area Photograph

01/07/2014 (PIRDY-57-200958)

Figure A.4-2
Kennebec (CAS 02-99-12) Vault with Lead Bricks Photograph

detector was held at a height of approximately 6 inches from the surface of the visible rad-chem piping. The results of the Ludlum Model 4410 survey are recorded in units of counts per minute (cpm) (see Figure A.4-6). See Sections A.4.1.3 and A.4.1.6 for additional information on the biasing of sample locations using the Ludlum Model 4410 instrument.

At the Area 3 Piping site, a radiological survey was conducted with the field instrument for the detection of low-energy radiation (FIDLER) instrument as discussed in the CAIP (NNSA/NFO, 2016) in order to bias a location for TLD placement (see Figure A.4-7). A small area of elevated radiological readings was identified outside the southeast corner of the fenced Platypus GZ area.

At Allegheny, a radiological survey was conducted with a Ludlum Model 4410 instrument as discussed in the CAIP in order to bias a location for TLD placement. Elevated radiological readings were detected on the Allegheny rad-chem wellhead (U-9x #1 R/C).

A.4.1.3 ISOCS Measurements

Although not specified in the CAIP (NNSA/NFO, 2016), to determine whether the waste in the Kennebec piping system may have the potential to cause a dose exceeding a FAL when the containment afforded by the piping fails, ISOCS measurements were collected as described in Section A.2.2.1 at three biased locations along the surface rad-chem piping, based on the highest accessible Ludlum Model 4410 reading locations. The first measurement was conducted at a visible elbow in the surface piping within the vault area (location A35); the second measurement was taken from the cyclone (location A22); and the last measurement was taken at a large pipe flange near the termination (location A10). See Figure A.4-3 for photographs of the ISOCS measurements and Figure A.4-6 for ISOCS measurement locations.

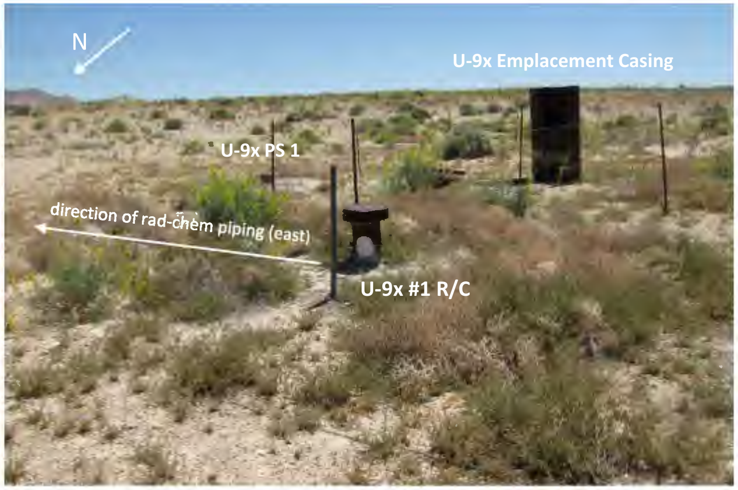
Although not specified in the CAIP, to determine whether the waste in the Allegheny piping may have the potential to cause a dose exceeding a FAL when the containment afforded by the piping fails, an ISOCS measurement was collected as described in Section A.2.2.1 at the U-9x #1 R/C wellhead (location A18). This is the only location where the piping system is exposed. See Figure A.4-4 for photographs of the ISOCS measurement and Figure A.4-5 for the ISOCS measurement location.

03/13/2017 (PIRDY-57-215598)

03/13/2017 (PIRDY-57-215600)

03/14/2017 (PIRDY-57-215626)

Figure A.4-3
Kennebec (CAS 02-99-12) ISOCS and Sample Location Photographs



05/12/2016 (PIRDY-57-212022)

03/14/2017 (PIRDY-57-215625)

04/03/2017 (PIRDY-57-215697)

Figure A.4-4
Allegheny (CAS 09-99-08) ISOCS and Sample Location Photographs

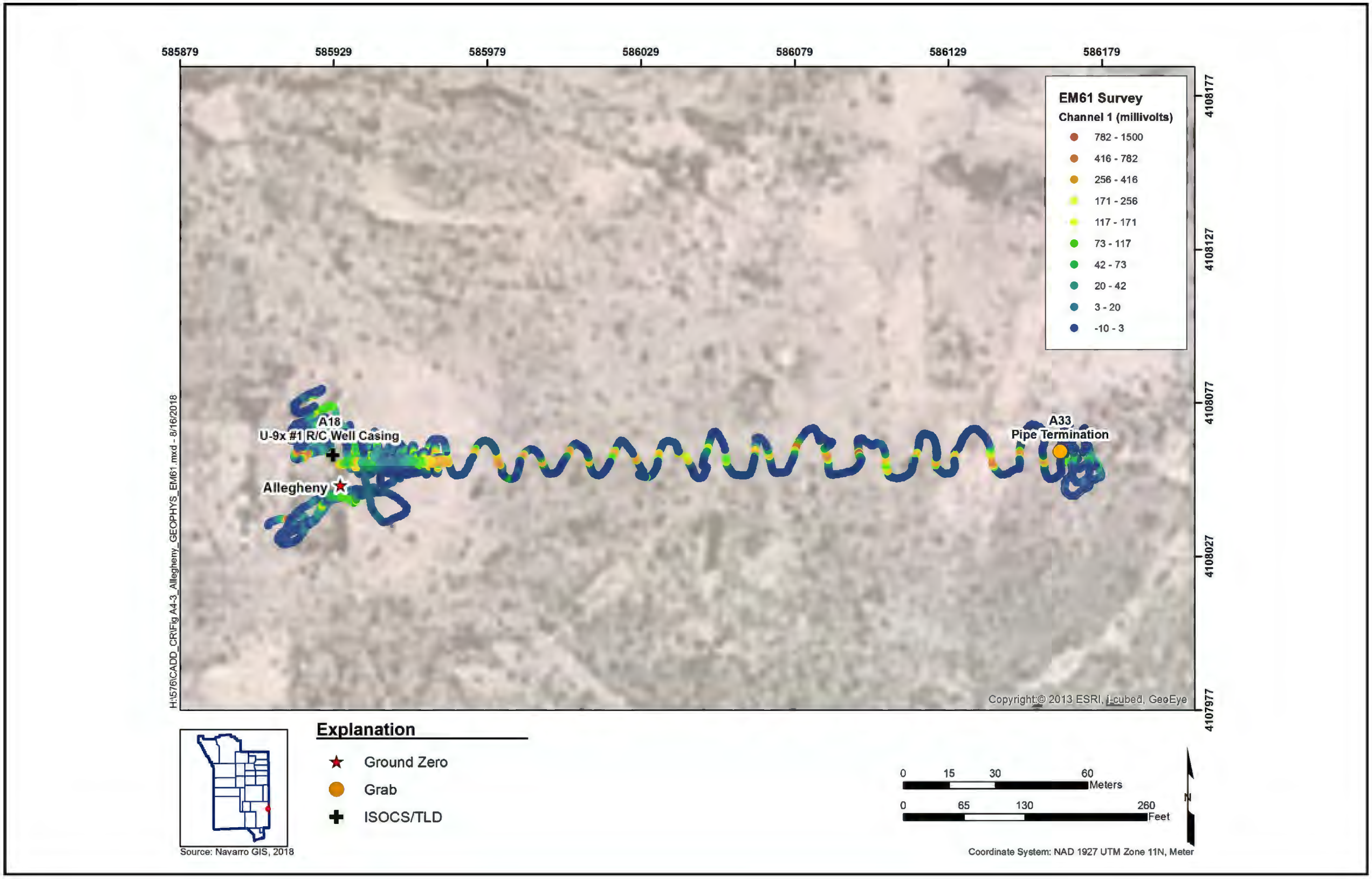


Figure A.4-5
Allegheny (CAS 09-99-08) Geophysical Survey and Sample Locations

A.4.1.4 Geophysical Surveys

A geophysical survey was conducted at the Allegheny site to verify the location of the subsurface rad-chem piping originating from U-9x #1 R/C. Two instruments (the EM31-MK2 earth conductivity meter and the EM61-MK2A time domain metal detector) were used to conduct the surveys. The EM31-MK2 measures the conductivity of the material (soil) interrogated as well as detects the presence of metal. The EM61-MK2A detects both ferrous and non-ferrous conductive objects. It is relatively insensitive to the electrical conductivity of the soil.

Per an engineering drawing (see Figure 2-16 in the CAIP [NNSA/NFO, 2016]) the subsurface piping was placed in a 2-ft trench and extended approximately 800 ft from U-9x #1 R/C (U9x-1 on the drawing) in an unknown direction (north arrow not identified in drawing). The geophysical survey identified a subsurface disturbance extending east approximately 800 ft from U-9x #1 R/C. The subsurface disturbance ended within a visually identifiable surface soil mound. A geophysical survey was also performed around the soil mound and the subsurface disturbance did not extend past the soil mound. It is, therefore, believed that the subsurface disturbance is the Allegheny rad-chem piping, which terminates within the soil mound. See Figure A.4-5 for the results of the geophysical survey.

A.4.1.5 Radiological Field Screening

Radiological field screening was used at Allegheny to aid in the selection of a biased soil sample from the soil mound at the pipe termination area. The NE Electra instrument was used to determine the depth interval sample with the highest amount of radioactivity at the sample location. Soil screening samples were collected and field screened for radioactivity in 5-cm-depth increments to a total depth of 30 cm bgs. The subsurface depth interval with the highest reading was sent for offsite laboratory analyses.

A.4.1.6 TLD Samples

At Kennebec, one TLD (number 6008) was placed at the location of the highest Ludlum Model 4410 readings (cyclone area - location A22) to estimate the maximum potential external dose. This was done in accordance with the CAIP (NNSA/NFO, 2016). In addition, two background TLDs were staged in Area 2 of the NNSS to measure background dose as discussed in Section A.2.2.2. See Table A.4-1 and Figure A.4-6 for the TLD sample location at Kennebec.

Table A.4-1
SG2 Sample Location Details

Release Name	Location	Soil Sample Collected	TLD Placed	Purpose
Kennebec	A10	Yes	No	Grab sample
	A22	No	Yes	TLD
Area 3 Piping	A21	No	Yes	TLD
	A36	No	Yes	TLD
Allegheny	A18	No	Yes	TLD
	A33	Yes	No	Grab Sample

At the Area 3 Piping site, a TLD was placed at the location of the highest radiological readings of the exposed piping identified by the FIDLER instrument. Because the Platypus wellhead was the only location with exposed piping, the TLD was placed above the wellhead (location A36) in accordance with the CAIP. An additional TLD was placed at a location of elevated radiological readings that was identified during the CAI (location A21). In addition, two background TLDs were staged in Area 3 of the NNSS to measure background dose as discussed in Section A.2.2.2. See Table A.4-1 and Figure A.4-7 for the TLD sample locations at the Area 3 Piping site.

At Allegheny, in accordance with the CAIP, one TLD was placed at the only exposed rad-chem piping at the site, U-9x #1 R/C wellhead (location A18). In addition, two background TLDs were staged in Area 9 of the NNSS to measure background as discussed in Section A.2.2.2. See Table A.4-1 and Figure A.4-5 for the TLD sample locations at Allegheny.

A.4.1.7 Soil Samples

At Kennebec, in accordance with the CAIP (NNSA/NFO, 2016), a judgmental soil grab sample (AB7A009) and duplicate (AB7A010) was collected from the soil within the pipe termination area (location A10). These samples were biased to the location directly adjacent to the end of the rad-chem pipe. These samples were submitted for gamma spectroscopy, isotopic Pu, isotopic U, and isotopic Am analyses. See Figure A.4-6 for sample locations and Figure A.4-8 for a photo of Sample Location A10.

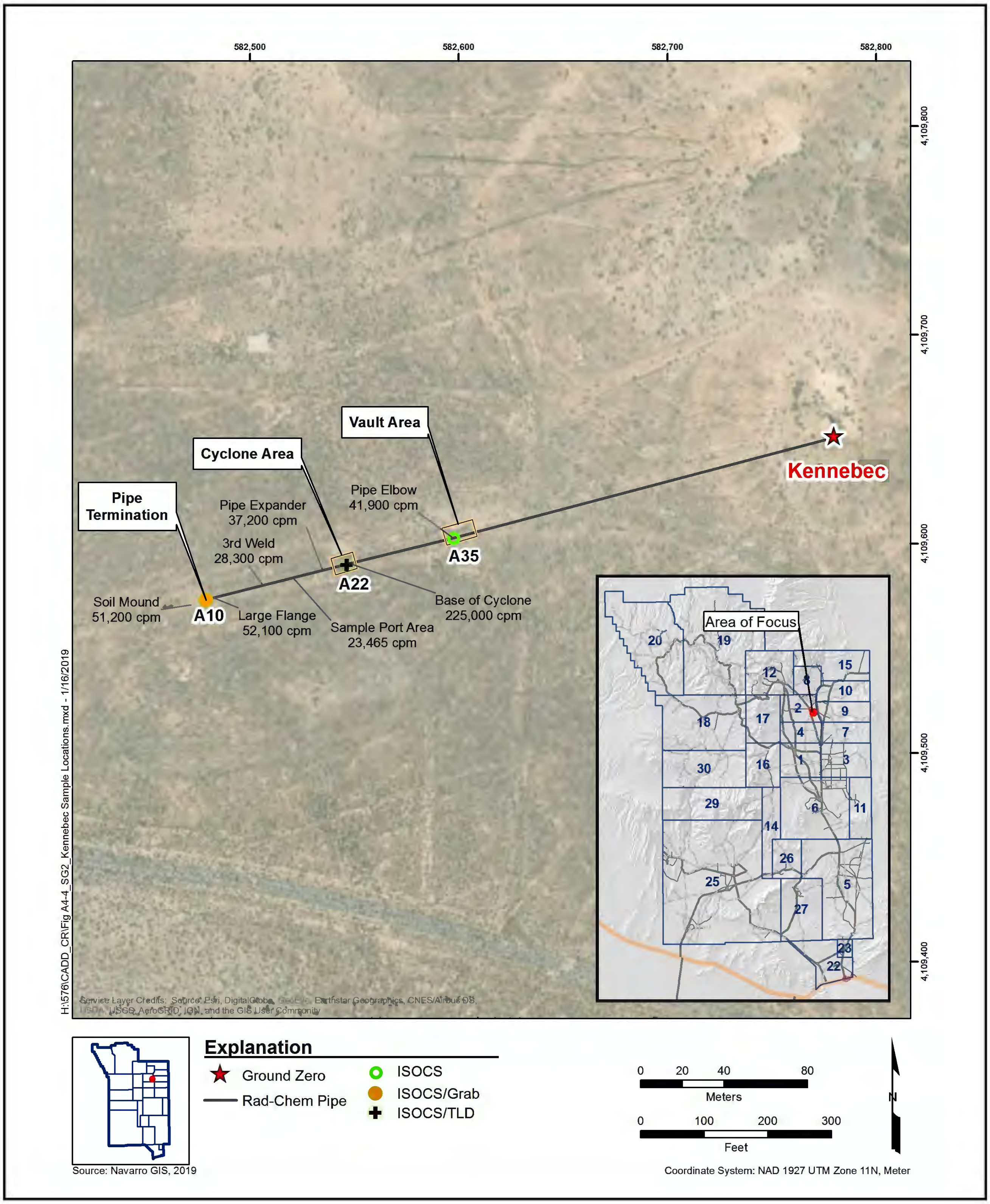


Figure A.4-6
Kennebec (CAS 02-99-12) Sample Locations

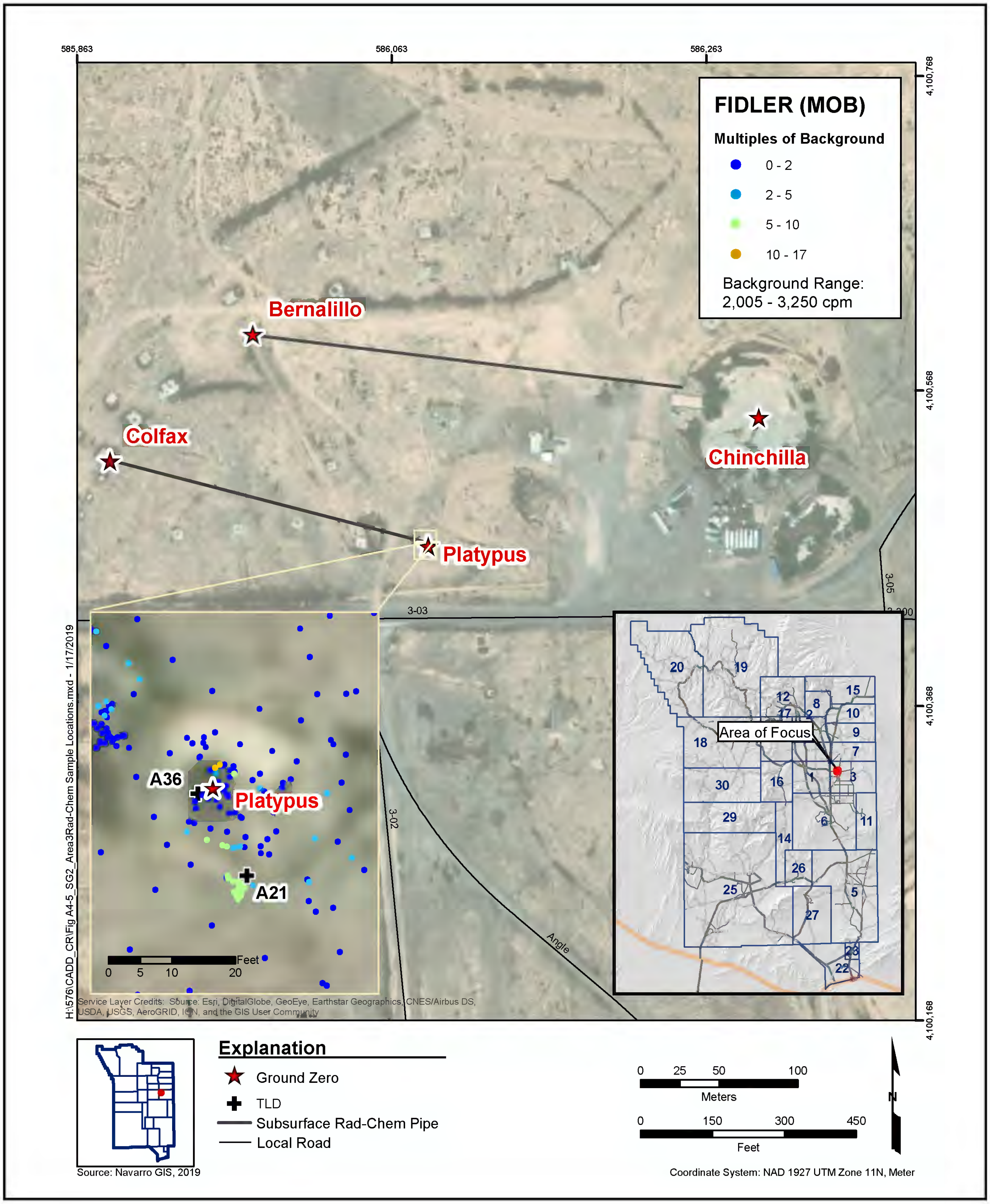


Figure A.4-7
Area 3 Piping (CAS 03-99-20) FIDLER Survey Results and Sample Locations

03/15/2017 (PIRDY-57-215612)

Figure A.4-8
Kennebec (CAS 02-99-12) Sample Location A10 Photograph

At Allegheny, in accordance with the CAIP, a single judgmental soil grab sample (AB7A026) was collected from the termination of the rad-chem pipe within a soil mound (location A33). This sample was biased to the location directly adjacent to the end of the rad-chem pipe, within the soil mound, and was submitted for gamma spectroscopy, isotopic Pu, isotopic U, and isotopic Am analyses. See Figure A.4-5 for the location of the soil sample collected at Allegheny and Figure A.4-4 for a photo of sample location A33.

Analytical data for SG2 are provided in Appendix G.

A.4.2 Investigation Results

The following subsections present the internal, external, and TED results for surface samples collected at Kennebec, Area 3 Piping, and Allegheny. The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr.

A.4.2.1 ISOCS Radiological Dose Estimate

ISOCS measurements taken at the Kennebec site at locations A10, A22, and A35 identified the presence of Cs-137 at activities of 33 pCi/g, 303 pCi/g, and 282 pCi/g. Using the hot spot RRMG for Cs-137 of 24,800 pCi/g, the projected future dose at the estimated time of containment failure location A22 (the location of the highest activity) is estimated to be 0 mrem/OU-yr. See Figure A.4-3 for photographs of the ISOCS sampling at the flex line pipe and Figure A.4-4 for the ISOCS sample location.

The ISOCS measurement taken at the Allegheny site at location A18 (the U-9x #1 R/C wellhead) identified the presence of Cs-137 at an activity of 27,249 pCi/g. Using the hot spot RRMG for Cs-137 of 24,800 pCi/g, the projected future dose at the estimated time of containment failure at location A18 (the wellhead location) is estimated to be 7 mrem/OU-yr. See Figure A.4-3 for photographs of the ISOCS sampling at the flex line pipe and Figure A.4-4 for the ISOCS sample location.

A.4.2.2 Internal Radiological Dose Calculations

Estimates for the internal dose that a receptor would receive at sample locations in SG2 were determined as described in Section A.2.3.1. Internal dose was calculated for the IA and OU exposure scenarios for sampled locations in SG2.

At Kennebec, two grab soil samples were collected from the soil within the pipe termination area (location A10). The internal dose for each exposure scenario (IA and OU) at location A10 is presented in Table A.4-2.

Table A.4-2
Internal Dose at Sample Locations in SG2

Release Name	Sample Location	Number of Samples	IA (mrem/IA-yr)	OU (mrem/OU-yr)
Kennebec	A10	2	0	0
Allegheny	A33	1	0	0

No soil samples were collected from the Area 3 Piping site. Therefore, internal dose was not calculated.

At Allegheny, one grab soil sample was collected from the termination of the rad-chem pipe within a soil mound at location A33. The internal dose for each exposure scenario (IA and OU) at location A33 is presented in Table A.4-2.

A.4.2.3 External Radiological Dose Calculations

The estimate for the external dose that a receptor would receive at sample locations in SG2 were determined as described in Section A.2.3.2. External dose was calculated for the IA and OU exposure scenario for sampled locations in SG2.

At Kennebec, one TLD was placed within the cyclone area at location A22. External dose for location A10 was estimated using soil sample analytical results as described in Section A.2.3.2.

At the Area 3 Piping site, one TLD was placed at the location of the highest radiological readings (location A21) near the Platypus CA fence. A second TLD was placed above the wellhead at the Platypus GZ (location A36).

At Allegheny, one TLD was placed at the location of the highest radiological readings adjacent to the U-9x #1 R/C wellhead (location A18). External dose for location A33 was estimated using soil sample analytical results as described in Section A.2.3.2.

The average and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.4-3. The minimum sample size requirements were met for the TLD sample locations.

A.4.2.4 Total Effective Dose

At each location within SG2 where soil samples were collected (the rad-chem pipe termination areas at Kennebec [location A10] and Allegheny [location A33]), the TED was calculated by adding the external dose value and the internal dose value estimated from soil sample analytical results. Values for the average TED for the IA and OU exposure scenarios are presented in Table A.4-4. The TED did not exceed the FAL of 25 mrem/OU-yr at any SG2 location.

Table A.4-3
External Dose at Sample Locations in SG2

Release Name	Location	TLD Placed	Number of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
				Average	95% UCL	Average	95% UCL
Kennebec	A10	No	1	2	N/A[a]	0	N/A[a]
	A22	Yes	3	3	6	0	0
Area 3 Piping (Platypus)	A21	Yes	3	0	0	0	0
	A36	Yes	3	0	0	0	0
Allegheny	A18	Yes	3	13	15	1	1
	A33	No	1	0	N/A[a]	0	N/A[a]

[a] UCLs cannot be calculated for less than 3 sample results.

N/A = Not applicable

Table A.4-4
TED at SG2 Sample Locations

Release Name	Location	Type of Samples	IA (mrem/IA-yr)	OU (mrem/OU-yr)
			Average TED	
Kennebec	A10	Grab Only	2	0
Allegheny	A33	Grab Only	0	0

A.4.3 Nature and Extent of COCs

Based on the data evaluation and the proposed scenario, the 95 percent UCL of the average TED does not exceed the FAL of 25 mrem/OU-yr at location A10 (Kennebec) or A33 (Allegheny). However, at Kennebec and Allegheny, it is assumed that the subsurface piping and the piping within the crater area (Kennebec) exceed FALs; therefore, corrective action is required. At the Area 3 Piping, it is assumed that the subsurface rad-chem piping from Bernalillo to Chinchilla and from Colfax to Platypus exceeds the radiological FAL; therefore, corrective action is required. Additionally, the vaults with lead bricks at Kennebec require corrective action. The corrective action boundaries are shown on Figures A.4-9 through A.4-11. The selected corrective action is closure in place with a UR (see Appendix D), as determined during the CAA meetings held on September 5, 2017, and July 31, 2018.

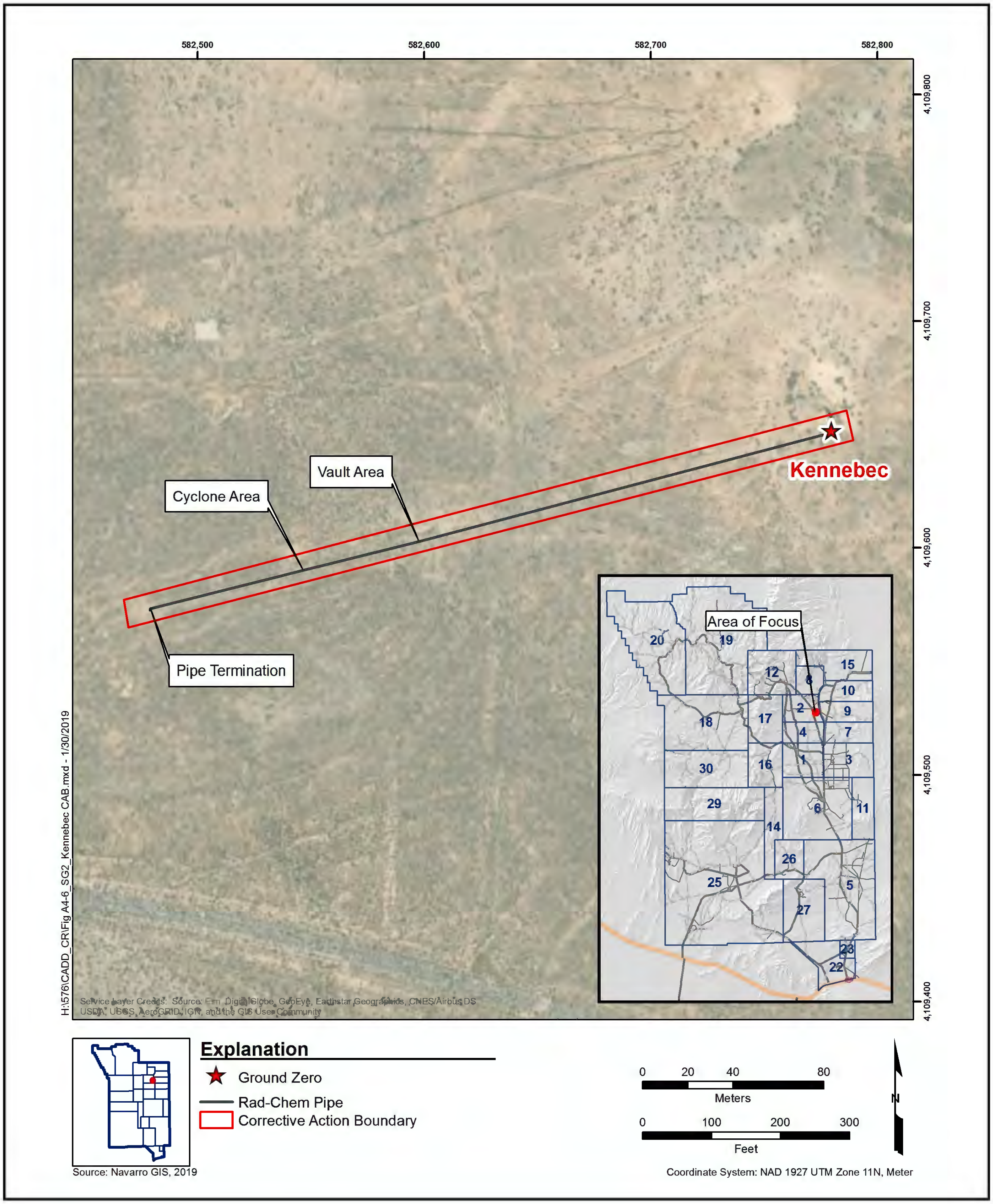


Figure A.4-9
Kennebec (CAS 02-99-12) Corrective Action Boundary

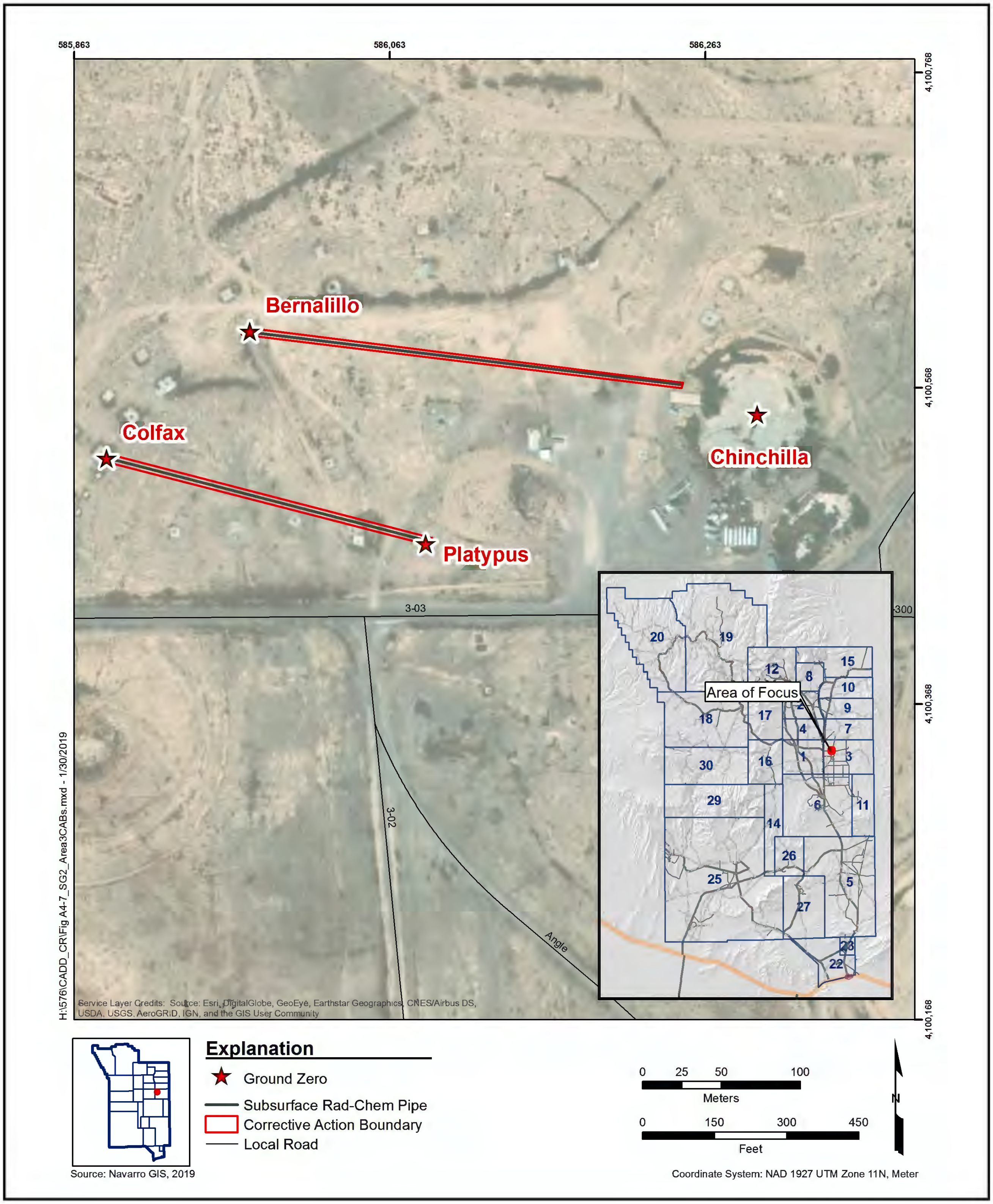


Figure A.4-10
Area 3 Piping (CAS 03-99-20) Corrective Action Boundary

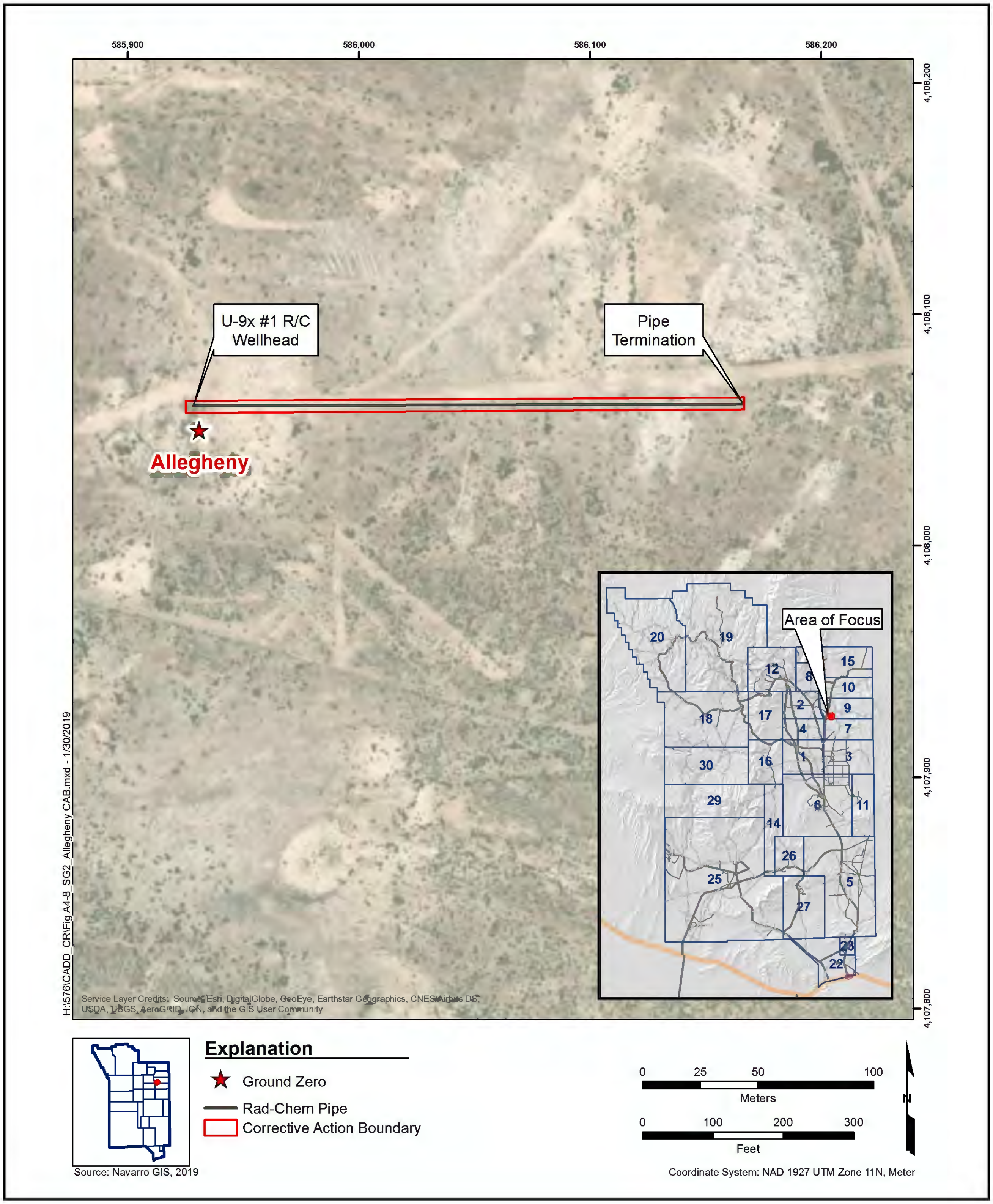


Figure A.4-11
Allegheny (CAS 09-99-08) Corrective Action Boundary

A.4.4 Deviations/Revised CSM

At SG2, the CAIP requirements (NNSA/NFO, 2016) were met, with no deviations. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.5.0 SG3, Rad Waste Dump

SG3 consists of one site located in Area 5 of the NNSS on northern edge of the Frenchman Flat Playa. This site was identified on a 1965 Frenchman Flat Quadrangle map as a "radioactive waste dump." An area measuring approximately 30 by 30 ft was identified as having removable contamination and was posted with "Caution Contamination Area" signs. Additional detail on the history of SG3 is provided in the CAIP (NNSA/NFO, 2016).

A.5.1 CAI Activities

CAI activities specific to SG3 included visual surveys, geophysical surveys, terrestrial radiological surveys, soil sampling, and TLD placement.

A.5.1.1 Visual Surveys

Visual inspections were conducted inside and outside the CA over the course of the field investigation. No drainage channels or staining was identified; however, scattered debris was identified around the site. This debris is covered under the scope of SG4 (see Section A.6.0).

A.5.1.2 Geophysical Survey

A geophysical survey was completed at the Rad Waste Dump using both an EM31-MK2 earth conductivity meter and an EM61-MK2A time domain metal detector. The EM31-MK2 measures the conductivity of the material (soil) interrogated as well as detects the presence of metal. The EM61-MK2A detects both ferrous and non-ferrous conductive objects. This survey was conducted to determine whether or not there are buried metallic materials indicating the potential for backfilled disposal pits at the site. The survey concluded that no disposal pits are present at this site. See Appendix I for the geophysical survey report.

A.5.1.2.1 Radiological Surveys

A radiological survey using a FIDLER was conducted at the Area 5 Rad Waste Dump to identify the general distribution of radiological contamination and to bias sample locations during the CAI. Count-rate and position data were collected and recorded at 1-second intervals via a Trimble Systems

GeoXT GPS unit. The travel speed was approximately 1 to 2 meters per second with the radiation detector at a height of approximately 0.5 m ags. Count rates for the FIDLER are recorded in units of cpm.

Before conducting each radiological survey at SG3, a background radiation level was established for that day's survey for that particular instrument. This was done at a location that had been determined to have field conditions (e.g., soil type, elevation, vegetative cover) similar to what was observed over most of the site to be surveyed, but was not impacted by contaminants from the release. The location used to establish the background radiation level is shown in the inset on Figure A.5-1. The background radiation level was established as the average of the one-second readings (in cpm) collected over a five-minute interval. The survey values for that day were divided by this background to produce a value representing a multiple of the background level, expressed in units of multiples of background (MOB). FIDLER survey data were captured in the field as discrete data points that coincide with the path walked/driven by the field technician.

Figure A.5-1 presents the FIDLER data collected for the rad waste dump. The results of the FIDLER survey show two areas of elevated radiological readings. One sample plot was established at each of the areas of elevated readings (locations A26 and A27).

A.5.1.2.2 TLD Samples

One TLD was placed at each of two locations (A26 and A27) as determined by the highest FIDLER readings to estimate the maximum potential external dose. These locations coincided with the center of each sample plot, in accordance with the CAIP (NNSA/NFO, 2016). In addition, two background TLDs were staged in Area 5 of the NNSS to measure background dose as discussed in Section A.2.2.2. See Table A.5-1 and Figure A.5-1 for the TLD sample locations at the Rad Waste Dump.

A.5.1.2.3 Soil Samples

In accordance with the CAIP (NNSA/NFO, 2016), soil sampling for the rad waste dump (SG3) consisted of collecting surface samples from two sample plots located at the areas of highest radiological readings as identified in the FIDLER survey. Four composite samples were collected

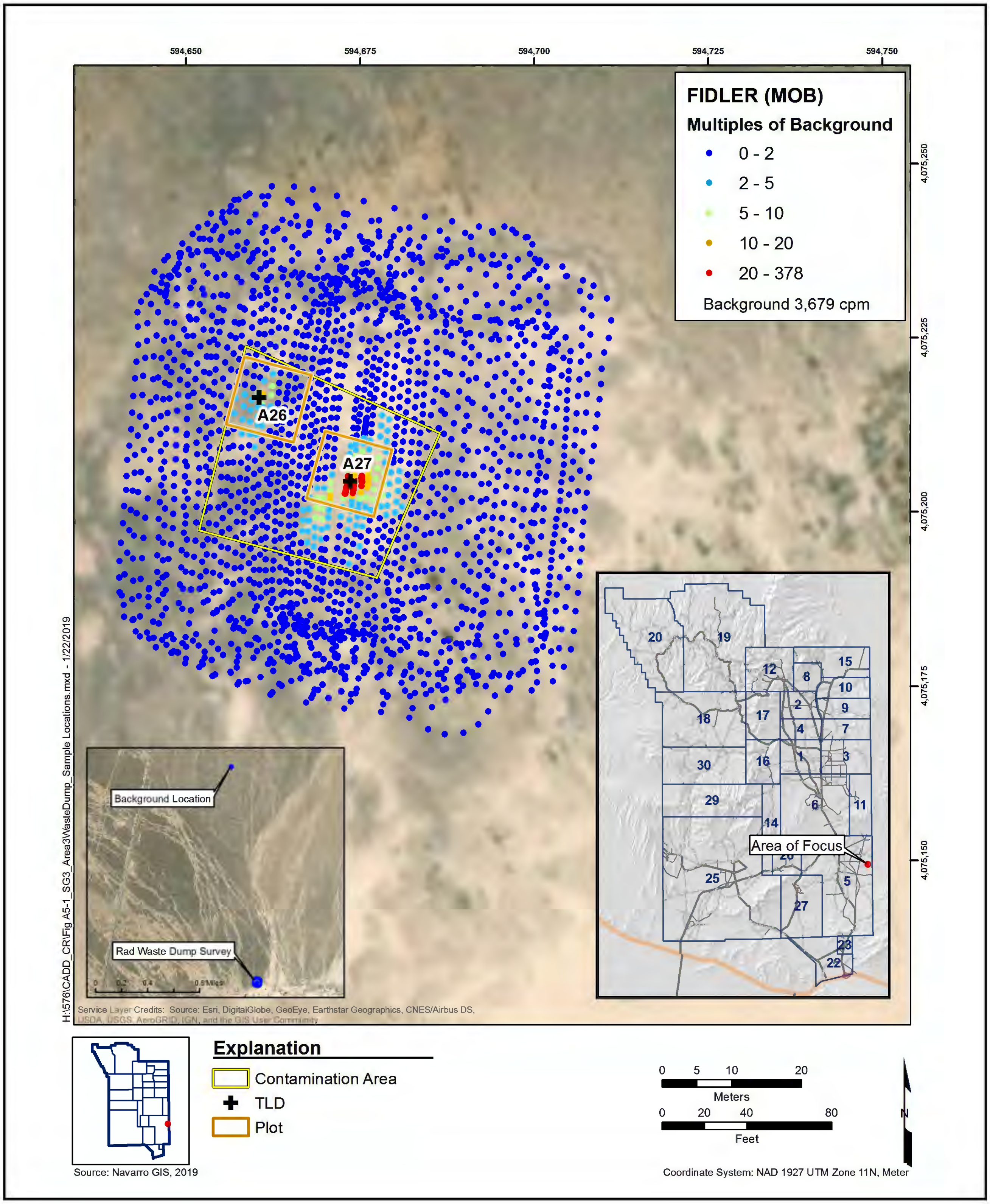


Figure A.5-1
Rad Waste Dump (CAS 05-19-04) FIDLER Survey Results, Sample Locations, and Background Location

Table A.5-1
SG3 Sample Location Details

Release Name	Location	Soil Sample Collected	TLD Placed	Purpose
Rad Waste Dump	A26	Yes	Yes	Plot Sample/TLD
	A27	Yes	Yes	Plot Sample/TLD

from each sample plot. Each composite was composed of nine randomly located aliquots, resulting in a total of 36 aliquots collected from each plot. Each aliquot was collected using a "vertical-slice cylinder and bottom-trowel" method. This required the insertion of the 9-cm inside diameter cylinder to a depth of 5 cm, excavation of the outside soil along one side of the cylinder (to permit trowel placement), and horizontal insertion of a trowel along the bottom of the cylinder. This method captured a cylindrical-shaped section of the soil from 0 to 5 cm bgs.

Samples AB7A014 through AB7A017 were collected from sample plot location A26. Samples AB7A018 through AB7A021 were collected from sample plot location A27. These samples were submitted for gamma spectroscopy, isotopic Pu, isotopic U, and isotopic Am analyses. See Table A.5-1 and Figure A.5-1 for the sample locations at the Rad Waste Dump.

A.5.2 Investigation Results

The following subsections present the internal, external, and TED results for surface soil samples collected at the Rad Waste Dump. The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr.

A.5.2.1 Internal Radiological Dose Calculations

At SG3, surface soil samples (0 to 5 cm bgs) were collected from two sample plots (locations A26 and A27), located at the areas of highest radiological readings. Estimates for the internal dose that a receptor would receive at each SG3 sample location were determined as described in Section A.2.3.1. Internal dose was calculated for the IA and OU exposure scenario for sampled locations in SG3. The average and 95 percent UCL of the internal dose for each exposure scenario (IA and OU) are presented in Table A.5-2.

Table A.5-2
Internal Dose at Sample Locations in SG3

Release Name	Sample Location	Sample Depth (cm bgs)	Number of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
				Average	95% UCL	Average	95% UCL
Rad Waste Dump	A26	0-5	4	2	4	0	0
	A27	0-5	4	11	14	1	1

A.5.2.2 External Radiological Dose Calculations

TLDs were placed at all SG3 sample locations. The estimate for the external dose that a receptor would receive at sample locations in SG3 were determined as described in Section A.2.3.2. External dose was calculated for the IA and OU exposure scenarios for each sample location. The average and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.5-3.

Table A.5-3
External Dose at Sample Locations in SG3

Release Name	Sample Location	TLD	Number of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
				Average	95% UCL	Average	95% UCL
Rad Waste Dump	A26	Yes	3	1	2	0	0
	A27	Yes	3	7	12	0	1

A.5.2.3 Total Effective Dose

The TED for each SG3 sample location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the IA and OU exposure scenarios are presented in Table A.5-4. The 95 percent UCL of the TED did not exceed the FAL of 25 mrem/OU-yr at location A26 or A27.

Table A.5-4
TED at Sample Locations in SG3

Release Name	Sample Location	Type of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
			Average	95% UCL	Average	95% UCL
Rad Waste Dump	A26	Sample Plot	2	6	0	0
	A27	Sample Plot	18	**26**	1	1

Bold indicates the values exceeding 25 mrem/yr.

A.5.3 Nature and Extent of COCs

Based on the data evaluation and the proposed scenario, the 95 percent UCL of the average TED does not exceed the FAL of 25 mrem/OU-yr at sampled locations A26 or A27 in SG3. Additionally, the geophysical survey did not identify a landfill in the area of the Rad Waste Dump. Therefore, no corrective action is required for SG3. However, contamination is present in surface soil (less than 5 cm) that warrants a best management practice (BMP) of an administrative UR, as the estimated dose at location A27 could exceed 25 mrem/IA-yr if full-time industrial activities were to occur at this site.

A.5.4 Deviations/Revised CSM

According to the CAIP (NNSA/NFO, 2016), two sample plots would be placed at the locations of highest radiological survey values using the NE Electra. Instead, the FIDLER instrument was used to determine the areas of highest radiation readings, and sample plots were placed in the locations of those elevated readings. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.6.0 SG4, Debris

SG4 consists of legacy debris left behind from testing activities. The debris was identified during the cesium-piping preliminary investigation and during CAU 576 CAI activities. The debris is located in Areas 2, 3, 5, 8 and 9 of the NNSS. As stated in the CAIP (NNSA/NFO, 2016), all debris items that are identified as metallic lead are defined as PSM. Additional detail on the history of SG4 is provided in the CAIP.

A.6.1 CAI Activities

CAI activities specific to SG4 included visual surveys, radiological surveys, soil sampling, and TLD placement. A summary of the sample locations is provided in Table A.6-1 and Figure A.6-3.

A.6.1.1 Visual Surveys

During visual inspections, debris items were identified including: lead items (bricks, plates, pieces, shot, shielding, object), broken lead-acid batteries, metallic tower debris, two small drums containing a white powdery substance, and radiologically elevated soil between the two drums. See Figures A.6-1 and A.6-2 for photographic examples of the debris identified at SG4.

A.6.1.2 Radiological Survey

At sample locations A11 (tower debris) and A12 (drum site), radiological surveys were completed with an NE Electra instrument to bias surface soil sample and TLD sample locations. See Sections A.6.1.3 and A.6.1.4 for additional information on the biasing of sample locations using the NE Electra instrument.

A.6.1.3 TLD Samples

Per the CAIP (NNSA/NFO, 2016), a single TLD was placed in the area of highest radiological survey values at the tower debris site (location A11) and the drum site (location A12) to estimate the maximum potential external dose. See Table A.6-1 and Figure A.6-3 for the TLD sample locations at SG4. In addition, two background TLDs were staged in Areas 3 and 9 of the NNSS to measure background as discussed in Section A.2.2.2.

Table A.6-1
SG4 Sample Location Details

Associated Release Name	Location	Debris Item	Soil Sample Collected	TLD Placed	Purpose
Debris	A01	Lead plate and 2 lead bricks near Cumberland (U2e)	Yes (AB7A001)	No	Verification plot sample
	A02	Lead bricks (1/2 plus miscellaneous pieces) outside Kennebec radioactive material area (SG2)	Yes (AB7A002)	No	Verification plot sample
	A03	Lead shielding near Anchovy (U3bq)	Yes (AB7A003)	No	Verification plot sample
	A04	Lead brick near Bunker (U9bb)	Yes (AB7A004)	No	Verification plot sample
	A05	Broken lead-acid battery in Area 9	Yes (AB7A005)	No	Verification plot sample
	A06	Lead bricks (1.5 total) in Area 9	Yes (AB7A006)	No	Verification plot sample
	A07	Broken lead-acid battery near Cyathus (U8b)	Yes (AB7A007)	No	Verification plot sample
	A08	Lead object on concrete pad near Kawich A-White (U8n)	No	No	N/A
	A11	Metallic tower debris with elevated radiological readings near Mataco (U3bk)	Yes (AB7A011)	Yes	Grab sample/TLD
	A12	Area of elevated radiological readings between two small drums containing a white powdery substance at the drum site near Raritan (U9u)	Yes (AB7A012)	Yes	Grab sample/TLD
		Two small drums containing a white powdery substance at the drum site near Raritan (U9u)	Yes (AB7A501)	No	Composite grab sample
	A25	Broken lead-acid battery near Kennebec (SG2)	Yes (AB7A013)	No	Verification plot sample
	A28	Melted lead pieces near Waste Dump (SG3)	Yes (AB7A022)	No	Verification plot sample
	A29	Lead brick near Waste Dump (SG3)	Yes (AB7A023)	No	Verification plot sample
	A30	Lead shot near Waste Dump (SG3)	Yes (AB7A024, AB7A025)	No	Verification plot sample (and duplicate)

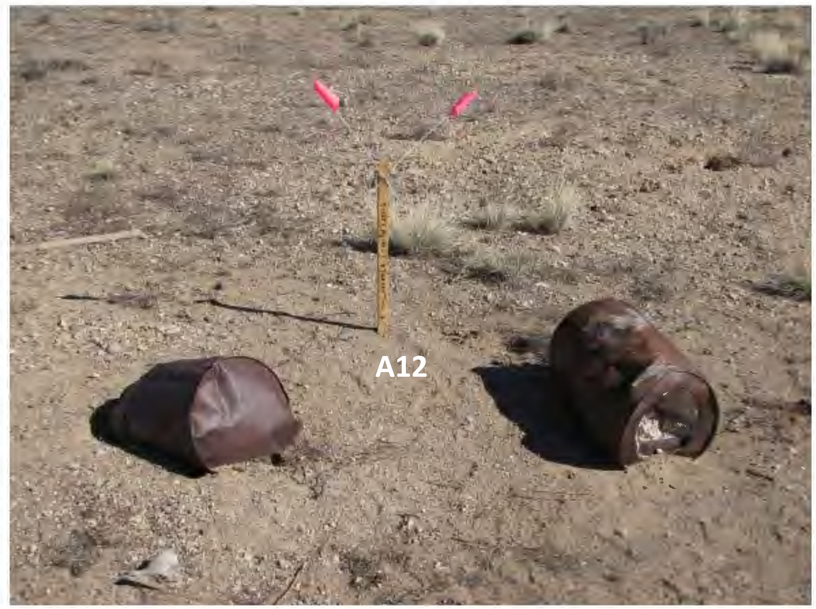
01/12/2016 (PIRDY-57-210941)

02/04/2016 (PIRDY-57-210888)

10/07/2014 (PIRDY-57-203514)

Figure A.6-1
Debris (CAS 00-99-01) PSM Photographs

03/16/2017 (PIRDY-57-215606)



03/16/2017 (PIRDY-57-215607)

Figure A.6-2
Tower Debris and Drum Site (CAS 00-99-01) Photographs

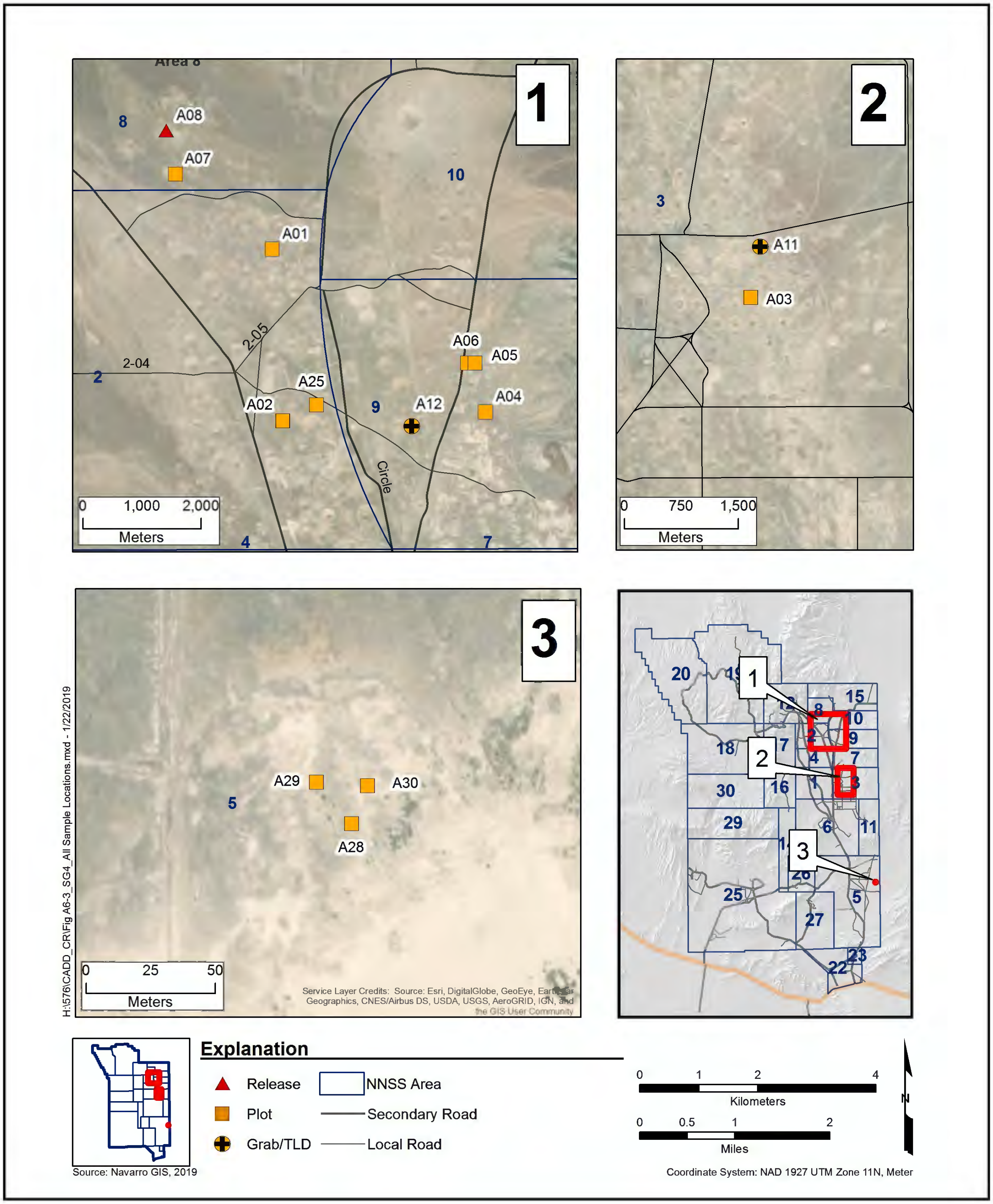


Figure A.6-3
Debris (CAS 00-99-01) Sample Locations

A.6.1.4 Soil Samples

Surface verification plot samples (0 to 5 cm bgs) were collected from beneath the lead PSM at SG4, with the exception of the lead object at location A08. No sample was collected from beneath location A08 because the lead object was situated on a concrete pad. The plot samples consisted of a 2-by-2-ft grid except at the two lead-acid battery locations, which consisted of a 3-by-3-ft grid, from which nine aliquots were collected and combined into a single sample. The samples of the lead PSM were submitted for RCRA metals analysis.

One surface grab sample was collected from an area of elevated radiological readings at the tower debris site (location A11) from a depth of 0 to 5 cm bgs. This sample (AB7A011) was submitted for gamma spectroscopy, isotopic Pu, isotopic U, and isotopic Am analyses.

One surface grab sample was collected from the area of elevated radiological readings between the two small drums containing an unknown white powdery substance at the drum site (location A12), from a depth of 0 to 5 cm bgs. This sample (AB7A012) was submitted for gamma spectroscopy, isotopic Pu, isotopic U, isotopic Am, and Pu-241 analyses. One composite grab sample (AB7A501) was collected of the white powdery substance within the two small drums and was submitted for gamma spectroscopy and RCRA metals analyses. See Table A.6-1 and Figure A.6-3 for the soil sample locations at SG4. The analytical data are provided in Appendix G.

A.6.2 Investigation Results

The following subsections present the internal, external, and TED results for surface soil samples collected from the tower debris location (A11) and from the drum site at location A12. The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. These subsections also present the chemical results for soil samples collected from beneath the PSM (lead items) in SG4. The chemical results are reported as individual concentrations that are comparable to their corresponding FALs.

A.6.2.1 Internal Radiological Dose Calculations

At SG4, surface soil grab samples (0 to 5 cm bgs) were collected from two locations (A11 and A12), located at the areas of highest radiological readings near the tower debris and the drum site, respectively. Estimates for the maximum potential internal dose that a receptor could receive at each SG4 sample location were determined as described in Section A.2.3.1. Internal dose was calculated for the IA and OU exposure scenario for sampled locations in SG4. The internal dose for each exposure scenario (IA and OU) is presented in Table A.6-2.

Table A.6-2
Internal Dose at Sample Locations in SG4

Release Name	Sample Location	Sample Depth (cm bgs)	Number of Samples	IA (mrem/IA-yr)	OU (mrem/OU-yr)
Tower Debris	A11	0-5	1	0	0
Drum Site	A12	0-5	1	0	0

A.6.2.2 External Radiological Dose Calculations

TLDs were placed at two SG4 sample locations (A11 and A12). The estimate for the external dose that a receptor would receive at sample locations in SG4 were determined as described in Section A.2.3.2. External dose was calculated for the IA and OU exposure scenarios for each sample location. The average and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.6-3.

Table A.6-3
External Dose at Sample Locations in SG4

Release Name	Sample Location	TLD	Number of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
				Average	95% UCL	Average	95% UCL
Tower Debris	A11	Yes	3	2	5	0	0
Drum Site	A12	Yes	3	21	23	1	1

A.6.2.3 Total Effective Dose

The TED for each SG4 sample location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the IA and OU exposure scenarios are presented in Table A.6-4. The 95 percent UCL of the TED did not exceed the FAL of 25 mrem/OU-yr at location A11 or A12.

Table A.6-4
TED at Sample Locations in SG4

Release Name	Sample Location	Type of Samples	IA (mrem/IA-yr)		OU (mrem/OU-yr)	
			Average	95% UCL	Average	95% UCL
Tower Debris	A11	Grab and TLD	2	5	0	0
Drum Site	A12	Grab and TLD	21	23	1	1

A.6.2.4 Chemical Contaminants

PSM items consisting of a variety of lead items (e.g., bricks, plates, pieces, shot, shielding, object, and broken lead-acid batteries) were identified at SG4. These PSM items require corrective action. All lead PSM items were removed from the site as an interim corrective action. After the PSM was removed, verification soil plot samples were collected from lead locations A01 through A07, A25, and A28 through A30 and analyzed for RCRA metals. No sample was collected from the soil beneath the lead object at location A08, because the lead object was situated on a concrete pad. All chemical results from sample location A12 (two small drums containing unknown white powdery substance) and these lead locations were below FALs. See Table A.6-5 for the chemical sample results exceeding MDCs at the PSM locations and location A12 in SG4.

Table A.6-5
SG4 Sample Results for Metals Detected above MDCs
(Page 1 of 2)

Sample Location	Sample Number	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury
	FAL (mg/kg)	22.5	220,000	980	44.1	5,740	350
A01	AB7A001	3.7	140	0.18	6.4	36	0.027
A02	AB7A002	3.2	120	0.17	7	630	0.035
A03	AB7A003	3.1	150	0.3	4	24	0.042
A04	AB7A004	3.5	230	0.33	4.7	230	0.033
A05	AB7A005	3.9	150	0.47	4.9	250	0.024
A06	AB7A006	4.2	300	0.68	5	31	0.019
A07	AB7A007	4	140	0.22	8	730	0.034
A12	AB7A501	3.4	28	--	2.5	3.6	0.0047

Table A.6-5
SG4 Sample Results for Metals Detected above MDCs
(Page 2 of 2)

Sample Location	Sample Number	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury
	FAL (mg/kg)	22.5	220,000	980	44.1	5,740	350
A25	AB7A013	4.1	140	0.2	9.1	280	0.036
A28	AB7A022	5	170	2.3	9	890	0.028
A29	AB7A023	5.6	210	1.9	9.3	27	0.036
A30	AB7A024	5.5	170	0.48	8.1	95	0.018
A30	AB7A025	4.9	180	0.79	9.5	23	0.02

-- = Not detected above MDC.

A.6.3 Nature and Extent of COCs

Based on the data evaluation and the proposed scenario, the 95 percent UCL of the average TED does not exceed the FAL of 25 mrem/OU-yr at sampled locations A11 or A12 in SG4. Additionally, the chemical FALs are not exceeded in residual soil at any sample location within SG4. Therefore, the corrective action for SG4 of removal of PSM was effective and no further corrective action is required.

A.6.4 Deviations/Revised CSM

According to the CAIP (NNSA/NFO, 2016), one judgmental surface grab sample would be collected beneath the lead debris items. Instead, composite soils samples were collected at these locations comprising nine aliquots from plots as described in Section A.6.1.4. No soil sample was collected from beneath the lead object at location A08 because the object was located on a concrete pad. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.7.0 Waste Management

This section addresses the characterization and management of investigation and remediation wastes generated at CAU 576. Waste management activities were conducted as specified in the CAIP (NNSA/NFO, 2016).

A.7.1 Generated Wastes

The wastes listed in Table A.7-1 were generated during investigation and closure activities at CAU 576. Wastes were segregated to the greatest extent possible, and waste minimization techniques were integrated into the field activities to reduce the amount of waste generated. Controls were in place to minimize the use of hazardous materials and the unnecessary generation of hazardous and/or mixed waste. The amount, type, and source of waste placed into each container were recorded in waste management records that are maintained in the CAU 576 file. The executed waste shipping and disposal documentation for CAU 576 are included in Appendix D.

Table A.7-1
Waste Stream Characterization Table

Waste Stream	Waste Characterization				
	Hazardous	Hydrocarbon	PCBs	Radioactive	Waste Type
Lead Debris	Yes	No	No	Yes	MLLW

MLLW = Mixed low-level waste
PCB = Polychlorinated biphenyl

Wastes generated during the corrective action activities were segregated into the following waste stream:

- *Lead Debris,* consisting of four 10-gallon (gal) drums of radiologically contaminated elemental lead debris items.

A.7.2 Waste Characterization

Waste characterization of the lead debris items was based on process knowledge. Elemental lead identified in the debris items meets the definition of a RCRA-regulated hazardous waste. Because these waste items were also characterized as containing low-level radioactive contamination, this waste stream was characterized as MLLW. A brief description of the characterization information for the lead debris waste stream is provided in Table A.7-1.

A.7.3 Waste Disposal

The wastes shown in Table A.7-2 were generated during the corrective action activities. Four 10-gal drums of MLLW were disposed of at the Area 5 Radioactive Waste Management Complex (RWMC).

Table A.7-2
Waste Disposal Table

Waste Stream	Waste Type	Disposal Facility	Waste Volume	Disposal Date	Disposal Doc [a]
Lead Debris	MLLW	Area 5 RWMC	4 x 10 gal	09/20/2018	CD

[a] Copies of waste disposal documents are located in Attachment D-2 of this document.

CD = Certificate of Disposal

A.8.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 576 CAI. The following subsections 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 contaminants of potential concern (COPCs) present. Rigorous QA/QC was implemented for all laboratory sample data, 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 Soils Activity QAP (NNSA/NSO, 2012).

A.8.1 Data Validation

Data were validated in accordance with the Soils Activity QAP (NNSA/NSO, 2012) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 576 were evaluated for data quality in a tiered process. 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 CAU 576 files as electronic media.

All laboratory data were subjected to Tier I and Tier II evaluations. Laboratory data packages were reviewed for completeness. The analytical data contained within the packages were evaluated for correctness, compliance, precision, and accuracy. Where issues were encountered within the data, validation qualifiers were assigned with descriptions of why the qualifiers were added.

A Tier III evaluation was performed on the analytical results for two samples, which represents approximately 5 percent of the samples collected for site characterization. This review was performed by Analytical Quality Associates, Inc., of Albuquerque, New Mexico. The Tier III data validation review was in general agreement with the Tier II data validation, and no corrections to the Tier II validation were necessary.

A.8.2 QC Samples

Laboratory QC samples used to measure precision and accuracy were analyzed by the laboratory with each batch of samples submitted for analysis. When QC criteria were exceeded, qualifying flags were added to sample results, along with the reason for estimation or rejection. Documentation of data qualifications is retained in the Analytical Services Database and in the data packages located in Navarro Central Files.

A.8.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

A.8.4 Laboratory Nonconformances

The analytical laboratories report data quality issues such as fluctuations in analytical instrumentation operations, sample preparations, missed holding times, spectral interferences, high or low chemical yields/matrix spikes, and precision that do not fall within the limits of their QC parameters. No data quality issues were reported by the analytical laboratories for samples from CAU 576 (see Appendix B).

A.9.0 Summary

Radionuclide contaminants detected in environmental samples during the CAI were used to calculate conservative estimates of maximum potential dose for FFACO decision-making purposes only. These estimates were evaluated against the radiological FAL to estimate the presence and extent of COCs at the site. Chemical contaminants detected in environmental samples during the CAI were evaluated against FALs to determine the presence and extent of lead within CAU 576.

No radionuclides or chemicals were detected above FALs in soil samples collected from CAU 576. However, radionuclides in concentrations exceeding the FALs are assumed to be present within the subsurface piping and piping within crater/potential crater areas, and require corrective action. It was also assumed that metallic lead objects meet the definition of PSM and require corrective action.

For CAS 00-99-01, Potential Source Material, PSM lead items including bricks, plates, pieces, shot, shielding, objects, and broken lead-acid batteries were identified and removed as a corrective action. After the PSM was removed, verification samples were collected. All results were below FALs. Additionally, two soil areas with elevated radiological readings were identified near the tower debris and the drum sites. Soil samples were collected from these areas, and results were below the radiological FAL. Based on the corrective action of removal of the PSM, no further corrective action is required for CAS 00-99-01.

For CAS 02-99-12, U-2af (Kennebec) Surface Rad-Chem Piping, radionuclides exceeding the FAL are assumed to be present within the subsurface rad-chem piping, piping within the crater area, and within the wellhead at U-2af. Lead bricks are present within vaults in the vicinity of the rad-chem piping that meet the definition of PSM. Therefore, the piping and PSM require corrective action. Based on the results of the evaluation of CAAs presented in Appendix E, the corrective action of closure in place with an FFACO UR was implemented for the rad-chem piping and lead PSM at CAS 02-99-12. As part of the corrective action, a fence was constructed around the portion of the piping system outside of the crater.

For CAS 03-99-20, Area 3 Piping, radionuclides exceeding the FAL are assumed to be present within the subsurface rad-chem piping originating from U-3ag (Chinchilla) and U-3ad (Platypus). This subsurface piping requires corrective action. Based on the results of the evaluation of CAAs presented in Appendix E, the corrective action of closure in place with an FFACO UR was implemented for the subsurface rad-chem piping at CAS 03-99-20.

For CAS 05-19-04, Frenchman Flat Rad Waste Dump, soil samples were collected from the rad waste dump and results were below the radiological FAL. Therefore, no further corrective action is required for CAS 05-19-04. However, a BMP of an administrative UR is recommended as the estimated dose at location A27 could exceed 25 mrem/IA-yr if full-time industrial activities were to occur at this site.

For CAS 09-99-08, U-9x (Allegheny) Subsurface Rad-Chem Piping, radionuclides exceeding the FAL are assumed to be present within the subsurface rad-chem piping. This piping requires corrective action. Based on the results of the evaluation of CAAs presented in Appendix E, the corrective action of closure in place with an FFACO UR was implemented for the rad-chem piping at CAS 09-99-08.

For CAS 09-99-09, U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line, radionuclides exceeding the FAL are assumed to be present within the potential crater area at U-9its u24. This flex line pipe requires corrective action. Based on the results of the evaluation of CAAs presented in Appendix E, the corrective action of closure in place with an FFACO UR was implemented for the flex line pipe at CAS 09-99-09. As part of the corrective action, the portion of the flex line pipe outside the potential crater area was moved to within the potential crater area.

A summary of CAI results is presented in Table A.9-1.

Table A.9-1
Summary of CAI Results

Study Group	CAS	CAS Name	Release Name	Release Component	COC	CAA
1	09-99-09	U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line	Flex Line	Rad-Chem Piping	Assumed TED above FALs within potential crater area	Closure in Place
2	02-99-12	U-2af (Kennebec) Surface Rad-Chem Piping	Kennebec	Rad-Chem Piping	Assumed TED above FALs in subsurface piping	Closure in Place
				Lead Bricks	Lead	
	03-99-20	Area 3 Subsurface Rad-Chem Piping	Area 3 Piping	Rad-Chem Piping	Assumed TED above FALs in subsurface piping	Closure in Place
	09-99-08	U-9x (Allegheny) Subsurface Rad-Chem Piping	Allegheny	Rad-Chem Piping	Assumed TED above FALs in subsurface piping	Closure in Place
3	05-19-04	Frenchman Flat Rad Waste Dump	Waste Dump	Potential Spills/Debris/Buried Debris	None	No Further Action
4	00-99-01	Potential Source Material	Debris	Lead Items	None[a]	Clean Closure[a]
				Two areas with elevated radiological readings		

[a] After completion of corrective action removal activities

A.10.0 References

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Appendix B

Data Assessment

B.1.0 Data Assessment

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

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.

2. *Conduct a Preliminary Data Review.* Review QA reports and inspect 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.

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.

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

5. *Draw Conclusions from the Data.* Perform the calculations required for the test.

B.1.1 Review DQOs

This section contains a review of the DQO process presented in Appendix A of the CAIP (NNSA/NFO, 2016). The DQO decisions are presented with the DQO provisions to limit false-negative or false-positive decision errors. Special features, potential problems, or any deviations to the sampling design are also presented.

B.1.1.1 Decision I

The Decision I statement as presented in the CAIP (NNSA/NFO, 2016) is as follows: “Is any COC present in environmental soil within the study group?” For judgmental sampling design, any analytical result for a COPC above the FAL will result in that COPC being designated as a COC. For probabilistic (unbiased) sampling design, any COPC that has a 95 percent UCL of the average concentration above the FAL will result in that COPC being designated as a COC. A COC may be assumed to be present based on the presence of wastes that have the potential to release COC concentrations in the future (i.e., PSM) or the presence of removable contamination at levels exceeding the criteria for defining a high contamination area. 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 contaminant analysis (NNSA/NFO, 2014). If a COC is detected, then Decision II must be resolved.

B.1.1.2 Decision II

Decision II as presented in the CAIP (NNSA/NFO, 2016) is as follows: "If corrective action is required, is sufficient information available to evaluate potential CAAs?" Sufficient information is defined to include the following:

- The lateral and vertical extent of COC contamination
- The information needed to predict potential remediation waste types and volumes
- The information needed to evaluate the feasibility of remediation alternatives

For radiological contaminants, the presence of a COC is defined as the condition where the most exposed individual has the potential to receive a TED exceeding 25 mrem/yr.

Contaminants were assumed to be present above the radiological FAL at SG1 and SG2, and PSM was assumed to be present at the Kennebec site in SG2 and at various locations in SG4. Therefore, Decision II must be resolved at these study groups. The lateral and vertical extents of contamination at SG1 and SG2 was determined through visual and geophysical surveys. The lateral and vertical extents of contamination at SG1 and SG2 were determined as the physical extent of the piping. Contaminants were not detected above FALs at SG3.

The information required to predict potential remediation waste types for all study groups was provided by the analytical results from soil samples. The information needed to evaluate the feasibility of remediation alternatives was provided by the potential waste volumes and the potential waste types.

B.1.1.3 DQO Provisions To Limit False-Negative Decision Error

A false-negative decision error (when it is concluded that contamination exceeding FALs is not present when it actually is) was controlled by meeting the following criteria:

1a) For Decision I, having a high degree of confidence that sample locations selected will identify COCs if present anywhere within the study group (judgmental sampling).

1b) Maintaining a false-negative decision error rate of 0.05 (probabilistic sampling).

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.

Criteria 1b, 2, and 3, were assessed based on the entire dataset. Therefore, these assessments apply to both Decision I and Decision II.

B.1.1.3.1 Criterion 1a (Confidence Judgmental Sample Locations Identify COCs)

Decision I for SG2 was resolved during the DQO process with the assumption that subsurface piping exceeds the radiological FAL and requires corrective action. Therefore, Decision I sampling only applied to SG1, SG3, and SG4. A judgmental sampling approach was used to resolve Decision I in all of these study groups with two probabilistic sample plots in SG4.

Judgmental sample locations were selected using biasing factors such as radiological survey results and/or the presence of debris. Soil samples were collected from the initial locations identified in the CAIP (NNSA/NFO, 2016) and further refined using the biasing factors identified in the DQOs.

SG1 (Surface Rad-Chem Piping)

As radiation levels in the area of the flex line pipe were indistinguishable from background, the radiological survey could not be used to bias sample locations. Decision I sampling consisted of one ISOCS sampling location determined by the location nearest to GZ that could be accessed. The ISOCS result was used to estimate the presence and activity of radionuclides within the piping to determine whether dose could exceed FAL at the time when the containment afforded by the piping fails. A single TLD was placed at the termination of the flex line pipe to determine whether the currently contained contamination could provide an external dose that exceeds the FAL. In addition, a grab soil sample was collected at the termination of the piping to determine whether COCs had been discharged to the soil.

Decision II was resolved as the physical extent of the piping.

SG2 (Subsurface Rad-Chem Piping)

As the DQO process resulted in the assumption that subsurface piping exceeds the radiological FAL and requires corrective action, no Decision I samples were required.

Samples were collected at the pipe terminations for both the Kennebec and Allegheny sites to determine whether COC contamination is present that extends beyond the extent of the piping. The Kennebec sample location was determined visually, and the Allegheny location was determined by a geophysical survey. Decision II for both sites was resolved as the physical extent of the piping.

SG3 (Rad Waste Dump)

Decision I was resolved for subsurface contamination based on the results of a geophysical survey that determined buried wastes are not present at the site. The geophysical survey locations encompassed the area of the CA. The Decision I sample locations for surface contamination were biased to the locations of the two highest radiological survey values within the CA.

As no buried debris was identified and the surface samples did not exceed FALs, no Decision II samples were required.

SG4 (Debris)

As Decision I for PSM was resolved using process knowledge based on the presence of metallic lead, no samples were required. For radiological contaminants, a single TLD was placed at the locations of the highest radiological survey values at the tower debris and at the drum site. Decision II for the PSM was resolved by collecting soil samples biased to the locations beneath the debris items.

B.1.1.3.2 Criterion 1b (Confidence in Probabilistic False-Negative Decision Error Rate)

Control of the false-negative decision error for the probabilistic samples collected from within sample plots (note that only two sample plots were collected at SG3) was accomplished by ensuring the following:

- The samples are collected from unbiased locations within the sample plots (note that the sample plots were biased judgmentally to the locations of the highest radioactivity).
- A sufficient sample size was collected (see Section B.1.1.2).
- A false rejection rate of 0.05 was used in calculating the 95 percent UCLs and minimum sample size.

Within each sample plot, a composite soil sample was collected from nine aliquot locations. Selection of the sample aliquot locations was accomplished using a random start, systematic triangular grid pattern for sample placement. This permitted that any given location within the boundaries of the sampling area would have an equal probability of being chosen as any other location.

The minimum number of samples required for each probabilistic sample was calculated for both the internal (soil samples) and external (TLD elements) dose samples. The minimum number of samples was also calculated for the TLDs placed at grab sample locations. The minimum sample size (*n*) was calculated using the following EPA sample size formula (EPA, 2006):

$$n = \frac{s^2(z_{.95} + z_{.80})^2}{(\mu - C)^2} + \frac{z^2_{.95}}{2}$$

where

s = standard deviation
$z_{.95}$ = z score associated with the false-negative rate of 5 percent
$z_{.80}$ = z score associated with the false-positive rate of 20 percent
μ = dose level where false-positive decision is not acceptable (12.5 mrem/yr)
C = FAL (25 mrem/yr)

The use of this formula requires the input of basic statistical values associated with the sample data. Data from a minimum of three samples are required to calculate these statistical values and, as such, the least possible number of samples required to apply the formula is three. Therefore, in instances where the formula resulted in a value fewer than three, three is adopted as the minimum number of samples required. The results of the minimum sample size calculations and the number of samples collected at SG3 sample plot locations are presented in Table B.1-1. The minimum sample size calculations were conducted for probabilistic samples as stipulated in the CAIP (NNSA/NFO, 2016) based on the following parameters:

- A false rejection rate of 0.05
- A false acceptance rate of 0.20
- The maximum acceptable gray region set to one-half the FAL (12.5 mrem/yr)
- The calculated standard deviation

Table B.1-1
Input Values and Determined Minimum Number of Samples for Sample Plots in SG3

Sample Plot Location	Standard Deviation (OU Scenario)	Minimum Sample Size	Number of Samples Collected
A26	0.11	3	4
A27	0.17	3	4

TLDs were placed at the center of each sample plot in SG3 and at judgmental sample locations in all of the study groups. Although the TLD locations were not established at random locations, they provided three independent measurements of dose per TLD, that integrate unbiased measurements from an area around the TLD location. The minimum sample size for the environmental TLDs placed at CAU 576 are provided in Table B.1-2. All TLD locations met the required minimum sample size.

B.1.1.3.3 Criterion 2 (Confidence in Detecting COCs Present in Samples)

The analytical suites selected for CAI samples was sufficient to identify any COCs potentially present in the samples. The analytical methods were chosen during the DQO process as the analyses required to detect any of the COPCs listed in the CAIP (NNSA/NFO, 2016) that were defined as the contaminants that could reasonably be expected at the site that could contribute to a dose or risk exceeding FALs. The COPCs were identified based on operational histories, waste inventories, release information, investigative background, contaminant sources, release mechanisms, and migration pathways as presented in the CAIP. This provides assurance that the analyses conducted for each sample has the capability of identifying any COPC present in the sample.

Table B.1-2
Input Values and Determined Minimum Number of Samples for TLDs

Study Group	TLD Location	Standard Deviation (OU Scenario)	Minimum Sample Size	Number of Samples Collected
SG1, Flex Line	A09	0.12	3	3
SG2, Allegheny	A18	0.08	3	3
SG2, Kennebec	A22	0.11	3	3
SG2, Platypus	A21	0.00	3	3
SG2, Platypus GZ	A36	0.00	3	3
SG3, Waste Dump	A26	0.05	3	3
SG3, Waste Dump	A27	0.15	3	3
SG4, Debris	A11	0.09	3	3
SG4, Debris	A12	0.06	3	3

Note: The actual required minimum number of samples calculated for TLDs by the one-sample t-test (EPA, 2006; PNNL, 2007) was fewer than 3. However, a minimum number of 3 samples is required to calculate statistics.

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Soils Activity QAP (NNSA/NSO, 2012). The sensitivity acceptance criterion for analytical constituents is that all detection limits are less than their corresponding OU internal dose RRMGs or chemical FAL. All of the analytical detection limits were less than their corresponding RRMGs or chemical FAL. Therefore, the DQI for sensitivity has been met for all contaminants, and no data were qualified for sensitivity.

B.1.1.3.4 Criterion 3 (Confidence that Dataset Is of Sufficient Quality and Complete)

To satisfy the third criterion, the dataset was assessed against the acceptance criteria for the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Soils Activity QAP (NNSA/NSO, 2012). The DQI acceptance criteria are presented in Table 6-1 of the CAIP (NNSA/NFO, 2016). The individual DQI results are presented in the following subsections.

Precision

No analytical data from the CAU 576 CAI had data quality problems that resulted in them being qualified for precision. Therefore, the data met the precision rate CAIP criterion of 80 percent. The potential for a false-negative DQO decision error is negligible, and the results can be confidently used for decision making.

Accuracy

No analytical data from the CAU 576 CAI had data quality problems that resulted in them being qualified for accuracy. Therefore, the data met the accuracy rate CAIP criterion of 80 percent. The potential for a false-negative DQO decision error is negligible, and the results can be confidently used for decision making.

Representativeness

The DQO process as identified in Appendix A of the CAIP (NNSA/NFO, 2016) was used to address sampling and analytical requirements for CAU 576. 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 [judgmental sampling] or that represent contamination of the sample plot [probabilistic sampling] and locations that bound COCs) (Section A.2.1). The sampling locations identified in the Criterion 1a discussion meet this criterion.

Special consideration is needed for Am and Pu isotope concentrations related to representativeness. This is due to the nature of these contaminants in soil (Bernhardt, 1976). These isotopes may be present in soil in the form of small particles that may or may not be captured in a small soil sample of 1 to 2 grams. As individual particles of these radionuclides can make a significant impact on analytical results, small soil samples taken from the same site can produce analytical results that are very different (i.e., poor accuracy). However, the Am and Pu isotopes are co-located (e.g., Am-241 is a daughter product of Pu-241), and the relative concentrations between different samples from the same site (i.e., the ratio of Am to Pu isotope concentrations) should be equal. Based on process knowledge and demonstrated by analytical results from previously sampled Soils sites, the ratios between Am and Pu isotopes in soil contamination from any given source is expected to be the same throughout the contaminant plume at any given time. Therefore, if the ratios are known and one of these isotopic concentrations is known, the concentrations of the other isotopes can be estimated.

Am-241 is reported by the gamma spectrometry method as well as the isotopic Am method. As the gamma spectrometry measurement is based on a much larger soil sample (usually 1 liter), the particle distribution problem discussed above is greatly diminished and the probability of the result being representative of the sampled site is much improved. Therefore, the ratios between the Am and Pu isotopes will be established using the isotopic analytical results and these ratios will be used to infer concentrations of Pu isotopes using the gamma spectrometry results for Am-241. These inferred Pu values will be more representative of the sampled area than the isotopic results. For CAU 576, the isotopic ratios of Am-241 to Pu-238, Pu-239/240, and Pu-241 are 0.071, 5.6249, and 1.6049, respectively.

Based on the methodical selection of sample locations and the use of inferred Pu activities, the analytical data acquired during the CAU 576 CAI are representative of the sampled population. Therefore, the dataset is determined to be acceptable for the criterion of representativeness.

Comparability

Field sampling, as described in the CAIP (NNSA/NFO, 2016), was performed and documented in accordance with approved procedures that are comparable to standard industry practices. Approved analytical methods and procedures were used to analyze, report, and validate the data. These are comparable to other methods used not only in industry and government practices, but most importantly are comparable to other investigations conducted for the NNSS. Therefore, CAU 576 datasets are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting DQO requirements. In addition, 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/NFO, 2016) 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 release-specific analytes identified in the CAIP having valid results. Data that were qualified as rejected are listed in Table B.1-3. These data were not used in the resolution of DQO decisions and are not counted toward meeting the completeness acceptance criterion. As shown in Table B.1-3, the only constituent that had rejected data results was curium (Cm)-243, which had a completeness percent of 79 and did not meet the 80 percent criterion. However, Cm-243 was not identified as a COPC at CAU 576 release sites and is not expected to be present. It is commonly reported as an analyte in the gamma spectroscopy analyses and results have been reported for 2,791 samples at the NNSS. Of these, 23 sample results have detected Cm-243 and the highest concentration in any

Table B.1-3
Completeness Measurements

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Cm-243	Gamma Spectroscopy	3	14	79

sample was 12.3 pCi/g. This maximum detected concentration is a 0.0017 fraction of the 7,210 pCi/g RRMG for Cm-243. Therefore, is it highly unlikely that Cm-243 could be present at CAU 576 at levels exceeding the FAL and sufficient information is available to make the DQO decisions without these missing data.

B.1.1.4 DQO Provisions To Limit False-Positive Decision Error

The false-positive decision error was controlled by assessing the potential for false-positive analytical results. QA/QC samples such as method blanks were used to determine whether a false-positive analytical result may have occurred. This provision is evaluated during the data validation process, and appropriate qualifiers are applied to the data when applicable. There were no data qualifiers that would indicate a potential false-positive analytical result.

The use of disposable sampling equipment also minimized the potential for cross contamination that could lead to a false-positive analytical result.

B.1.2 Sampling Design

SG1 (Surface Rad-Chem Piping)

Decision I sampling consisted of two ISOCS sampling locations determined judgmentally at the closest accessible location along the flex line pipe to GZ and at the termination of the flex line pipe where there was a potential for a discharge. A single TLD and a single grab soil sample was judgmentally collected at the termination of the piping.

SG2 (Subsurface Rad-Chem Piping)

As Decision I was resolved in the DQOs, no samples were collected for Decision I. A single TLD was judgmentally collected in the area of highest radiological survey value at each release site to estimate the highest current external dose. At the Kennebec site, a TLD location was judgmentally determined as the highest accessible location of several radiological survey readings from exposed piping. At the Allegheny and Area 3 Piping sites, the TLD locations were judgmentally determined as the only locations with a piping surface feature. Decision II soil samples were judgmentally determined at the termination of the exhaust pipes for both the Kennebec and Allegheny sites to determine whether the COC contamination is present from a discharge.

SG3 (Rad Waste Dump)

Decision I sampling for subsurface contamination consisted of a geophysical survey to determine the presence or absence of buried wastes. The area of the geophysical survey was determined judgmentally as the current posted CA (as specified in the CAIP [NNSA/NFO, 2016]) and expanded to cover additional areas where debris was identified.

Decision I sampling for surface contamination consisted of two probabilistic sample plots selected judgmentally at the two locations of the highest radiological survey values using the NE Electra. For each sample plot location, samples were collected probabilistically from unbiased locations within the 100-m^2 sample plots area designed to generate a TED value that represents the population of doses within the sample plot. Results from these locations were used to infer a characteristic representative of the sample plot area as a whole (i.e., representing the average of the entire sample plot area, not the maximum at any one location).

SG4 (Debris)

Decision I was resolved without sampling using the criteria for the presence of PSM as defined in the Soils RBCA document (NNSA/NFO, 2014). Verification samples were collected from sample plots selected judgmentally beneath each lead debris item. For each sample plot location, a sample was collected from nine unbiased locations within the sample plot area designed to be representative of the sample plot area as a whole (i.e., representing the average of the entire sample plot area, not the maximum at any one location). A single TLD and a grab sample were collected at judgmentally determined locations of the highest radiological survey values at the tower debris and drum sites.

B.1.3 Conduct a Preliminary Data Review

A preliminary data review was conducted by reviewing QA reports and inspecting the data. The contract analytical laboratories generate a QA non-conformance report when data quality does not meet contractual requirements. All data received from the analytical laboratories met contractual requirements, and a QA non-conformance report was not generated. Data were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified in the Soils Activity QAP (NNSA/NSO, 2012). The validated dataset quality was found to be satisfactory.

B.1.4 Select the Test and Identify Key Assumptions

The test for making DQO decisions for radiological contamination was the comparison of the TED to the FAL of 25 mrem/OU-yr. This standard is based on an exposure duration to a site worker using the OU exposure scenario. The key assumptions that could impact a DQO decision are listed in Table B.1-4.

B.1.5 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 576 DQOs and Table B.1-4. All data collected during the CAI supported the CSM, and no revisions to the CSM were necessary.

B.1.5.1 Other DQO Commitments

The following commitments were made in the CAIP (NNSA/NFO, 2016):

SG1 (Surface Rad-Chem Piping)

- Collect three ISOCS measurements from locations determined by highest rad survey readings to estimate the presence of any radionuclides within the flex line pipe.

  Result. An ISOCS measurement was collected along the flex line pipe at the fence. This deviation is explained in Section A.3.4.

Table B.1-4
Key Assumptions

Exposure Scenario	Occasional Worker
Affected Media	Surface and subsurface soil and debris
Location of Contamination/Release Points	Surface soil surrounding rad-chem piping components and other debris items and subsurface soil surrounding rad-chem piping and debris buried at the waste dump.
Transport Mechanisms	Lateral transport of contamination through drainage channels and overland flow is a major driving force for migration of surface contaminants. Wind may also contribute to lateral transport through resuspension and redistribution of windborne contaminants; however, this transport mechanism is less likely to cause migration of contamination at levels exceeding the FAL. Mechanical disturbance from excavation activities may also serve to displace or redistribute contaminants. Percolation/infiltration of precipitation through soil is a minor force for contaminant migration.
Preferential Pathways	Lateral transport is the major force for migration; wind and percolation/infiltration are minor forces for migration.
Lateral and Vertical Extent of Contamination	Contamination is expected to be initially contiguous to release points. Concentrations are expected to generally decrease with distance and depth from the source. Lateral and vertical extent of contamination exceeding the FAL is assumed to be within the spatial boundaries.
Groundwater Impacts	None; groundwater contamination is not expected.
Future Land Use	Industrial
Other DQO Assumptions	Current containment of contaminants by piping systems will eventually fail. Contamination at locations that were not sampled exceed FALs.

- Collect a single TLD from the location of the highest rad survey reading along the flex line pipe to estimate the maximum current external dose.

  Result. A TLD measurement was collected at the termination of the flex line pipe.This deviation is explained in Section A.3.4.

- Collect a single grab sample at the termination piping (nozzle).

  Result. A single grab sample was collected at the termination of the flex line pipe.

SG2 (Subsurface Rad-Chem Piping)

- Collect a single TLD from the location of the highest rad survey reading along the surface piping to estimate the maximum current external dose at each release site.

  Result. TLD measurements were collected to meet this commitment (see Section B.1.2).

- Collect a grab soil sample at the piping exhaust for the Kennebec and Allegheny sites to determine whether COCs are present beyond the piping.

  Result. The grab soil samples were collected as specified in the CAIP.

SG3 (Rad Waste Dump)

- Perform a geophysical survey to determine presence of buried waste.

  Result. A geophysical survey was conducted as specified in the CAIP.

- Collect a sample from each of two sample plots located at the highest rad survey readings.

  Result. Samples were collected from each of two sample plots as specified in the CAIP.

SG4 (Debris)

- Collect a grab soil sample from beneath each lead object.

  Result. A composite soil sample from a sample plot was collected from beneath each lead object except as discussed in Section A.6.4.

- Collect a TLD and grab soil sample at the location of the highest rad survey value at the tower debris and at the radiologically elevated soil at the drum site.

  Result. A TLD and grab soil sample was collected at the location of the highest rad survey value at the tower debris and at the radiologically elevated soil at the drum site as specified in the CAIP.

B.1.6 Draw Conclusions from the Data

The following subsections resolve the two DQO decisions for each of the CAU 576 study groups.

B.1.6.1 Decision Rules for Both Decision I and II

Decision rule. If contamination levels are inconsistent with the CSM or extends beyond the spatial boundaries identified in the CAIP, then work will be suspended and the investigation strategy will be reconsidered, else the decision will be to continue sampling.

- **Result.** The contamination levels are consistent with the CSM and do not extend beyond the spatial boundaries.

B.1.6.2 Decision Rules for Decision I

Decision rule. If the population parameter of any COPC in the Decision I population of interest exceeds the corresponding FAL, then Decision II will be resolved and a corrective action will be determined, else no further action will be necessary for that COPC in that population.

- **Result.** Contaminants were not detected above the FAL in any sample from any study group. As COCs were assumed to be present within SG1, SG2, and SG4; resolution of Decision II is required.

Decision rule. If a waste is present that, if released, has the potential to cause future soil contamination at levels exceeding a FAL, then a corrective action will be determined, else no further corrective action will be necessary.

- **Result.** Metallic lead debris in SG4 was assumed to meet the definition of PSM and require corrective action. After removal of this debris under a corrective action conducted during the CAI, no metallic lead debris remained, and soil beneath the lead debris items did not exceed the FAL. Metallic lead bricks present at the Kennebec site in SG2 were assumed to meet the definition of PSM and require corrective action.

B.1.6.3 Decision Rules for Decision II

Decision rule. If the spatial extent of any COC has not been defined, then additional samples will be collected, else no further investigation will be necessary. If sufficient information is not available to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, additional waste characterization samples will be collected, else no further investigation will be necessary.

- **Results.** The only identified COCs were those assumed to be present in subsurface rad-chem piping systems and in the portion of the flex line pipe inside the fence. The spatial extent of these assumed COCs was resolved as the physical extent of the piping.

- Potential remediation waste types were identified sufficiently by the analytical results collected during the CAI.

- Data collected from sampling, geophysical surveys, radiological surveys, and visual surveys are sufficient to support the evaluation of CAAs for CAU 576.

B.1.7 Decision-Supporting Data Quality

B.1.7.1 Radiological Surveys for Contaminant Distribution

The intended use of the FIDLER, NE Electra, and Ludlum 2221 with a 44-10 probe radiation detection instruments is to identify the presence of anomalous radioactivity and estimate the relative magnitude of radioactivity. When used in conjunction with a GPS unit, the spatial distribution of radioactive contaminants can be depicted for the purpose of biasing sample locations. Each instrument's response is capable of differentiating areas of high and low levels of radioactive contaminants in a reliable and repeatable fashion.

Radiological surveys are conducted according to instrument specific procedures that require the quality checks necessary to ensure that the data are usable for their intended use, as follows:

- These instruments are subject to a QC program that dictates requirements for calibrations, performance, and daily response checks to controlled radioactive sources to ensure that they are operating as expected.
- Operational guidance is given as to instrument configuration and speed of survey.
- The GPS units are configured so that data of undesirable spatial quality are not recorded.

The survey post-processing invokes additional QC checks that address the following:

- Daily background signatures, collected in the field at a single location, are reviewed for histogram normality and response levels.
- Processed surveys are verified for correctness by those who originally performed the survey.
- Surveys adjacent to or overlapping area where previous surveys have been performed are inspected as to their agreement with the existing data.

Radiological surveys produce data with well-documented pedigrees in accordance with rigorous procedures. Those data meet QC checks designed to ensure that they are suitable for their intended use.

B.1.7.2 Surface Electromagnetic Survey Data

The instruments that generated the electromagnetic survey values used to delineate probable locations of buried debris are operated according to specific procedures that invoke the quality checks necessary to ensure that the resultant data are usable for their intended use. The operating procedures invoke processes whereby the instruments are as follows:

1. Calibrated pre- and post-survey.
2. Periodically checked during the course of a survey.
3. Appropriate for the type(s), levels, and energies of the debris encountered.
4. Appropriate for existing environmental conditions.
5. Routinely tested for operability.

The pre- and post-survey calibration checks include testing the instrument response to metallic test objects. The instrument response checks empirically demonstrate that the instrument is working and is reliably detecting metallic debris. Throughout the course of the survey, the operator monitors instrument response, particularly with respect to metallic objects observed on the surface as well as subsurface anomalies detected. Data generated under these conditions are sufficient to make the decision that buried debris is (or is not) present.

B.2.0 References

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Appendix C

Risk Assessment

C.1.0 Risk Assessment

The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NFO, 2014). This process conforms with *Nevada Administrative Code* (NAC) Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2016a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2016b) requires the use of ASTM International (ASTM) Method E1739 (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 or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

The ASTM Method E1739 defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- **Tier 1 evaluation.** Sample results from source areas (highest concentrations) are compared to Tier 1 action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the CAU 576 CAIP [NNSA/NFO, 2016]). 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 action levels using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 action levels 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.

- **Tier 3 evaluation.** Conducted by calculating Tier 3 action levels on the basis of more sophisticated risk analyses using methodologies described in Method E1739 that consider site-, pathway-, and receptor-specific parameters.

The RBCA decision process stipulated in the Soils RBCA document (NNSA/NFO, 2014) is summarized in Figure C.1-1.

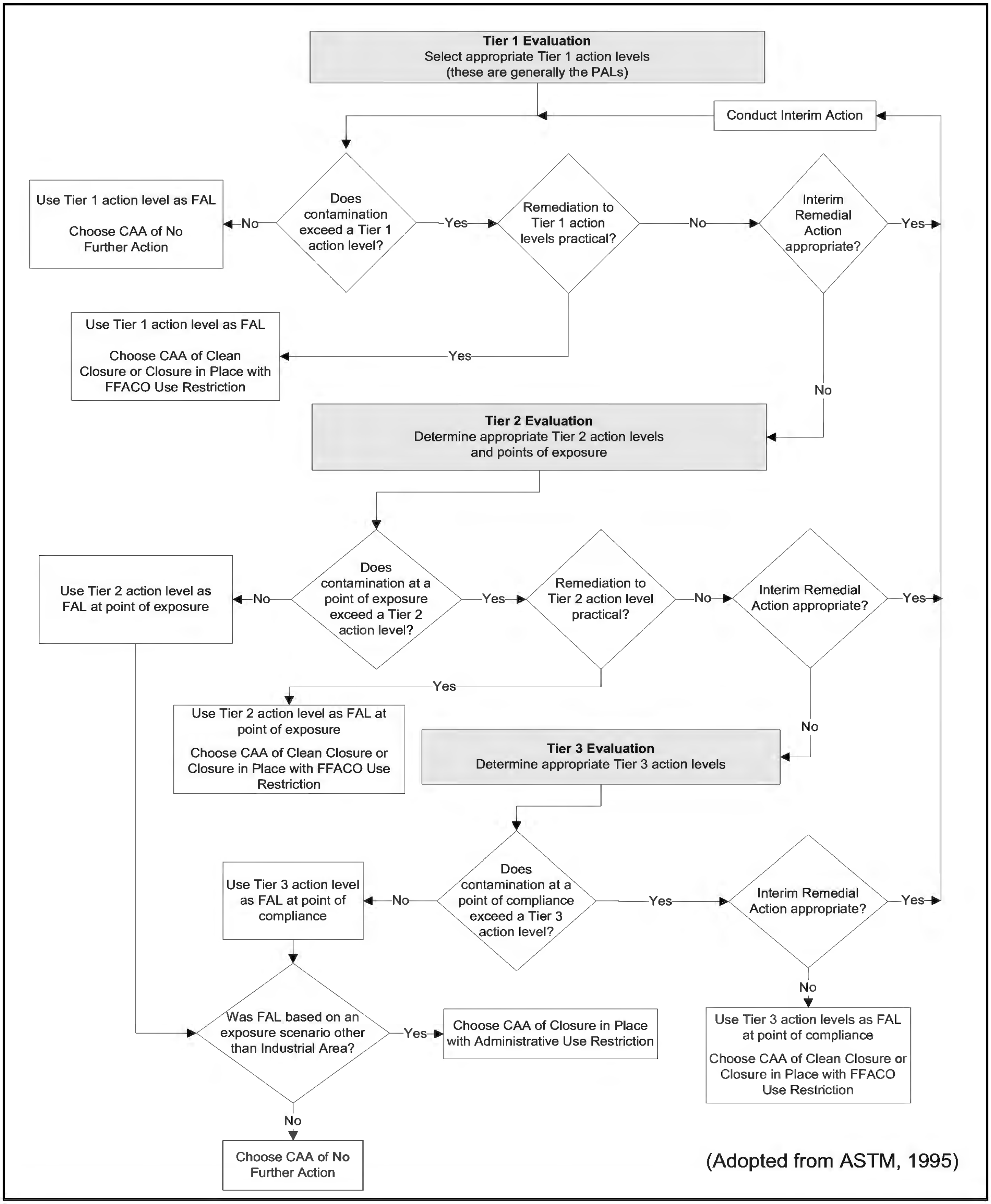


Figure C.1-1
RBCA Decision Process

C.1.1 Scenario

CAU 576, Miscellaneous Radiological Sites and Debris, comprises six CASs (arranged here by study groups):

- **CAS 09-99-09,** U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line
- **CAS 02-99-12,** U-2af (Kennebec) Surface Rad-Chem Piping
- **CAS 03-99-20,** Area 3 Subsurface Rad-Chem Piping
- **CAS 09-99-08,** U-9x (Allegheny) Subsurface Rad-Chem Piping
- **CAS 05-19-04,** Frenchman Flat Rad Waste Dump
- **CAS 00-99-01,** Potential Source Material

CASs 09-99-09, 02-99-12, 03-99-20, and 09-99-08 are associated with rad-chem piping systems used to retrieve samples from nuclear detonations. CASs 05-19-04 and 00-99-01 are associated with surface or potentially buried debris items.

C.1.2 Site Assessment

These CASs include areas potentially affected by past and future releases of radioactivity and chemical contaminants associated with nuclear testing. It is assumed that contaminants currently contained within rad-chem sampling piping systems will at some future time be released to the environment when the steel pipe deteriorates. Debris present at the debris and waste dump sites contain elemental lead that is assumed to be a source of sufficient lead contamination to (currently or at some time in the future) cause underlying soil to exceed the FAL for lead (i.e., meets the definition of PSM). Investigation activities at CAU 576 included visual surveys, radiological surveys, geophysical surveys, collection of surface and subsurface soil samples, and placement of TLDs. The CAI results are presented in Appendix A.

The OU scenario based FAL was established in this appendix (25 mrem/OU-yr) as it is consistent with the actual current and projected site use. The maximum estimated TED for decision-making purposes (based on the OU scenario) was 1 mrem/yr in a surface soil sample. Buried contamination may exist at the site that was not sampled and could potentially provide a higher dose if exposed.

C.1.3 Site Classification and Initial Response Action

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

Based on the CAI, subsurface contamination is present that could potentially pose a short-term threat to human health, safety, and the environment if inadvertently exposed. Therefore, CAU 576 has been determined to be a Classification 2 site as defined by ASTM Method E1739 (ASTM, 1995).

C.1.4 Development of Tier 1 Action Level Lookup Table

Tier 1 action levels are defined as the PALs listed in the CAIP (NNSA/NFO, 2016) as established during the DQO process. The PALs represent a very conservative estimate of risk, are preliminary in nature, and are generally used for site screening purposes. Although the PALs are not intended to be used as FALs, FALs may be defined as the Tier 1 action level (i.e., PAL) value if implementing a corrective action based on the Tier 1 action level is appropriate.

The PALs were based on the IA exposure scenario which assumes continuous industrial use of a site. This scenario addresses exposure to industrial workers exposed daily to contaminants in soil during an average workday. This scenario assumes that this is the regular assigned work area for the worker who will be on the site for an entire career (250 day/yr, 8 hr/day for 25 years). The 25-mrem/yr dose-based Tier 1 action level for radiological contaminants is determined by calculating the dose a site worker would receive if exposed to the site contaminants over an annual exposure period of 2,000 hours.

Chemical PALs defined in the CAIP (NNSA/NFO, 2016) as the EPA Region 9 RSLs for chemical contaminants in industrial soils (EPA, 2017). Background concentrations for RCRA metals will be used instead of screening levels when natural background concentrations exceed the screening level, as is often the case with arsenic on the NNSS. Background is considered the mean plus two standard deviations of the mean for sediment samples collected by the Nevada Bureau of Mines and

Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999).

Although the PALs are based on an industrial scenario, no industrial activities are conducted at this site and there are no assigned work stations in the surrounding area. Therefore, the use of an industrial scenario is overly conservative and is not representative of current land use.

C.1.5 Exposure Pathway Evaluation

For all releases, the DQOs stated that site workers could be exposed to COCs through oral ingestion, inhalation, or dermal contact (absorption) of soil due to inadvertent disturbance of these materials or irradiation by radioactive materials. The potential exposure pathways would be through worker contact with the contaminated soil or debris currently present at the site. The limited migration demonstrated by the analytical results, elapsed time since the releases, and depth to groundwater support the selection and evaluation of only surface and shallow subsurface contact as the complete exposure pathways. Ingestion of groundwater is not considered to be a significant exposure pathway.

C.1.6 Comparison of Site Conditions with Tier 1 Action Levels

An exposure time based on the IA scenario (2,000 hr/yr) was used to calculate the Tier 1 action levels (i.e., PALs). For radiological contaminants, dose values were calculated for comparison to the Tier 1 action level based on an exposure time of 2,000 hr/yr. Individual chemical analytical results were directly compared to chemical PALs.

Only one sampled location at CAU 576 exceeded a Tier 1 action level (i.e., PAL) and is listed in Table C.1-1. No chemical contamination was detected at any sample location that exceeded the Tier 1 action level. Based on the unrealistic but conservative assumption that a site worker would be exposed to the maximum dose calculated at any sampled location, this site worker would receive a 25-mrem dose at the release location in the exposure time listed in Table C.1-2.

However, it is assumed that contamination is present in subsurface rad-chem piping that exceeds the Tier 1 action level and requires corrective action. Also PSM is present at the debris sites that are assumed to cause the underlying soil to exceed a Tier 1 action level when the PSM is eventually released to the soil.

Table C.1-1
Locations Where 95 Percent UCL of the TED Exceeds the Tier 1 Action Level (mrem/IA-yr)

Study Group	Location	Average TED	95 Percent UCL TED
3	A27	18	**26**

Bold indicates the values exceeding 25 mrem/yr

Table C.1-2
Minimum Exposure Time to Receive a 25-mrem/IA-yr Dose

Location	Average TED (mrem/IA-yr)	Minimum Exposure Time (hours)
A27	18	2802

C.1.7 Evaluation of Tier 1 Results

Because the release site listed in Table C.1-1 exceeded the Tier 1 action level and the Tier 1 action levels are based on exposures (i.e., a full-time industrial worker) that are not representative of current or future use of these sites, the EM Nevada Program determined that remediation to the Tier 1 action level is not appropriate. The risk to receptors from contaminants at CAU 576 is directly related to the amount of time a receptor is exposed to the contaminants. A review of the current and projected use at all sites in CAU 576 determined that workers would not be present at these sites for more than 40 hours per year (see Section C.1.10). As it is not reasonable to assume that any worker would be present at this site for 2,000 hr/yr (see Section C.1.10), it was determined to conduct a Tier 2 evaluation.

C.1.8 Tier 1 Remedial Action Evaluation

No remedial actions are proposed based on Tier 1 action levels.

C.1.9 Tier 2 Evaluation

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

C.1.10 Development of Tier 2 Action Levels

The Tier 2 action levels are typically compared to contaminant values that are representative of areas at which an individual or population may come in contact with a COC originating from a CAS. This concept is illustrated in the EPA's Human Health Evaluation Manual (EPA, 1989). This document states that "the area over which the activity is expected to occur should be considered when averaging the monitoring data for a hot spot. For example, averaging soil data over an area the size of a residential backyard (e.g., an eighth of an acre) may be most appropriate for evaluating residential soil pathways." When evaluating industrial receptors, the area over which an industrial worker is exposed may be much larger than for residential receptors. For a site that is limited to industrial uses, the receptor would be a site worker, and patterns of employee activity would be used to estimate the area over which the receptor is exposed. This can be very complicated to calculate, as industrial workers may perform routine activities at many locations where only a portion of these locations may be contaminated. A more practical measure of integrated risk to radiological dose for an industrial worker is to calculate the portion of total work time that the worker is in proximity to elevated contaminant levels.

For the development of radiological Tier 2 action levels, the annual dose limit for a site worker is 25 mrem/yr (the same as was used for the Tier 1 evaluation). The Tier 2 evaluation is based on a receptor exposure time that is more specific to actual site conditions. The maximum potential exposure time for the most exposed worker at any CAU 576 release was determined based on an evaluation of current and reasonable future activities that may be conducted at the site.

Activities on the NNSS are strictly controlled through a formal work control process. This process requires facility managers to authorize all work activities that take place on the land or at the facilities within their purview. As such, these facility managers are aware of all activities conducted at the site. The facility managers responsible for the area of CAU 576 identified the activities of fencing, posting, maintenance, and military use as the general types of work activities that are currently conducted at the site. Site activities that may occur in the future were identified by assessing tasks related to maintenance of existing infrastructure and long-term stewardship of the site (e.g., inspection and maintenance of UR signs, trespasser). In order to estimate the amount of time a site worker might spend conducting current or future activities, the EM Nevada Program and/or M&O contractor departments responsible for these activities were consulted. Under the current and projected land use at each of the CAU 576 releases, the following workers were identified as being potentially exposed to site contamination:

- **Inspection and Maintenance Worker.** Workers sent to conduct the annual inspection of the UR areas. The URs require a periodic inspection to ensure that any required access controls are intact and legible. This may require two people to spend up to 10 hr/yr each at each UR.

- **Military Trainee.** Periodic military training activities could be conducted at these sites. These workers typically spend one to two weeks per year training in the general area that includes these CASs. Although they are routinely advised to avoid areas containing radiological contamination, these workers could potentially inadvertently enter these CAS areas. It was conservatively assumed that this type of worker would spend up to one week per year (40 hours) in one or more of these CASs.

- **Trespasser.** This would include workers or individuals who do not have a specific work assignment at one of the CASs. Workers could potentially inadvertently enter these CAS areas and come in contact with site contamination. This is assumed to be an infrequent occurrence (i.e., once per year) that would result in a potential exposure of less than a day (8 hours).

Under the current land use at each of the CAU 576 releases, the most exposed worker would be the military trainee, who could be exposed to site contamination for up to 40 hr/yr. In the CAU 576 DQOs, it was conservatively determined that the OU exposure scenario (as listed in Section 3.1.1 of the CAIP [NNSA/NFO, 2016]) would be appropriate in calculating receptor exposure time based on current land use at all CAU 576 releases. This exposure scenario assumes exposure to site workers who are not assigned to the area as a regular work site but may occasionally use the site for intermittent or short-term activities. Site workers under this scenario are assumed to be on the site for an equivalent of 80 hr/yr. As the use of this scenario provides a more conservative (longer) exposure to site contaminants than the most exposed worker (based on current and projected future land use), the development and evaluation of Tier 2 action levels were based on the OU exposure scenario.

The EPA's risk assessment tool for lead (the Adult Lead Methodology [ALM]) was used to calculate a Tier 2 action level for lead. This methodology is recommended by EPA because a reference dose value for lead is not available. In the commercial/industrial setting, the most sensitive receptor is the fetus of a worker who has a non-residential exposure to lead. Based on the available scientific data, a fetus is more sensitive to the adverse effects of lead than an adult (National Academy of Sciences, 1993). The EPA assumes that cleanup levels that are protective of a fetus will also afford protection for male or female adult workers. This Tier 2 action level estimates the concentration of lead in the blood of pregnant women and developing fetuses who might be exposed to lead-contaminated soils (EPA, 2003). The methodology for using the ALM to establish action levels for lead in soil is described in the Soils RBCA document (NNSA/NFO, 2014). This document lists all the input parameters to be used in the ALM, including the EPA-established lead concentration limits in fetal blood.

Although the Tier 2 action levels for other contaminants were developed using the OU exposure scenario, the Tier 2 action level for lead was developed using the Remote Work Area exposure scenario. The Remote Work Area exposure scenario was used to calculate the Tier 2 action level for lead because EPA states that the minimum frequency of exposure of 1 day per week is recommended for short-term exposures. The recommended full-time exposure frequency of 219 day/yr equates to approximately 44 weeks per year. At 1 day per week, this minimum exposure frequency of 44 day/yr is equivalent to the Remote Work Area exposure scenario.

Therefore, the Remote Work Area exposure scenario soil ingestion rate (0.067 grams per day) and the exposure frequency of 44 day/yr were used to calculate a Tier 2 action level for lead of 5,739 mg/kg.

C.1.11 Comparison of Site Conditions with Tier 2 Action Levels

The TEDs calculated using the OU exposure scenario were then compared to the 25-mrem/OU-yr Tier 2 action level. For the CAU 576 chemical contaminants, the Tier 2 action levels were compared to maximum contaminant concentrations from each sample location. No contamination was detected in samples that exceeded Tier 2 action levels. However, it is assumed that contamination is present in subsurface rad-chem piping that exceeds the Tier 2 action level. Also, PSM is present at the debris sites that are assumed to cause the underlying soil to exceed the Tier 2 action level when the PSM is eventually released to the soil.

C.1.12 Tier 2 Remedial Action Evaluation

It was determined that remediation to the Tier 2 action levels was feasible and appropriate. Therefore, the FALs for CAU 576 were established at the Tier 2 action levels. As the FALs for all contaminants that were passed on to a Tier 2 evaluation were established as the Tier 2 action levels, a Tier 3 evaluation is not necessary.

C.2.0 Summary

The Tier 2 action levels are typically compared to results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Points of exposure are defined as those locations or areas at which an individual or population may come in contact with a COC originating from a release. However, for CAU 576, the Tier 2 action levels were conservatively compared to the contaminant or dose levels from single point locations. These conservative estimated maximum potential doses were used for resolving corrective action DQO decisions.

The corrective actions for CAU 576 are based on the assumption that activities on the NNSS will be limited to those that are industrial in nature and that the NNSS will maintain controlled access (i.e., restrict public access and residential use). The FALs were based on an exposure time of 80 hr/yr of site worker exposure to CAS surface soils. If the land use at the site changes to a more intensive use where a site worker could be potentially exposed to site contamination for longer exposure times, the worker could potentially receive an unacceptable level of risk. Should the future land use of the NNSS change such that these assumptions no longer are valid, additional evaluation may be necessary.

C.3.0 References

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2015). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E1739-95(2015). West Conshohocken, PA.

EPA, see U.S. Environmental Protection Agency.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (SAIC) titled "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.

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

National Academy of Sciences. 1993. *Measuring Lead Exposure in Infants, Children, and Other Sensitive Populations.* Prepared by the Committee on Measuring Lead in Critical Populations, National Research Council. Washington, DC: National Academy Press.

Nevada Administrative Code. 2016a. 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 18 September 2017.

Nevada Administrative Code. 2016b. 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 18 September 2017.

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, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2016. *Corrective Action Investigation Plan for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Tonopah Test Range, Nevada*, Rev. 1, DOE/NV--1550. Las Vegas, NV.

U.S. Environmental Protection Agency. 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A),* EPA/540/1-89/002. Washington, DC: Office of Emergency and Remedial Response.

U.S. Environmental Protection Agency. 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil,* EPA-540-R-03-001. Washington, DC: Technical Review Workgroup for Lead.

U.S. Environmental Protection Agency. 2017. *Pacific Southwest, Region 9: Regional Screening Levels (Formerly PRGs), Screening Levels for Chemical Contaminants.* As accessed at http://www.epa.gov/region9/superfund/prg on 18 September. Prepared by EPA Office of Superfund and Oak Ridge National Laboratory.

Appendix D

Closure Activity Summary

D.1.0 Closure Activity Summary

The following subsections document closure activities proposed for each of the six CASs in CAU 576. Each site is slightly different but a combination of soil samples, TLD measurements, ISOCS measurements, geophysical surveys, and radiological surveys were collected to characterize the presence and lateral extent of radiological contamination at these sites. PSM was removed, where necessary.

D.1.1 Flex Line Closure Activities

Based on the results of this investigation, a corrective action of closure in place with a UR was implemented. No radiological dose above the FAL of 25 mrem/OU-yr was identified for the flex line pipe outside the potential crater; it was assumed that contamination exceeds FALs within the inaccessible portions of the rad-chem piping system, and corrective action was required. The portion of the flex line pipe outside the potential crater area was moved and placed as far as possible inside the fenced potential crater area without entering the potential crater area. An FFACO UR was implemented, and signs were installed surrounding the corrective action boundary.

The established FFACO UR for CAS 09-99-09, U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line, is defined by the coordinates listed in the FFACO (1996, as amended) and is illustrated in Attachment D-1. The FFACO UR is recorded in the FFACO database, M&O contractor Geographic Information Systems (GIS), and the EM Nevada Program CAU/CAS files. Any use of the area within the FFACO UR for activities that are restricted by the URs will require NDEP notification.

D.1.2 Kennebec Closure Activities

Based on the results of this investigation, a corrective action of closure in place with a UR was implemented. No radiological dose above the FAL of 25 mrem/OU-yr was identified for the exposed portion of the Kennebec rad-chem piping. However, it was assumed that the subsurface rad-chem piping exceeds FALs. It was also assumed that lead contamination within the vaults with lead bricks at the site exceeds the FAL for chemical lead. Therefore, a corrective action of closure in place with a UR was implemented for the rad-chem piping and vaults with lead bricks. A fence with UR signs was installed outside the UR boundary.

The established FFACO UR for CAS 02-99-12, U-2af (Kennebec) Surface Rad-Chem Piping, is defined by the coordinates listed in the FFACO (1996, as amended) and is illustrated in Attachment D-1. The FFACO UR is recorded in the FFACO database, M&O contractor GIS, and the EM Nevada Program CAU/CAS files. Any use of the area within the FFACO UR for activities that are restricted by the URs will require NDEP notification.

D.1.3 Area 3 Piping Closure Activities

Based on the results of this investigation and the Soils RCBA document (NNSA/NFO, 2014), it is assumed that the subsurface rad-chem piping from the Chinchilla to Bernalillo, and from Platypus to Colfax exceeds FALs, and corrective action is required. Closure in place with a UR was implemented and encompasses the two subsurface rad-chem piping systems. Results from the CAI demonstrate that no significant potential dose is present at the only surface feature of the piping system (the Platypus wellhead). The UR signs were installed outside the UR boundary.

The established FFACO UR for CAS 03-99-20, Area 3 Subsurface Rad-Chem Piping, is defined by the coordinates listed in the FFACO (1996, as amended) and is illustrated in Attachment D-1. The FFACO UR is recorded in the FFACO database, M&O contractor GIS, and the EM Nevada Program CAU/CAS files. Any use of the area within the FFACO UR for activities that are restricted by the URs will require NDEP notification.

D.1.4 Allegheny Closure Activities

Based on the results of this investigation, a corrective action of closure in place with a UR was implemented. No radiological doses above the FAL of 25 mrem/OU-yr were identified for the exposed portion of the Allegheny rad-chem piping. However, it was assumed that the subsurface rad-chem piping exceeds FALs. Therefore, a corrective action of closure in place with a UR was implemented for the subsurface rad-chem piping. The UR signs were installed outside the UR boundary.

The established FFACO UR for CAS 09-99-08, U-9x (Allegheny) Subsurface Rad-Chem Piping, is defined by the coordinates listed in the FFACO (1996, as amended) and is illustrated in Attachment D-1. The FFACO UR is recorded in the FFACO database, M&O contractor GIS, and the

EM Nevada Program CAU/CAS files. Any use of the area within the FFACO UR for activities that are restricted by the URs will require NDEP notification.

D.1.5 Waste Dump Closure Activities

Based on the results of this investigation, corrective action is not required for CAS 05-19-04, Frenchman Flat Rad Waste Dump, as described in Section A.5.0. In accordance with the Soils RBCA document (NNSA/NFO, 2014), an administrative UR was identified as a BMP for the Waste Dump as the estimated dose at location A27 indicates that a future site worker could receive an annual dose exceeding 25 mrem/yr if the land use were to change and a more intensive use of the area (up to a full-time industrial use) was implemented. This administrative UR (implemented as a BMP) is not an FFACO corrective action. The administrative UR boundary was established at the current CA boundary and encompasses location A27. The administrative UR was recorded and is controlled in the same manner as the FFACO URs, but no warning signs were installed. The administrative UR is presented in Attachment D-1.

D.1.6 Debris Closure Activities

Based on the results of this investigation, the lead PSM items required corrective action. The PSM items were removed as a corrective action of clean closure, and soil verification samples were collected and analyzed for RCRA metals. Verification samples collected after completion of the corrective action demonstrate that soil contamination does not remain at levels exceeding the chemical FALs. Therefore, no further corrective action is required. Contamination at location A11 (tower debris) and location A12 (drum site) did not exceed radiological FALs; therefore, no corrective actions were implemented at those sites.

D.2.0 References

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

Federal Facility Agreement and Consent Order. 1996 (as amended March 2010). 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. Appendix VI, which contains the Soils Sites Strategy, was last modified June 2014, Revision No. 5.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

Attachment D-1

Use Restrictions

(29 Pages)

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:	576 - Miscellaneous Radiological Sites and Debris
Corrective Action Site (CAS) Number & Description:	02-99-12 - U-2af (Kennebec) Surface Rad-Chem Piping
CAU/CAS Owner:	Soils - 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 CAS 02-99-12 final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	582,397	4,109,767
	2	582,396	4,109,771
	3	582,703	4,109,850
	4	582,704	4,109,846
	5	582,397	4,109,767

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

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

Boundary Applies to: Both Surface and Subsurface

Starting Depth: 0 **Ending Depth:** 5

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

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Fence	Present and provides barrier.
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: N/A

Section II. Administrative UR

An Administrative UR is not identified for this site.

Section III. Supporting Documentation

UR Source Document(s)

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

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

Attachments

- CAU 576, CAS 02-99-12 FFACO UR Boundary Map (UTM, Zone 11, NAD 83 meters)
- CAU 576, CAS 02-99-12 Supplemental Information Figure (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

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

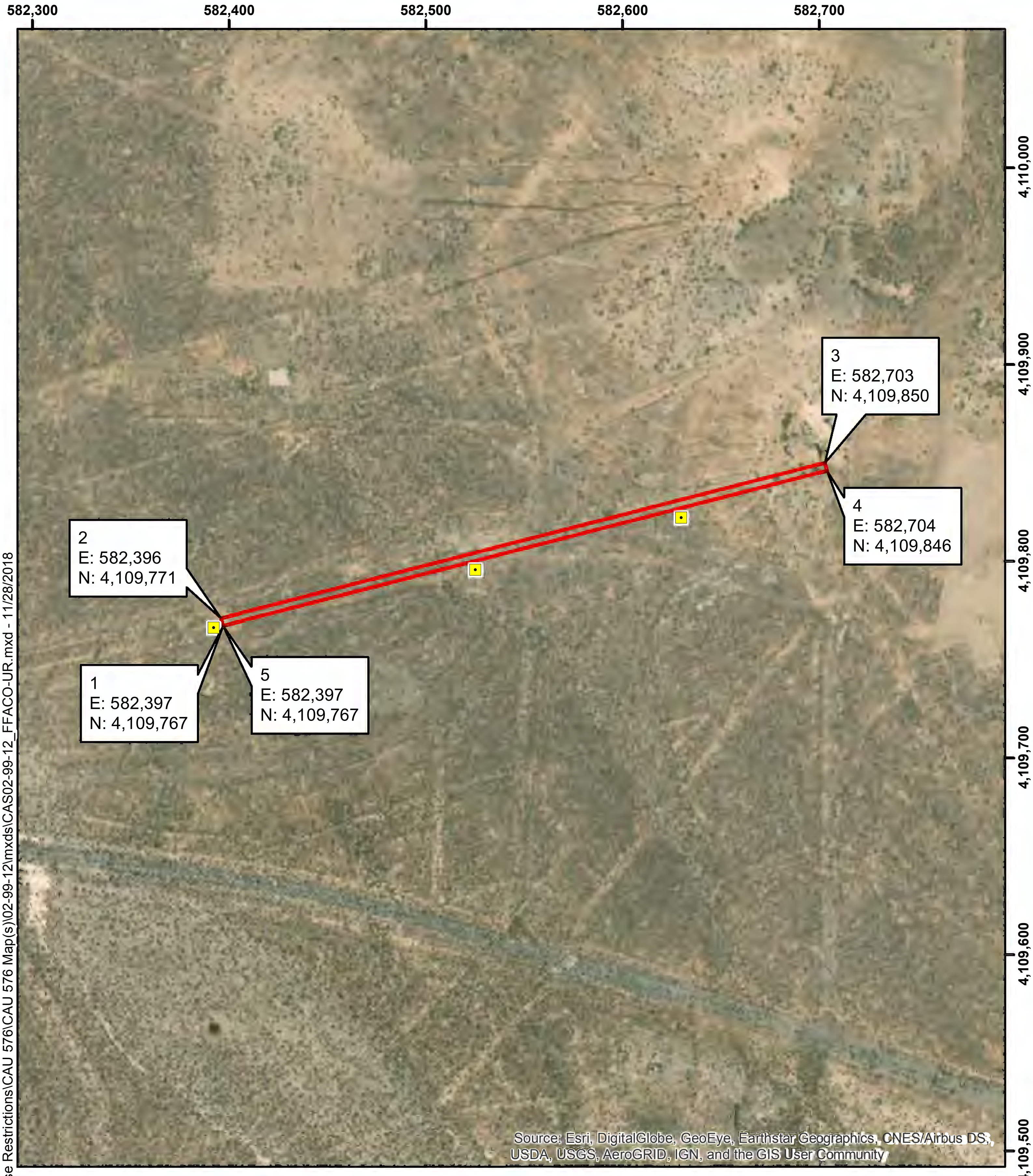
Section V. EM Nevada Program Approval

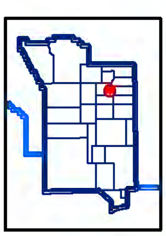
/s/ Kevin Cabble   Date: 2/4/19

Kevin Cabble

Activity Lead

EM Nevada Program





CAU 576, CAS 02-99-12
U-2af (Kennebec) Surface
Rad-Chem Piping
FFACO UR Boundary

Explanation

FFACO UR

Approximate Location of UR Sign

Uncontrolled When Printed

0 20 40 80 Meters

0 50 100 200 Feet

N

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2018

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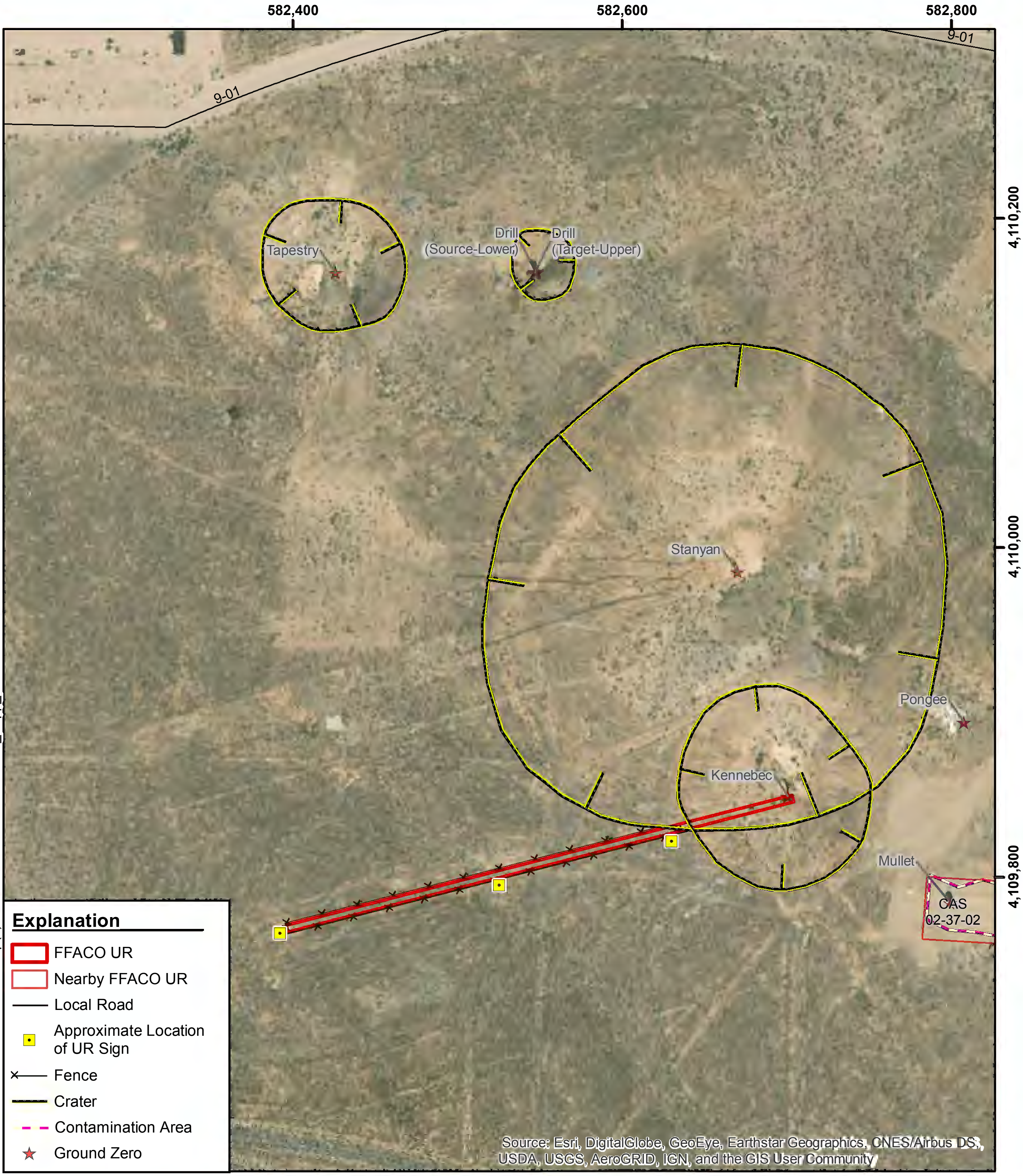
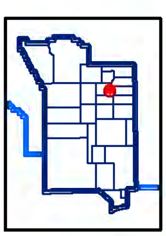
Supplemental Information Figure

The attached supplemental information figure contains additional information on site features. This information was derived from readily available existing sources and has not been verified. Therefore, site features may not be accurately represented.

This information is not required by the FFACO UR and does not imply any additional regulatory requirements. It is solely intended to benefit site users.





CAU 576, CAS 02-99-12
U-2af (Kennebec) Surface Rad-Chem Piping
Supplemental Information
General Location of Site Features

Uncontrolled When Printed

0 20 40 80 Meters

0 100 200 400 Feet

N

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2019

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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:	576 - Miscellaneous Radiological Sites and Debris
Corrective Action Site (CAS) Number & Description:	03-99-20 - Area 3 Subsurface Rad-Chem Piping
CAU/CAS Owner:	Soils - 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 contaminants that were released at this site. Radiological contaminants are assumed to be present that exceed CAS 03-99-20 final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

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

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary 1	1	586,169	4,100,765
	2	585,890	4,100,799
	3	585,892	4,100,804
	4	586,170	4,100,769
	5	586,169	4,100,765
FFACO Boundary 2	1	586,008	4,100,665
	2	585,803	4,100,718
	3	585,804	4,100,724
	4	586,011	4,100,670
	5	586,008	4,100,665

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

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

Boundary Applies to: Subsurface

Starting Depth: 0 **Ending Depth:** 5

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Signage	Present and legible.

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

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: The basis for this UR is the assumed presence of subsurface contamination. No surface contamination is present exceeding background levels.

Section II. Administrative UR

An Administrative UR is not identified for this site.

Section III. Supporting Documentation

UR Source Document(s)

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

Attachments

- CAU 576, CAS 03-99-20 FFACO UR Boundary Map (UTM, Zone 11, NAD 83 meters)
- CAU 576, CAS 03-99-20 Supplemental Information Figure (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

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

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

Section V. EM Nevada Program Approval

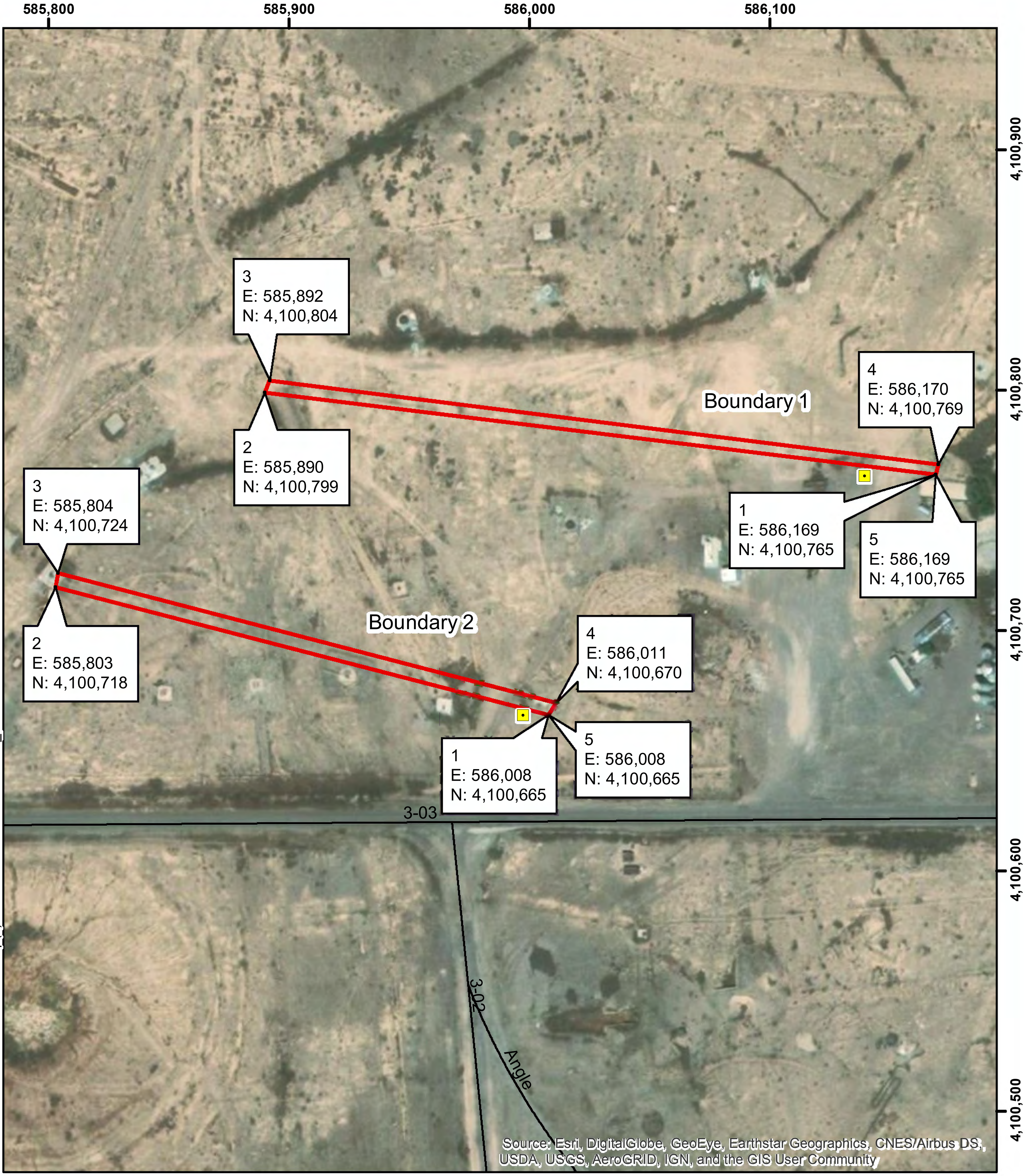
/s/ Kevin Cabble

Date: 2/4/19

Kevin Cabble

Activity Lead

EM Nevada Program



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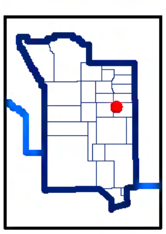


CAU 576, CAS 03-99-20
Area 3 Subsurface
Rad-Chem Piping
FFACO UR Boundary

Explanation

- FFACO UR
- Local Road
- Approximate Location of UR Sign

0 15 30 60 Meters

0 50 100 200 Feet

N

Uncontrolled When Printed

Source: Navarro GIS, 2019

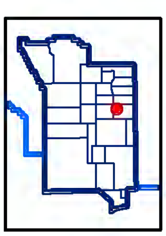
NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Supplemental Information Figure

The attached supplemental information figure contains additional information on site features. This information was derived from readily available existing sources and has not been verified. Therefore, site features may not be accurately represented.

This information is not required by the FFACO UR and does not imply any additional regulatory requirements. It is solely intended to benefit site users.



CAU 576, CAS 03-99-20
Area 3 Subsurface Rad-Chem Piping
Supplemental Information
General Location of Site Features

Uncontrolled When Printed

0 25 50 100 Meters

0 75 150 300 Feet

N

Source: Navarro GIS, 2019

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

L:\Soils\Soils Common\Use Restrictions\CAU 576\CAU 576 Map(s)\03-99-20\mxds\CAS03-99-20_Supp_20190122.mxd - 1/22/2019

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

General Information

Use Restriction (UR) Type(s):	Administrative Only
Corrective Action Unit (CAU) Number & Description:	576 - Miscellaneous Radiological Sites and Debris
Corrective Action Site (CAS) Number & Description:	05-19-04 - Frenchman Flat Rad Waste Dump
CAU/CAS Owner:	Soils - ER
Note:	N/A

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

An FFACO UR is not identified for this site.

Section II. Administrative UR

Basis for Administrative UR

Summary Statement: This Administrative UR is established to protect workers should future land use result in increased exposure to site contaminants. Radiological contaminants are present that exceed CAS 05-19-04 final action levels under the Industrial Area (2,000 hours per year) exposure scenario. Removable contamination is present that exceeds the criteria for establishing a Contamination Area.

Administrative UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
Admin Boundary	1	594,598	4,075,387
	2	594,573	4,075,394
	3	594,579	4,075,421
	4	594,607	4,075,408
	5	594,598	4,075,387

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

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

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

Boundary Applies to: Surface

Starting Depth: 0 **Ending Depth:** 5

Depth Unit: Centimeters

Survey Source: GIS

Administrative UR Requirements

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

Site Controls:

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

Section III. Supporting Documentation

UR Source Document(s)

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

Attachments

- CAU 576, CAS 05-19-04 Administrative UR Boundary Map (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

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

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

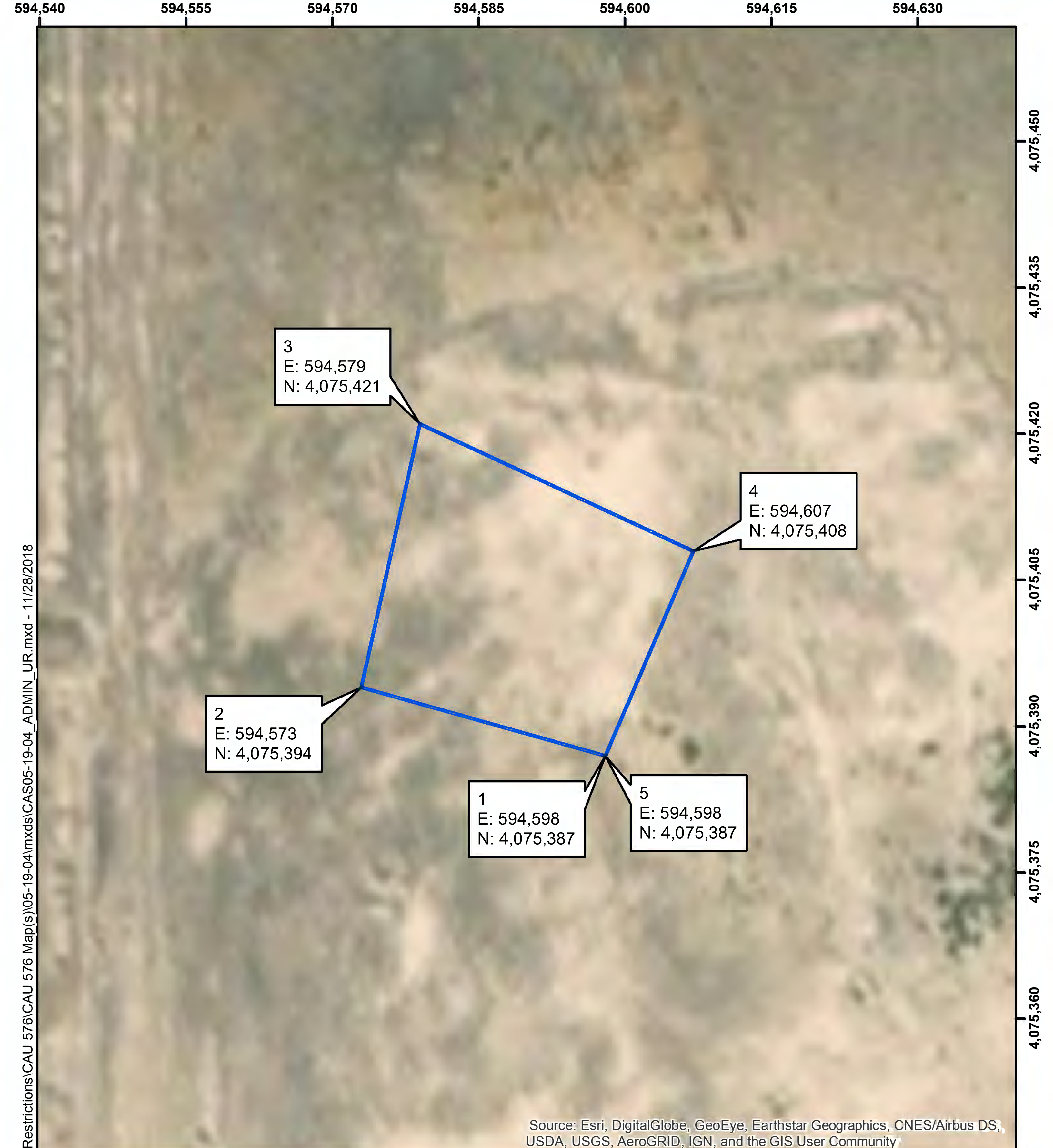
Section V. EM Nevada Program Approval

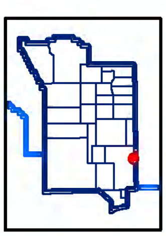
/s/ Kevin Cabble Date: 2/4/19

Kevin Cabble

Activity Lead

EM Nevada Program

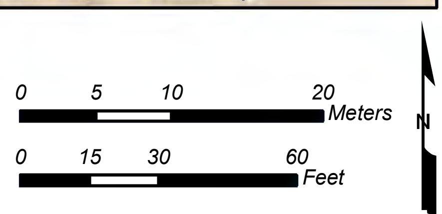




CAU 576, CAS 05-19-04
Frenchman Flat
Rad Waste Dump
Administrative UR Boundary

Explanation

Administrative UR



Uncontrolled When Printed

NOTE: Size and location of features are approximated.

Source: Navarro GIS, 2018

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Supplemental Information Figure

A supplemental information figure is not attached, as additional information on site features is not available.

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:	576 - Miscellaneous Radiological Sites and Debris
Corrective Action Site (CAS) Number & Description:	09-99-08 - U-9x (Allegheny) Subsurface Rad-Chem Piping
CAU/CAS Owner:	Soils - 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 contaminants that were released at this site. Radiological contaminants are assumed to be present that exceed CAS 09-99-08 final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	586,088	4,108,255
	2	585,846	4,108,254
	3	585,846	4,108,260
	4	586,088	4,108,262
	5	586,088	4,108,255

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

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

Boundary Applies to: Subsurface

Starting Depth: 0 **Ending Depth:** 5

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

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: The basis for this UR is the assumed presence of subsurface contamination. No surface contamination is present exceeding background.

Section II. Administrative UR

An Administrative UR is not identified for this site.

Section III. Supporting Documentation

UR Source Document(s)

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

Attachments

- CAU 576, CAS 09-99-08 FFACO UR Boundary Map (UTM, Zone 11, NAD 83 meters)

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

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

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

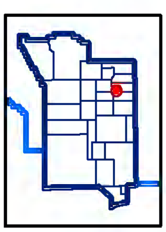
Section V. EM Nevada Program Approval

/s/ Kevin Cabble — Date: 2/4/19

Kevin Cabble

Activity Lead

EM Nevada Program



CAU 576, CAS 09-99-08
U-9x (Allegheny) Subsurface
Rad-Chem Piping
FFACO UR Boundary

Explanation

FFACO UR

Approximate Location of UR Sign

Uncontrolled When Printed

0 20 40 80 Meters

0 60 120 240 Feet

N

NOTE: Size and location of features are approximated.

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Source: Navarro GIS, 2018

L:\Soils\Soils Common\Use Restrictions\CAU 576\CAU 576 Map(s)\09-99-08\mxds\CAS09-99-08_FFACO-UR.mxd - 12/13/2018

Supplemental Information Figure

A supplemental information figure is not attached, as additional information on site features is not available.

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:	576 - Miscellaneous Radiological Sites and Debris
Corrective Action Site (CAS) Number & Description:	09-99-09 - U-9its u24 (Avens-Alkermes) Surface Contaminated Flex Line
CAU/CAS Owner:	Soils - 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 contaminants that were released at this site. Radiological contaminants are assumed to be present that exceed CAS 09-99-09 final action levels under the Occasional Use Area (80 hours per year) exposure scenario.

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	585,352	4,110,542
	2	585,348	4,110,542
	3	585,347	4,110,547
	4	585,348	4,110,557
	5	585,361	4,110,569
	6	585,372	4,110,560
	7	585,355	4,110,553
	8	585,353	4,110,547
	9	585,352	4,110,542

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

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

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

Boundary Applies to: Both Surface and Subsurface

Starting Depth: 0 **Ending Depth:** 5

Depth Unit: Meters

Survey Source: GIS

FFACO UR Requirements

Site Controls:

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

Control	Criteria
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments: Depth of contamination is limited to the surface except at the wellhead.

Section II. Administrative UR

An Administrative UR is not identified for this site.

Section III. Supporting Documentation

UR Source Document(s)

U.S. Department of Energy, Environmental Management Nevada Program. 2018. Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Rev. 0, DOE/EMNV--0001. Las Vegas, NV.

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

Attachments

- CAU 576, CAS 09-99-09 FFACO UR Boundary Map (UTM, Zone 11, NAD 83 meters)
- CAU 576, CAS 09-99-09 Supplemental Information Figure (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

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

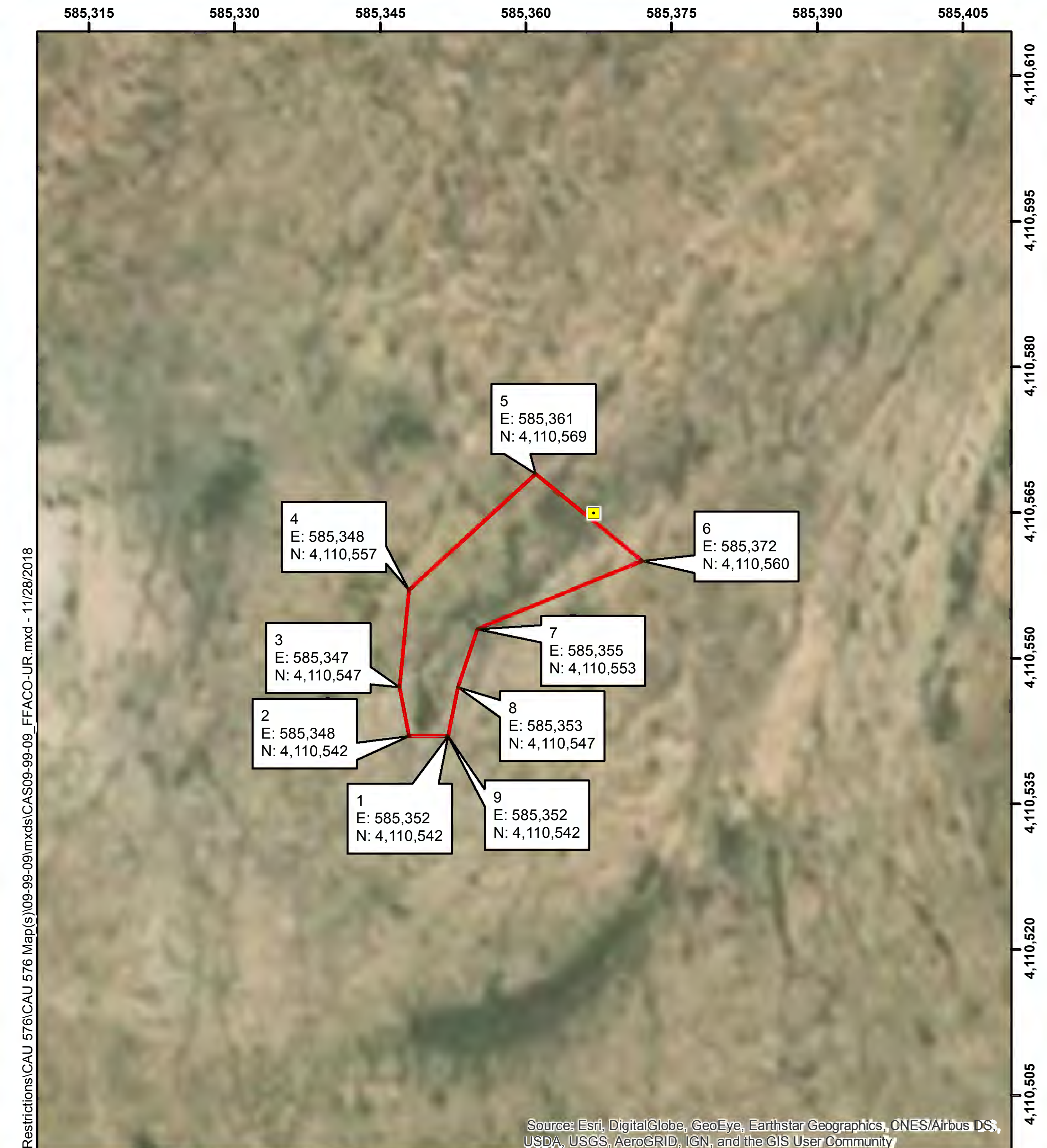
Section V. EM Nevada Program Approval

/s/ Kevin Cabble Date: 2/4/19

Kevin Cabble

Activity Lead

EM Nevada Program



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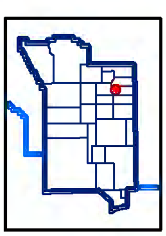
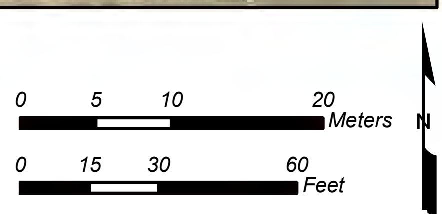


CAU 576, CAS 09-99-09
U-9its u24 (Avens-Alkermes)
Surface Contaminated Flex Line
FFACO UR Boundary

Explanation

- FFACO UR
- Approximate Location of UR Sign

Uncontrolled When Printed



Source: Navarro GIS, 2018

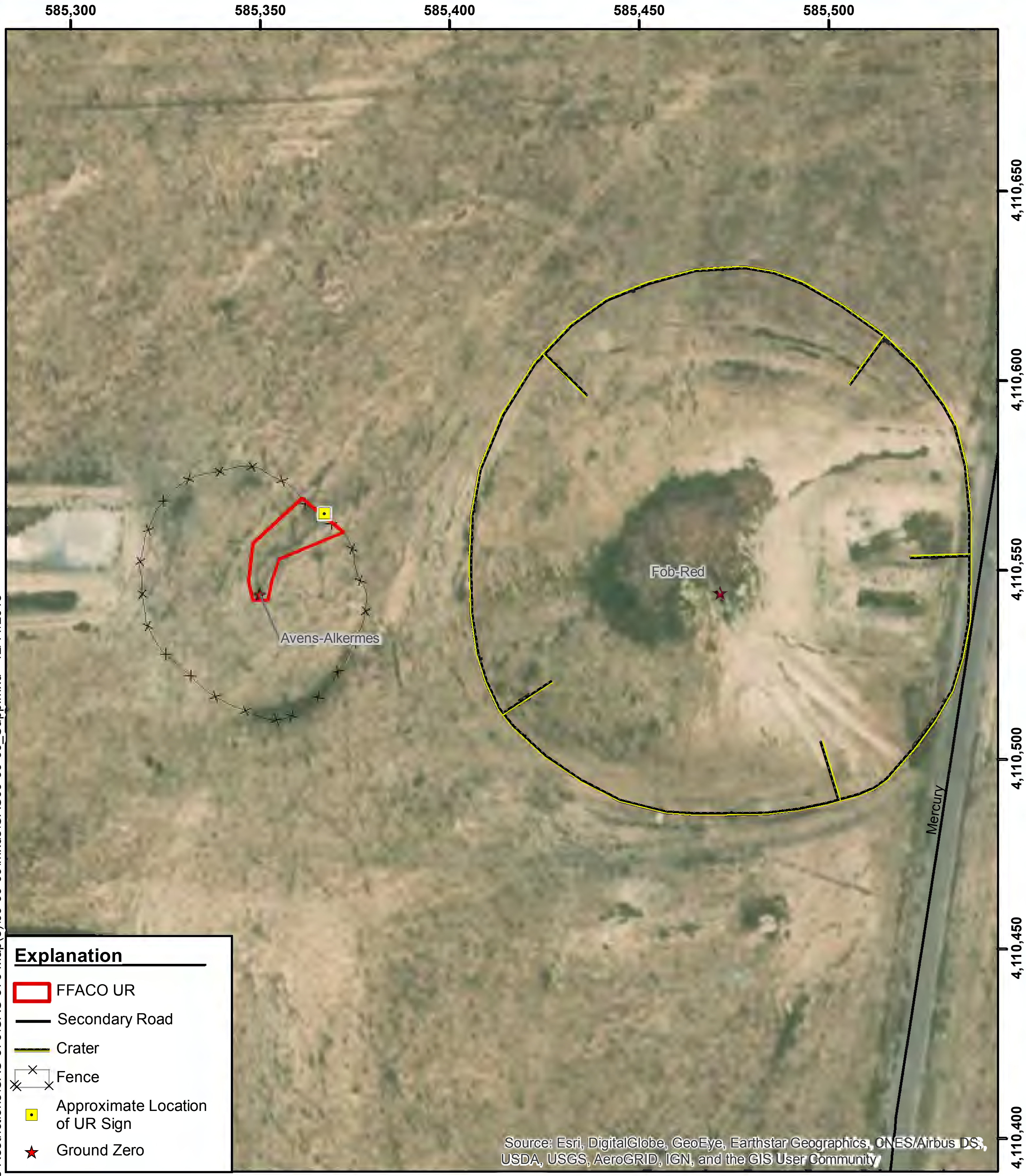
NOTE: Size and location of features are approximated.

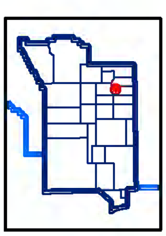
Coordinate System: NAD 1983 UTM Zone 11N, Meter

Supplemental Information Figure

The attached supplemental information figure contains additional information on site features. This information was derived from readily available existing sources and has not been verified. Therefore, site features may not be accurately represented.

This information is not required by the FFACO UR and does not imply any additional regulatory requirements. It is solely intended to benefit site users.





Source: Navarro GIS, 2018

CAU 576, CAS 09-99-09
U-9its u24 (Avens-Alkermes)
Surface Contaminated Flex Line
Supplemental Information
General Location of Site Features

0 10 20 40 Meters
0 40 80 160 Feet
N

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

L:\Soils\Soils Common\Use Restrictions\CAU 576\CAU 576 Map(s)\09-99-09\mxds\CAS09-99-09_Supp.mxd - 12/11/2018

Attachment D-2

Waste Disposal Documentation

(1 Page)

Company Form FRM-2217	CERTIFICATE OF DISPOSAL	02/26/18 Rev. 03 Page 1 of 1

Nevada National Security Site

This Certificate acknowledges that the following shipment(s) have been disposed at the Nevada National Security Site Radioactive Waste Management Complex.

Shipment Number	Waste Stream Identification #	Package #	Serial #	Date of Disposal
DPM18041	LRY5MWFY13001	18M070	176430 (B00015)	09-20-18

This certification is provided as a courtesy to the waste generator for information purposes only.

/s/ Signature on file — WGS Signature — Date: 09-20-18

Waste Inspector — Title

/s/ Signature on file — RWMC Signature — Date: 9-20-18

LLW SPECIALIST — Title

(Reference: OP-2151.304)

Appendix E

Evaluation of Corrective Action Alternatives

E.1.0 Introduction

This appendix presents the corrective action objectives for CAU 576, describes the general standards and decision factors used to screen the various CAAs, and develops and evaluates a set of selected CAAs that will meet the corrective action objectives. This CAA evaluation is intended for use in making corrective action decisions for CAU 576 conditions at the conclusion of the CAI (after the completion of any interim corrective actions).

On May 1, 1996, EPA issued an Advance Notice of Proposed Rulemaking (ANPR) for corrective action for releases from solid waste management units at hazardous waste management facilities (EPA, 1996). The EPA states that the ANPR should be considered the primary corrective action implementation guidance (Laws and Herman, 1997). The ANPR states that a basic operating principle for remedy selection is that corrective action decisions should be based on risk. It emphasizes that current and reasonably expected future land use should be considered when selecting corrective action remedies and encourages use of innovative site characterization techniques to expedite site investigations.

The ANPR provides the following EPA expectations for corrective action remedies (EPA, 1996):

- Treatment should be used to address principal threats wherever practicable and cost-effective.
- Engineering controls, such as containment, should be used where wastes and contaminated media can be reliably contained, pose relatively low long-term threats, or for which treatment is impracticable.
- A combination of methods (e.g., treatment, engineering, and institutional controls) should be used, as appropriate, to protect human health and the environment.
- Institutional controls should be used primarily to supplement engineering controls as appropriate for short- or long-term management to prevent or limit exposure.
- Innovative technologies should be considered where such technologies offer potential for comparable or superior performance or implementability, less adverse impacts, or lower costs.
- Usable groundwater should be returned to maximum beneficial use wherever practicable.

- Contaminated soils should be remediated as necessary to prevent or limit direct exposure and to prevent the transfer of unacceptable concentrations of contaminants from soils to other media.

E.1.1 Corrective Action Objectives

The corrective action objectives are the FALs as defined in the Soils RBCA document (NNSA/NFO, 2014). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2016a). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2016b) requires the use of ASTM Method E1739 (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 or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

E.1.2 Screening Criteria

The screening criteria used to evaluate and select the preferred CAAs are identified in the *Guidance on RCRA Corrective Action Decision Documents* (EPA, 1991) and the *Final RCRA Corrective Action Plan* (EPA, 1994).

CAAs are evaluated based on four general corrective action standards and five remedy selection decision factors. All CAAs must meet the four general standards to be selected for evaluation using the remedy selection decision factors.

The general corrective action standards are as follows:

- Protection of human health and the environment
- Compliance with media cleanup standards
- Control the source(s) of the release
- Comply with applicable federal, state, and local standards for waste management

The remedy selection decision factors are as follows:

- Short-term reliability and effectiveness
- Reduction of toxicity, mobility, and/or volume
- Long-term reliability and effectiveness
- Feasibility
- Cost

E.1.2.1 Corrective Action Standards

The following subsections describe the corrective action standards used to evaluate the CAAs.

Protection of Human Health and the Environment

Protection of human health and the environment is a general mandate of the RCRA statute (EPA, 1994). This mandate requires that the corrective action include any necessary protective measures. These measures may or may not be directly related to media cleanup, source control, or management of wastes.

Compliance with Media Cleanup Standards

The CAAs are evaluated for the ability to meet the proposed media cleanup standards. The media cleanup standards are the FALs defined in Appendix C.

Control the Source(s) of the Release

The CAAs are evaluated for the ability to stop further environmental degradation by controlling or eliminating additional releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to clean up releases may be ineffective or, at best, will involve a perpetual cleanup. Therefore, each CAA must provide effective source control to ensure the long-term effectiveness and protectiveness of the corrective action.

Comply with Applicable Federal, State, and Local Standards for Waste Management

The CAAs are evaluated for the ability to be conducted in accordance with applicable federal and state regulations (e.g., 40 *Code of Federal Regulations* (CFR) 260 to 282, "Hazardous Waste Management" [CFR, 2017a]; 40 CFR 761 "Polychlorinated Biphenyls," [CFR, 2017b]; and NAC 444.842 to 444.980, "Facilities for Management of Hazardous Waste" [NAC, 2015]).

E.1.2.2 Remedy Selection Decision Factors

The following text describes the remedy selection decision factors used to evaluate the CAAs.

Short-Term Reliability and Effectiveness

Each CAA must be evaluated with respect to its effects on human health and the environment during implementation of the selected corrective action. The following factors will be addressed for each alternative:

- Protection of the community from potential risks associated with implementation, such as fugitive dusts, transportation of hazardous materials, and explosion
- Protection of workers during implementation
- Environmental impacts that may result from implementation
- The amount of time until the corrective action objectives are achieved

Reduction of Toxicity, Mobility, and/or Volume

Each CAA must be evaluated for its ability to reduce the toxicity, mobility, and/or volume of the contaminated media. Reduction in toxicity, mobility, and/or volume refers to changes in one or more characteristics of the contaminated media by using corrective measures that decrease the inherent threats associated with that media.

Long-Term Reliability and Effectiveness

Each CAA must be evaluated in terms of risk remaining at the CAU after the CAA has been implemented. The primary focus of this evaluation is on the extent and effectiveness of the control that may be required to manage the risk posed by treatment of residuals and/or untreated wastes.

Feasibility

The feasibility criterion addresses the technical and administrative feasibility of implementing a CAA and the availability of services and materials needed during implementation. Each CAA must be evaluated for the following criteria:

- **Construction and Operation.** The feasibility of implementing a CAA given the existing set of waste and site-specific conditions.
- **Administrative Feasibility.** The administrative activities needed to implement the CAA (e.g., permits, URs, public acceptance, rights of way, offsite approval).
- **Availability of Services and Materials.** The availability of adequate offsite and onsite treatment, storage capacity, disposal services, necessary technical services and materials, and prospective technologies for each CAA.

Cost

Costs for each alternative are estimated for comparison purposes only. The cost estimate for each CAA includes both capital, and operation and maintenance costs, as applicable. The following is a brief description of each component:

- **Capital Costs.** Costs that include direct costs that may consist of materials, labor, construction materials, equipment purchase and rental, excavation and backfilling, sampling and analysis, waste disposal, demobilization, and health and safety measures. Indirect costs are separate and not included in the estimates.
- **Operation and Maintenance Costs.** Separate costs that include labor, training, sampling and analysis, maintenance materials, utilities, and health and safety measures. These costs are not included in the estimates.

E.1.3 Development of CAAs

This section identifies and briefly describes the viable corrective action technologies and the CAAs considered for each CAU 576 releases. The CAAs are based on the current nature of contamination at CAU 576 (Section 2.2.1). The evaluation of CAAs did not include corrective actions that were completed during the CAI. The corrective actions that were completed during the CAU 576 field investigation were as follows:

- **Removal of lead at SG4.** This corrective action involved the removal of a lead plate, lead shield, lead-acid batteries, miscellaneous lead pieces, melted lead pieces, lead shots and lead bricks. No soil was removed from the immediate area of the lead. Confirmation samples were collected and analyzed.

Verification of the completion of these corrective actions are documented in this report. Each CAA presented in Section E.1.3 was evaluated by stakeholders in CAA meetings held on September 5, 2017, and July 31, 2018, for the releases that require corrective action. A summary of the CAI results and required corrective actions are presented in Table E.1-1 for each CAU 576 release.

E.1.3.1 Flex Line

Based on the discussion of alternatives at the CAA meeting held on September 5, 2017, it was concluded that the CAA of no further action was not viable for the Flex Line, as contamination was assumed to be present within the flex line pipe and wellhead at levels exceeding the FAL. It was also concluded that the CAA of clean closure was not viable for the Flex Line, as the wellhead and the portion of the flex line pipe within the potential crater area could not be removed due to safety concerns. Therefore, it was concluded that the Flex Line would be closed under a corrective action of closure in place and would include the implementation of a UR at all areas that require corrective action. This UR will restrict inadvertent contact with contaminated media by prohibiting any activity that would cause a site worker to be exposed to COCs. The following three alternatives of closure in place were developed and evaluated in the CAA meeting held on September 5, 2017:

- **Alternative 1.** Leave flex line pipe in place.
- **Alternative 2.** Cut flex line pipe at fence.
- **Alternative 3.** Move flex line pipe inside fence.

Table E.1-1
Summary of Investigation Results

Release Name	Release Type	CAS Number	Corrective Action
Flex Line	Surface and/or shallow subsurface release of radionuclides from waste contained within the flex line	09-99-09	Required
Kennebec	• Subsurface release of radionuclides from waste contained within the subsurface rad-chem piping • Surface and/or shallow subsurface release of radionuclides from surface gas-sampling components • Surface and/or shallow subsurface release of radionuclides from venting of gases via the exhaust pipe • Subsurface chemical release from PSM	02-99-12	Required
Area 3 Piping (Platypus and Chinchilla)	Subsurface release of radionuclides from waste contained within the subsurface piping	03-99-20	Required
Allegheny	• Subsurface release of radionuclides from waste contained within the subsurface rad-chem piping • Surface and/or shallow subsurface release of radionuclides from surface gas-sampling components • Surface and/or shallow subsurface release of radionuclides from venting of gases via the exhaust pipe	09-99-08	Required
Frenchman Flat Rad Waste Dump	Surface and subsurface releases of radionuclides and other COCs from a possible landfill	05-19-04	None
Lead Debris	Surface and shallow subsurface chemical release from PSM	00-99-01	Completed
Tower Debris and Drum Site	Surface and shallow subsurface chemical release	00-99-01	None

E.1.3.1.1 Alternative 1 – Leave Flex Line in Place

Under Alternative 1, closure in place will be implemented with no modification of the rad-chem piping system. An FFACO UR will be established that encompasses the physical extent of the flex line pipe and wellhead. This alternative is a baseline case with which to compare and assess the other CAAs.

E.1.3.1.2 Alternative 2 – Cut Flex Line at Fence

Under Alternative 2, closure in place will be implemented with no modification of the rad-chem piping system inside the potential crater area fence and the removal of the flex line pipe outside the fence. This would involve cutting the flex line pipe at the fence and would include the following:

- Engineering containment controls at the location of the cut.
- Developing and obtaining approval of radiation work permits.
- Developing and obtaining approval of safety work permits.
- Mobilizing equipment and personnel to perform cutting of the flex line pipe.
- Managing the cut portion of the flex line pipe as low-level waste (LLW).
- Disposing of the waste.

Under Alternative 2, closure in place will be implemented with no modification of the rad-chem piping system inside the potential crater area fence and the removal of the flex line pipe outside the fence. A rad survey will be conducted after the removal to ensure that contamination was not released from the flex line pipe cut. The removed portion of the flex line pipe will be disposed of at an appropriate disposal facility. An FFACO UR will be established that encompasses the physical extent of the remaining flex line pipe and wellhead.

Verification samples will not be collected after the flex line pipe is removed, as the results of the CAI did not indicate the presence of any significant contamination levels in the portion of the flex line pipe outside the fence.

E.1.3.1.3 Alternative 3 – Move Flex Line Inside Fence

Under Alternative 3, closure in place will be implemented with no modification of the rad-chem piping system inside the potential crater area fence and moving the flex line pipe outside the fence to within the fence. This would involve cutting the fence at the location of the flex line pipe and would include the following:

- Developing and obtaining approval of safety work permits.
- Mobilizing equipment and personnel to perform cutting of the fence.
- Mobilizing equipment and personnel to perform moving the flex line pipe.

An FFACO UR will be established that encompasses the physical extent of the wellhead and the flex line pipe inside the fence. Verification samples will not be collected after the flex line pipe is moved, as the results of the CAI did not indicate the presence of any significant contamination levels in the portion of the flex line pipe outside the fence.

E.1.3.1.4 Evaluation and Comparison of CAAs

As presented in Section E.1.3.1, the preferred corrective action for the Flex Line was closure in place with UR, and three alternatives for closure in place were developed and evaluated during the CAA. The evaluation and comparison of CAAs during the CAA meeting held on September 5, 2017, were based on the general corrective action standards and the remedy selection decision factors, and are presented in Tables E.1-2 and E.1-3.

Table E.1-2
Evaluation of General Corrective Action Standards for the Flex Line
(Page 1 of 2)

STANDARD #1: PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Alternative 1 (Leave flex line pipe in place) - Least Preferred	**Alternative 2 (Cut flex line pipe at fence) - Most Preferred**	**Alternative 3 (Move flex line pipe inside fence)**
Determined to be least protective. There is less protection from the potential for future activities, as some of the line is not inside potential crater area.	Determined to be marginally more protective. Although there is cutting of the line, which could expose workers to contamination, some protection is afforded by the limited potential for future activities inside potential crater area, and some of the contamination will be removed with the removed portion of the flex line pipe.	Determined to be marginally less protective. Although some protection is afforded by the limited potential for future activities inside potential crater area and there is no cutting of the line that could expose workers to contamination, all of the contamination will remain.
STANDARD #2: COMPLIANCE WITH ENVIRONMENTAL CLEAN-UP STANDARDS STANDARD #3: COMPLIANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL STANDARDS FOR WASTE MANAGEMENT		
Alternative 1 (Leave flex line pipe in place)	**Alternative 2 (Cut flex line pipe at fence)**	**Alternative 3 (Move flex line pipe inside fence)**
All three alternatives were determined to equally meet these standards and are equally preferred		

Table E.1-2
Evaluation of General Corrective Action Standards for the Flex Line
(Page 2 of 2)

STANDARD #4: CONTROL THE SOURCE(S) OF THE RELEASE Because there is no ongoing source of contamination, all alternatives meet this standard.		
Alternative 1 (Leave flex line pipe in place) - Least Preferred	**Alternative 2 (Cut flex line pipe at fence)**	**Alternative 3 (Move flex line pipe inside fence) - Most Preferred**
Determined to be the least preferable alternative. Although there is no cutting of the line, which could expose workers to contamination, future release would not be confined to inside the potential crater area.	Determined to be marginally less preferable. Although some control is afforded, as any future release would be confined to inside the potential crater area, cutting of the line creates more potential in the short term for release of contaminants and exposure of workers to contamination.	Although this does not change the potential for long-term release, the release would be confined to inside the potential crater area. This alternative was determined to best control potential short-term release, as there is no cutting of the line that could expose workers to contamination.

Table E.1-3
Evaluation of Remedy Selection Decision Factors for the Flex Line
(Page 1 of 2)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS All three alternatives are protective, as they address access to the contamination by establishing a UR, and provide for periodic inspections and long-term maintenance to prevent potential exposure of site workers and the public.		
Alternative 1 (Leave flex line pipe in place) - Most Preferred	**Alternative 2 (Cut flex line pipe at fence)**	**Alternative 3 (Move flex line pipe inside fence)**
Determined to be marginally less reliable, as part of the flex line pipe would remain outside the potential crater area fence. The potential crater area provides some restrictions on future uses of this site.	Determined to be equally reliable as Alternative #3 and equally preferred	Determined to be equally reliable as Alternative #2 and equally preferred.
DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME All three alternatives provide no reduction in the toxicity, mobility, or volume of the contamination.		
Alternative 1 (Leave flex line pipe in place)	**Alternative 2 (Cut flex line pipe at fence)**	**Alternative 3 (Move flex line pipe inside fence)**
All three alternatives were determined to equally meet this decision factor and are equally preferred		

Table E.1-3
Evaluation of Remedy Selection Decision Factors for the Flex Line
(Page 2 of 2)

DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS		
Alternative 1 (Leave flex line pipe in place) - Most Preferred	**Alternative 2 (Cut flex line pipe at fence) - Least Preferred**	**Alternative 3 (Move flex line pipe inside fence)**
Determined to provide marginally more short-term reliability and effectiveness than the other two alternatives, as the flex line pipe would not be disturbed and workers would not be exposed to any additional risk from exposure to potentially contaminated materials or physical risks due to implementation of the alternative.	Determined to provide marginally less short-term reliability and effectiveness than the other two alternatives, as cutting the flex line pipe would potentially expose workers to additional risk from exposure to potentially contaminated materials and the physical risks associated with cutting the line.	Determined to provide marginally more short-term reliability and effectiveness than Alternative 2 and marginally less short-term reliability and effectiveness than Alternative 1, as the flex line pipe would not be cut and workers would not be exposed to potentially contaminated materials, but some physical risks would be present due to cutting of the fence and movement of the flex line pipe.
DECISION FACTOR #4: FEASIBILITY Implementations of all three alternatives are feasible. The alternatives were evaluated based on ease of implementation.		
Alternative 1 (Leave flex line pipe in place) - Most Preferred	**Alternative 2 (Cut flex line pipe at fence) - Least Preferred**	**Alternative 3 (Move flex line pipe inside fence)**
Alternative 1 (leave flex line pipe in place) was determined to be the most feasible, as it is the easiest to implement.	Alternative 2 (cut flex line pipe at fence) was determined to be the least feasible, as it requires the most resources to implement.	Alternative 3 (move flex line pipe inside fence) was determined to be marginally more feasible than Alternative 2 and marginally less feasible than Alternative 1.
DECISION FACTOR #5: COST		
Alternative 1 (Leave flex line pipe in place) - Most Preferred	**Alternative 2 (Cut flex line pipe at fence) - Least Preferred**	**Alternative 3 (Move flex line pipe inside fence)**
Alternative 1 (leave flex line pipe in place) was estimated to be the least costly with an estimated cost of $15,000 and $500/yr.	Alternative 2 (cut flex line pipe at fence) was determined to be the most costly with an estimated cost of $75,000 and $500/yr.	Alternative 3 (move flex line pipe inside fence) was determined to have an estimated cost of $40,000 and $500/yr.

E.1.3.2 Kennebec

Based on the discussion of alternatives at the CAA meeting held on July 31, 2018, it was concluded that the CAA of no further action was not viable for Kennebec, as contamination was assumed to be present at levels exceeding the FAL. Therefore, it was concluded that only the following two alternatives would be evaluated for Kennebec in the CAA meeting:

- **Alternative 1.** Clean Closure
- **Alternative 2.** Closure in Place

E.1.3.2.1 Alternative 1 – Clean Closure

Under Alternative 1, clean closure will be implemented with the removal of the rad-chem piping system located outside the Kennebec crater area, with no modification of the rad-chem piping system inside the crater area fence. This would include the following:

- Engineering containment controls at location where the piping emerges from the crater area and will be cut.
- Developing and obtaining approval of radiation work permits.
- Developing and obtaining approval of safety work permits.
- Mobilizing equipment and personnel to perform cutting of the rad-chem piping.
- Managing the removed components of the rad-chem piping system as LLW.
- Managing the removed lead bricks from the vaults as LLW or recycling of lead bricks if possible.
- Disposing of the waste.
- Involving the Site Historic Preservation Office (SHPO) as necessary.

A radiological survey will be conducted after the removal of the rad-chem piping to ensure that contamination was not released from the piping. Verification samples will not be collected after rad-chem pipes are removed, as the results of the CAI did not indicate the presence of any significant contamination levels in the exposed portions of the rad-chem pipes outside the fence. Verification samples will be collected from the soil beneath the lead vaults after the vaults containing lead bricks are removed. The removed portion of the rad-chem piping system will be disposed of at an appropriate disposal facility. Excavated areas will be returned to surface conditions compatible with the intended future use of the site.

Closure in place will be implemented for the rad-chem piping remaining within the crater fence. An FFACO UR will be established that encompasses the physical extent of the rad-chem piping inside the crater fence.

E.1.3.2.2 Alternative 2 – Closure in Place

Alternative 2 includes the implementation of a UR around the entire rad-chem piping system. A fence will be erected around the rad-chem piping system extending outside the crater area. This UR will restrict inadvertent contact with contaminated media by prohibiting any activity that would cause a site worker to be exposed to COCs exceeding the risk evaluation basis as presented in Appendix C.

E.1.3.2.3 Evaluation and Comparison of CAAs

As presented in Section E.1.3.2, only the CAAs of clean closure and closure in place with UR met the general corrective action standards. The evaluation and comparison of CAAs during the CAA meeting held on July 31, 2018, were based on the general corrective action standards and the remedy selection decision factors, and are presented in Tables E.1-4 and E.1-5.

E.1.3.3 Area 3 Piping and Allegheny

Based on the discussion of alternatives at the CAA meeting held on September 5, 2017, it was concluded that the CAA of no further action was not viable for Area 3 Piping and Allegheny, as contamination was assumed to be present within the rad-chem piping at levels exceeding the FAL. Therefore, it was concluded that only the following two alternatives would be evaluated for Area 3 Piping and Allegheny in the CAA meeting:

- **Alternative 1.** Clean Closure
- **Alternative 2.** Closure in Place

Table E.1-4
Evaluation of General Corrective Action Standards for Kennebec

STANDARD #1: PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	
Clean Closure - Equal Preference	**Closure in Place with UR- Equal Preference**
The clean closure alternative is protective, as contamination outside the crater fence is removed, preventing future exposure. More potential dose and physical risk to remediation workers. The clean closure alternative increases the potential for environmental damage during clean-up activities. Potential for dose exceeding FALs is unlikely. This alternative meets the general standard.	The closure in place alternative is protective, as it would prevent exposure to the contamination through administrative means. Less potential dose and physical risk to remediation workers. Less environmental damage. Potential for a dose exceeding FALs is unlikely. This alternative meets the general standard.
STANDARD #2: COMPLIANCE WITH ENVIRONMENTAL CLEAN-UP STANDARDS **STANDARD #3: COMPLIANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL STANDARDS FOR WASTE MANAGEMENT**	
Clean Closure - Equal Preference	**Closure in Place with UR - Equal Preference**
The clean closure alternative complies with federal, state, and local standards. This alternative meets the general standard.	The clean closure alternative complies with federal, state, and local standards. This alternative meets the general standard.
STANDARD #4: CONTROL THE SOURCE(S) OF THE RELEASE	
Clean Closure - Preferred	**Closure in Place with UR**
Because there is no ongoing source of contamination, the clean closure alternative meets this standard. This alternative meets the general standard.	Because there is no ongoing source of contamination, the closure in place alternative meets this standard. This alternative meets the general standard.

Table E.1-5
Evaluation of Remedy Selection Decision Factors for Kennebec
(Page 1 of 2)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure - Preferred	**Closure in Place with UR**
The clean closure alternative is reliable and effective in the long term, as partial removal of the contaminated media reduces the potential for future exposure of site workers.	The closure in place alternative is protective, as it addresses access to the contamination, establishes URs, and provides for periodic inspections and long-term maintenance to reduce the potential for future exposure of site workers.

Table E.1-5
Evaluation of Remedy Selection Decision Factors for Kennebec
(Page 2 of 2)

DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME	
Clean Closure - Preferred	**Closure in Place with UR**
The clean closure alternative provides reduction of toxicity, due to the removal of the piping system and lead to the crater fence. Provides an increased waste volume.	The closure in place alternative provides no reduction of toxicity, mobility, or waste volume. No waste would be generated.
DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure	**Closure in Place with UR - Preferred**
The clean closure alternative would present a risk to site workers in the short term during implementation of the corrective action. This risk is based on the use of heavy equipment, exposure to potentially contaminated soil and debris, and travel to/from the site. The clean closure alternative is less effective.	The closure in place alternative would present minimal risk to site workers in the short term during travel to/from the site and installation/maintenance of use restriction signs. The closure in place alternative is more effective.
DECISION FACTOR #4: FEASIBILITY	
Clean Closure- Equal Preference	**Closure in Place with UR - Equal Preference**
This alternative is technically feasible and can be implemented. This alternative would require the most planning, resources, and time to implement, considering labor, equipment, transportation, and waste management and disposal. The clean closure alternative would require radiological controls and heavy equipment.	This alternative is feasible. This alternative is easily and quickly implemented, due to the limited actions involved.
DECISION FACTOR #5: COST	
Clean Closure	**Closure in Place with UR - Preferred**
$400,000 Plus SHPO costs	$25,000 $500/yr maintenance costs

E.1.3.3.1 Alternative 1 – Clean Closure

Under Alternative 1, clean closure will be implemented with the removal of the rad-chem piping system. This would include the following:

- Engineering containment controls at locations where the piping emerges from the wellhead and where piping will be cut into sections.

- Developing and obtaining approval of radiation work permits.
- Developing and obtaining approval of safety work permits.
- Mobilizing equipment and personnel to excavate the rad-chem piping.
- Mobilizing equipment and personnel to perform cutting of the rad-chem piping.
- Managing the removed rad-chem piping system as LLW.
- Disposing of the waste.

A rad survey will be conducted after the removal to ensure that contamination was not released from the rad-chem piping system cuts. The removed rad-chem piping system will be disposed of at an appropriate disposal facility.

If a rad survey indicates that radioactivity is present at levels exceeding local background after rad-chem pipes are removed, verification samples will be collected at the locations of the two highest rad survey readings.

Excavated areas will be returned to surface conditions compatible with the intended future use of the site.

E.1.3.3.2 Alternative 2 – Closure in Place

Alternative 2 includes the implementation of a UR around the entire rad-chem piping systems. This UR will restrict inadvertent contact with contaminated media by prohibiting any activity that would cause a site worker to be exposed to COCs exceeding the risk evaluation basis as presented in Appendix C.

E.1.3.3.3 Evaluation and Comparison of CAAs

As presented in Section E.1.3.3, only the CAAs of clean closure and closure in place with UR met the general corrective action standards. The evaluation and comparison of CAAs during the CAA meeting held on September 5, 2017, were based on the general corrective action standards and the remedy selection decision factors, and are presented in Tables E.1-6 and E.1-7.

Table E.1-6
Evaluation of General Corrective Action Standards for Area 3 Piping and Allegheny

STANDARD #1: PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	
Clean Closure - Preferred	**Closure in Place with UR**
The clean closure alternative is more protective, as the contamination is removed, preventing future exposure. Less potential dose to future generations. More potential dose and physical risk to site workers. Future monitoring not required. The clean closure alternative increases the potential for short-term environmental damage during cleanup activities.	Considering the remoteness of the site, proximity to the public, and depth to groundwater, the closure in place alternative is protective, as it establishes URs and provides for periodic inspections and long-term maintenance to prevent future exposure. More potential impact to future generations. Less potential dose and physical risk to site workers.
STANDARD #2: COMPLIANCE WITH ENVIRONMENTAL CLEAN-UP STANDARDS STANDARD #3: COMPLIANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL STANDARDS FOR WASTE MANAGEMENT	
Clean Closure - Equal Preference	**Closure in Place with UR - Equal Preference**
The clean closure alternative complies with cleanup standards established with the regulator through the FFACO process.	The closure in place alternative complies with closure in place standards established in the FFACO process.
STANDARD #4: CONTROL THE SOURCE(S) OF THE RELEASE	
Clean Closure- Preferred	**Closure in Place with UR**
Because there is no ongoing source of contamination, the clean closure alternative meets this standard. The clean closure alternative is more protective, as the source of the release(s) is removed. Minimizes risk to future generations.	Because there is no ongoing source of contamination, the closure in place alternative meets this standard. The closure in place alternative controls exposure by administrative controls and barriers, but does not remove hazard.

Table E.1-7
Evaluation of Remedy Selection Decision Factors for Area 3 Piping and Allegheny
(Page 1 of 2)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure - Preferred	**Closure in Place with UR**
The clean closure alternative is reliable and effective at protecting human health and the environment in the long term because removal of the contaminated media eliminates the future exposure of site workers and the environment.	The closure in place alternative is protective, as it establishes URs, and provides for periodic inspections and long-term maintenance to prevent future exposure of site workers and the public.

Table E.1-7
Evaluation of Remedy Selection Decision Factors for Area 3 Piping and Allegheny
(Page 2 of 2)

DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME	
Clean Closure - Preferred	**Closure in Place with UR**
The clean closure alternative provides no reduction of mobility but provides and increased waste volume. The clean closure alternative provides reduction of toxicity due to the removal of the piping system.	The closure in place alternative provides no reduction of toxicity or mobility but provides reduced waste volume.
DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure	**Closure in Place with UR - Preferred**
The clean closure alternative would present risk to site workers in the short term during implementation of the corrective action. This risk is based on the use of heavy equipment, exposure to contaminated soil and debris, and travel to/from the site. Short-term risks to worker due to exposure to dust and similar items and safety/occupational risks during clean closure of site.	The closure in place alternative would present minimal risk to site workers in the short term during travel to/from the site, and installation/maintenance of UR signs.
DECISION FACTOR #4: FEASIBILITY	
Clean Closure	**Closure in Place with UR - Preferred**
This alternative is technically feasible and can be implemented. This alternative would require the most planning, resources, and time to implement, considering labor, equipment, transportation, waste management, and disposal. The clean closure alternative would require radiological controls and heavy equipment, as well as the surface and/or subsurface rad-chem piping would be removed to a depth of 15 ft bgs.	This alternative is feasible. This alternative is easily and quickly implemented, due to the limited actions involved (establishing the URs).
DECISION FACTOR #5: COST	
Clean Closure	**Closure in Place with UR - Preferred**
Area 3 Piping - $800,000 Allegheny - $250,000	Area 3 Piping - $15,000 and $500/yr. Allegheny - $25,000 and $500/yr.

E.2.0 Recommended Alternatives

The CAAs for the sites that require additional corrective actions were evaluated based on technical merits focusing on reduction of toxicity, mobility and/or volume; reliability; short- and long-term feasibility; and cost. In addition to these listed technical merits, the recommended alternatives also consider cultural resources and as-low-as- reasonably-achievable (ALARA) principles during the CAA process. This process culminates in the CAA meeting, where stakeholders evaluate the alternatives based on the evaluation criteria and make a final selection of a CAA for each release site. CAA meetings were conducted for CAU 576 on September 5, 2017, and July 31, 2018. The corrective action recommendations by the stakeholders for CAU 576 are based on the assumption that activities on the NNSS will be limited to those that are industrial in nature and that the NNSS will maintain controlled access (i.e., restrict public access and residential use). Should the future land use of the NNSS change such that these assumptions are no longer are valid, additional evaluation may be necessary.

Based on the discussion of alternatives at the CAA meetings, it was concluded that the CAA of no further action was not viable for the Flex Line, Kennebec, Area 3 Piping, or Allegheny release sites, as contamination was assumed to be present within these rad-chem piping systems at levels exceeding the FAL, and chemical contamination within the vaults at Kennebec was assumed to be present at levels exceeding FALs.

It was concluded that the CAA of clean closure was not viable for the Flex Line, as the portions of this rad-chem piping system cannot be removed due to potential subsidence safety concerns. Therefore, it was concluded that the Flex Line release site would be closed under a corrective action of closure in place and would include the implementation of a UR. Three alternatives of closure in place were evaluated for the Flex Line. Closure in place with moving the flex line pipe inside the fence was the selected CAA at this site.

The CAAs of closure in place and clean closure were evaluated for Kennebec, the Area 3 Piping, Allegheny release sites. The CAAs evaluated for each release site and the selected CAAs are shown in Table E.2-1. As closure in place was the selected corrective action at all of these release sites, a UR was established at each site. These URs will restrict inadvertent contact with contaminated media by

Table E.2-1
CAAs at Release Sites

CAS	Release Site	CAAs Evaluated [a]
09-99-09	Flex Line	Leave flex line pipe in place
		Cut flex line pipe at fence
		Move flex line pipe inside fence
02-99-12	Kennebec	Clean Closure
		Closure in Place
03-99-20 and 09-99-08	Area 3 Piping and Allegheny	Clean Closure
		Closure in Place

[a] Selected CAA is highlighted.

restricting activities that would cause site workers to be inadvertently exposed to COCs. At Kennebec, a fence was erected around the portion of the rad-chem piping system extending outside the crater area.

In accordance with the Soils RBCA document (NNSA/NFO, 2014), an administrative UR was implemented as a BMP for the Waste Dump, as discussed in Section D.1.5. The administrative UR is presented in Attachment D-1.

All URs are recorded in the FFACO database, M&O Contractor GIS, and the EM Nevada Program CAU/CAS files. The development of URs for CAU 576 are based on current land use. Any use of the area within the UR for activities that are restricted by the URs will require NDEP notification.

E.3.0 Cost Estimates

The cost estimates for each of the selected CAAs for the CAU 576 release sites are presented in Table E.3-1. The initial costs are those associated with establishing the corrective action. For the Flex Line, this includes the costs associated with the following:

- Developing and obtaining approval of safety work permits.
- Mobilizing equipment and personnel to perform cutting of the fence.
- Mobilizing equipment and personnel to perform moving the flex line pipe.
- Procuring UR signs.
- Mobilizing equipment and personnel to install the UR signs.

Table E.3-1
Estimated Costs for Selected CAAs

CAS	Release Site	Selected CAA	Initial Cost	Annual Cost
CAS 09-99-09	Flex Line	Move flex line pipe inside fence	$40,000	$500
CAS 02-99-12	Kennebec	Closure in Place	$25,000	$500
CAS 03-99-20	Area 3 Piping	Closure in Place	$15,000	$500
CAS 09-99-08	Allegheny	Closure in Place	$25,000	$500
Total			$105,000	$2,000

For the other release sites, the initial costs include the following:

- Developing and obtaining approval of safety work permits.
- Procuring UR signs.
- Mobilizing equipment and personnel to install the UR signs.
- Installing fencing around the Kennebec rad-chem piping outside the crater area.

For all of the release sites, the ongoing annual costs include inspecting and occasionally replacing UR signs.

E.4.0 References

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2015). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E1739-95(2015). West Conshohocken, PA.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2017a. Title 40 CFR, Parts 260 to 282, "Hazardous Waste Management." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2017b. Title 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." Washington, DC: U.S. Government Printing Office.

EPA, see U.S. Environmental Protection Agency.

Laws, E.P., and S.A. Herman, U.S. Environmental Protection Agency. 1997. Memorandum to RCRA/CERCLA Senior Policy Managers Region I–X titled "Use of the Corrective Action Advance Notice of Proposed Rulemaking as Guidance," 17 January. Washington, DC: Offices of Solid Waste and Emergency Response, and Enforcement and Compliance Assurance.

NAC, see *Nevada Administrative Code*.

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

Nevada Administrative Code. 2015. NAC 444.842 to 444.980, "Facilities for Management of Hazardous Waste." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 18 September 2017.

Nevada Administrative Code. 2016a. 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 18 September 2017.

Nevada Administrative Code. 2016b. 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 18 September 2017

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Environmental Protection Agency. 1991. *Guidance on RCRA Corrective Action Decision Documents: The Statement of Bases, Final Decision and Response to Comments*, EPA/540/G-91/011. Washington, DC: Office of Waste Programs Enforcement.

U.S. Environmental Protection Agency. 1994. *Final RCRA Corrective Action Plan*, EPA/520-R-94-004. Washington, DC: Office of Solid Waste and Emergency Response.

U.S. Environmental Protection Agency. 1996. “Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities,” 1 May. In *Federal Register*, Vol. 61, No. 85.

Appendix F

Sample Location Coordinates

F.1.0 Sample Location Coordinates

The center of each sample plot and the locations of individual (judgmental) sample locations collected at CAU 576 were surveyed using a GPS instrument. Survey coordinates for these locations are listed in Table F.1-1

Table F.1-1
Sample Location Coordinates
(Page 1 of 2)

Location	Easting[a]	Northing[a]
A01	582423	4112499
A02	582599	4109595
A03	587257	4099599
A04	586038	4109742
A05	585856	4110575
A06	585734	4110572
A07	580785	4113774
A08	580627	4114507
A09	585474	4110399
A10	582479	4109573
A11	587377	4100266
A12	584785	4109501
A13	586027	4100153
A14	586541	4101059
A17	586435	4111343
A18	585928	4108060
A19	586567	4108628
A21	586085	4100466
A22	582547	4109590
A23	583054	4109928
A24	583403	4109783
A25	583171	4109866
A26	594660	4075216

Table F.1-1
Sample Location Coordinates
(Page 2 of 2)

Location	Easting[a]	Northing[a]
A27	594674	4075204
A28	594683	4075196
A29	594703	4075195
A30	594696	4075180
A31	594614	4075297
A32	594678	4075353
A33	586165	4108061
A34	585448	4110366
A35	582598	4109602
A36	586085	4100465

[a]UTM Zone 11, NAD 1927 (U.S. Western) in meters.

NAD = North American Datum
UTM = Universal Transverse Mercator

Appendix G

Analytical Test Results

G.1.0 Analytical Test Results

This appendix presents the analytical results for the soil samples and the TLDs collected at CAU 576. The analytical results of the investigation samples that were used to calculate doses are presented in Tables G.1-1 and G.1-2. The calculations to convert the analytical results to dose are contained in the Soils RBCA document (NNSA/NFO, 2014). The analytical results of the investigation samples that were used to evaluate chemical COPCs are presented in Table G.1-3. The results of the TLD analyses are presented in Table G.1-4.

Table G.1-1
Results for Gamma-Emitting Radionuclides Detected above MDCs

Sample Location	Sample Number	COPCs (pCi/g)				
		Ac-228	Am-241	Cs-137	Eu-152	Ag-108M
A09	AB7A008	1.33	--	6.56	8.2	--
A10	AB7A009	2.34	--	4.39	--	--
	AB7A010	1.81	--	4	--	--
A11	AB7A011	1.56	--	0.99	--	--
A12	AB7A012	1.98	7.9 J+	21.6	1.62	17.4
	AB7A501	--	1 J+	1.73	--	1.3
A26	AB7A014	1.83	120 J+	--	--	--
	AB7A015	1.6	17.7 J+	--	--	--
	AB7A016	1.43	28.4 J+	--	--	--
	AB7A017	1.55	26.5 J+	--	--	--
A27	AB7A018	1.56	222 J+	0.132	--	--
	AB7A019	1.55	330 J+	0.164	--	--
	AB7A020	1.54	332 J+	0.165	--	--
	AB7A021	1.55	198 J+	0.121	--	--
A33	AB7A026	1.59	--	0.58	--	--

J+ = The result is an estimated quantity, but the result may be biased high.
-- = Not detected above MDC.

Ac = Actinium
Ag = Silver
Eu = Europium

Table G.1-2
Results for Isotopic Radionuclides Detected above MDCs

Sample Location	Sample Number	COPCs (pCi/g)							
		Am-241	Am-243	Pu-238	Pu-239/240	Pu-241	U-234	U-235	U-238
A09	AB7A008	1.33	--	0.384	19.9	--	0.72	0.041	0.61
A10	AB7A009	0.81	--	--	0.87	--	0.67	0.029	0.7
	AB7A010	0.177	--	0.62	16.9	--	0.65	0.033	0.64
A11	AB7A011	0.209	--	0.103	2.21	--	1.21	0.07	0.92
A12	AB7A012	15.3	--	7.6	530	--	1.22	--	0.85
A26	AB7A014	26.6	--	1.7	136	40	0.77	--	0.84
	AB7A015	12.4	--	0.8	68	--	0.96	--	0.84
	AB7A016	87	0.57 J+	6	473	124	1.26	--	1.08
	AB7A017	49.3	0.26 J+	3.59	283	66	1.03	--	1.08
A27	AB7A018	169	2.14 J+	11.2	890	302	1.32	--	1.13
	AB7A019	250	1.77 J+	16.8	1410	432	1.87	--	0.96
	AB7A020	285	2.5 J+	21.8	1660	440	--	--	--
	AB7A021	147	0.93 J+	10.1	790	196	1.41	--	1.21
A33	AB7A026	2.24	--	0.312	17.8	--	0.94	--	0.73

J+ = The result is an estimated quantity, but the result may be biased high.
-- = Not detected above MDC.

Table G.1-3
Results for Chemicals Detected above MDCs
(Page 1 of 2)

Sample Location	Sample Number	COPCs (pCi/g)					
		Arsenic	Barium	Cadmium	Chromium	Lead	Mercury
A01	AB7A001	3.7	140	0.18 J	6.4	36	0.027 J
A02	AB7A002	3.2	120	0.17 J	7	630	0.035
A03	AB7A003	3.1	150	0.3 J	4	24	0.042
A04	AB7A004	3.5	230	0.33 J	4.7	230	0.033 J
A05	AB7A005	3.9	150	0.47 J	4.9	250	0.024 J
A06	AB7A006	4.2	300	0.68	5	31	0.019 J
A07	AB7A007	4	140	0.22 J	8	730	0.034

Table G.1-3
Results for Chemicals Detected above MDCs
(Page 2 of 2)

Sample Location	Sample Number	COPCs (pCi/g)					
		Arsenic	Barium	Cadmium	Chromium	Lead	Mercury
A12	AB7A501	3.4	28	--	2.5	3.6	0.0047 J
A25	AB7A013	4.1	140	0.2 J	9.1	280	0.036
A28	AB7A022	5	170	2.3	9	890	0.028 J
A29	AB7A023	5.6	210	1.9	9.3	27	0.036
A30	AB7A024	5.5	170	0.48 J	8.1	95	0.018 J
	AB7A025	4.9	180	0.79	9.5	23	0.02 J

J = Estimated value.
-- = Not detected above MDC.

Table G.1-4
Results for TLD Sample Locations at CAU 576 (mrem/OU-yr)

Sample Location	TLD Number	Element		
		2	3	4
A09	6268	1	1	1
A11	6070	0	0	0
A12	4746	1	1	1
A18	3818	1	1	1
A21	3651	0	0	0
A22	6008	0	0	0
A26	6483	0	0	0
A27	3763	1	0	0
A36	6131	0	0	0

G.2.0 References

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

Appendix H

Evaluation of Hot Spots

H.1.0 Evaluation of Hot Spots

H.1.1 Background

A methodology for the evaluation of radiological hot spots was developed to address corrective action decisions for small areas that may contain unacceptably high activities of residual radioactive material (i.e., hot spots), even though the areas do not cause a dose that exceeds the area-based FAL. Hot spots are locations of radioactivity anomalously above the surrounding area. This approach is based on the "Hot Spot Criterion for Field Application" in Section 3.3.2 of the *User's Manual for RESRAD Version 6* (Yu et al., 2001), which states the following:

> *"The derivation of remedial action criteria generally assumes homogeneous contamination of large areas (several hundred square meters or more), and the derived concentration guide is stated in terms of concentrations averaged over a 100-m^2 area. Because of this averaging process, hot spots can exist within these 100-m^2 areas that contain radionuclide concentrations significantly higher than the authorized limit. Therefore, the presence of hot spots could potentially pose a greater risk of exposure to individuals using the site than the risk associated with homogeneous contamination. To ensure that individuals are adequately protected and to ensure that the ALARA process is satisfied, the following hot spot criterion must be applied, along with the general criterion for homogeneous contamination."*

This approach is used by MARSSIM to comply with radiation protection requirements, and is fully evaluated and described in the *User's Manual for RESRAD Version 6* (Yu et al., 2001) and *Dose Modeling and Statistical Assessment of Hot Spots for Decommissioning Applications* (Abelquist, 2008). The hot spot RRMGs are based on the same computations used for the area-based RRMGs (based on an area of contamination of 1,000 m^2) that have been used throughout the Soils Activity with the only exception being that the area of contamination was reduced to 1 m^2.

H.1.2 Hot Spot RRMGs

This process produces a dose estimate that will conservatively protect potential receptors from an unacceptable dose due to a small area of elevated radioactive contamination (i.e., hot spot). The hot spot dose is calculated using the OU exposure scenario hot spot RRMGs. The area-based RRMGs are defined in the Soils RBCA document (NNSA/NFO, 2014). The hot spot RRMGs were developed using the inputs to the RESRAD code published in the Soils RBCA document for the OU exposure scenario except for a change to the area of contaminated zone parameter to represent the area of the hot spot (i.e., 1 m^2).

The resulting hot spot RRMGs (based on 1 m^2) for the OU exposure scenario are presented in Table H.1-1. Based on the area-based dose estimates of radionuclides from samples collected at the Flex Line, Kennebec, and Allegheny sites, RRMGs were developed for Cs-137, thorium (Th)-232, U-234, and U-238 as these radionuclides provide more than 99.5 percent of the dose.

Table H.1-1
Hot Spot RRMGs

	Cs-137	Th-232	U-234	U-238
OU Area-based RRMG	1,630	11,800	370,000	31,200
OU Hot Spot RRMG	24,800	110,000	10,500,000	336,000

H.2.0 References

Abelquist, E.W. 2008. *Dose Modeling and Statistical Assessment of Hot Spots for Decommissioning Applications.* University of Tennessee, Knoxville, Ph.D dissertation.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process,* Rev. 1, DOE/NV--1475-Rev. 1. 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, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 7.0 released in April 2014.)

Appendix I

Geophysical Survey Report

I.1.0 Background

Geophysical surveys were conducted by the Navarro Geophysics group in March 2017 at the Rad Waste Dump addressed under SG3 to determine whether buried metallic materials are present within the area of the suspected waste dump. The survey was conducted within the CA. The Navarro Geophysics group submitted the results, and an interpretation of the results of the geophysical survey in the report is presented in Attachment I-1.

All of the EM31 surveys were accomplished with the unit suspended from a shoulder harness. All of the EM61 surveys were conducted with the coils mounted to wheels. With the wheels attached, the bottom coil is about 40 cm ags. When the coils are suspended from the harness (rather than being mounted on the wheels), the bottom coil is about 20 cm from the land surface.

Surface metallic debris and man-made structures/materials that might be detected by the instruments and interfere with the interpretation of results were visually identified.

The data acquisition, processing, and reduction software described in Attachment I-1 are considered commercial off-the-shelf items that were used for the intended purpose without modification. All data transcriptions, reductions, and conversions were verified using a checkprint process.

Attachment I-1

Geophysical Survey

(19 Pages)

Technical Memorandum: Conduct of a Geophysical Survey at the Nevada National Security Site, Corrective Action Site 05-19-04 of Corrective Action Unit 576

Document Date: July 31, 2017

Introduction

Geophysical surveys were conducted on March 22, 2017, at Corrective Action Site (CAS) 05-19-04 belonging to Corrective Action Unit (CAU) 576. This CAS is located on Frenchman Flat.

This CAS was identified (DOE, 2016) during a review of a 1965 Frenchman Flat Quadrangle map, which noted a “radiological waste dump” (Poole, 1965) and is located on the northern edge of Frenchman Flat. When this location was inspected, it was identified as having surface soil contamination, scattered debris, and possible radiological waste. Radiological surveys and swipe samples collected during this inspection identified removable contamination in an approximately 30 by 30 foot area. This area was posted as a Contamination Area (CA).

The areas surveyed encompass the entire CA as well as some of the area surrounding the CA. The objective of the surveys was to detect if buried metallic materials are present indicating the potential for the presence of a landfill at the site.

Equipment Used

Two instruments were used to conduct the surveys:

- EM31-MK2 earth conductivity meter
- EM61-MK2A time domain metal detector

Both instruments are produced by Geonics Limited of Mississauga, Ontario, Canada.

The EM31-MK2 Earth Conductivity Meter

Figure 1 shows an EM31-MK2 in use on a survey. The instrument measures the conductivity of the materials interrogated as well as detects the presence of metal. A transmitter coil located at one end induces circular eddy current loops. Under certain conditions, the magnitude of any one of these current loops is directly proportional to the soil conductivity in the vicinity of that loop. Each one of the current loops generates a magnetic field which is proportional to the value of the current flowing within that loop. A part of the magnetic field from each loop is intercepted by the receiver coil on the opposite end of the instrument which results in an output voltage which is linearly related to the soil conductivity. The current loops surround the instrument. While detecting the presence of buried metallic objects, the instrument also detects metallic objects on the surface (e.g. surface debris, the metal legs of potable tables, etc.….).

Figure 1 Photo of the EM31-MK2 in Use (Geonics, 2012)

Both the quadrature-phase and in-phase signals were recorded. The quadrature-phase signal is the conductivity measurement and the instrument records this response in units of milli-Siemens/meter (mS/m). The in-phase measurement is recorded in units of parts per thousand (ppt). The quadrature-phase signal detects both metallic objects as well as the conductivity of the soil. Because it measures the conductivity of the soil, it can indicate areas of disturbed soil where there are still significant differences in conductivity caused by the disturbance. The in-phase signal is most sensitive to the presence of metallic objects.

The instrument was carried as shown in Figure 1. An Archer 14802 Field personal computer (PC) with integrated Hemisphere XF101 global positioning system (GPS) receiver from Juniper Systems, Inc. of Logan, Utah was used to collect the data produced by the EM31-MK2.

The survey data accompanies this memorandum. The data was reduced using the DAT31W software (Version 2.08, 2001-2012) provided by Geonics. This software allows the user to reduce the "raw" data files saved in the data-logger to files containing the Universal Transverse Mercator (UTM) coordinates of the data points, in meters, and the response values (quadrature-phase and in-phase) generated by the EM31-MK2. All location data was converted to the project standard UTM 11 North American Datum (NAD) 27 coordinate system using ArcMap Version 10 (ArcMap) by esri (esri, 2012). The EM31-MK2 response data, matched to the UTM 11 NAD 27 coordinates, was then imported into ArcMap for visualization. All of the files described above are listed with descriptions in Attachment 1 and are included with this memorandum.

The EM61-MK2A Four Channel Time Domain Metal Detector

The EM61-MK2A detects both ferrous and non-ferrous conductive objects with excellent spatial resolution. In comparison to the EM31-MK2, the EM61-MK2A is relatively insensitive to the electrical conductivity of the soil. The EM61-MK2A includes a single transmitter coil and two receiver coils. The coils are one meter by one-half meter in size. Figure 2 is a photo of the equipment with the coils mounted on wheels.

A primary magnetic field, generated by current supplied to the transmitter coil, induces eddy currents in nearby metallic objects. The induced eddy currents decay with time at a rate that is dependent on the characteristics of the object, producing a secondary magnetic field with the same rate of decay. The time-decay of the secondary magnetic field generates a signal within each of the two receiver coils, thereby detecting the presence of metal. Four channels of data are collected. The earlier channels improve the detection of smaller targets (Geonics, 2012). The instrument response is recorded in units of millivolts (mV). With the coils mounted on wheels, as shown in Figure 2, the lowermost coil is approximately 40 centimeters (cm) above the ground surface. The lowermost coil doubles as both a transmitter and receiver with the transmission occurring at 75 Hertz. When not transmitting, the same coil acts as a receiver. The uppermost coil is only used to receive the mV signals generated in nearby metallic objects.

Figure 2: Photo of the EM61-MK2A with Wheels Supporting Coils (Geonics, 2012)

The Archer field PC, with integrated GPS receiver, used with the EM31-MK2 was also used to collect the data produced by the EM61-MK2A. To improve positioning accuracy, a model 150-1013-00 patch antenna was connected to the integrated GPS receiver and mounted on the top coil of the EM61-MK2A.

The survey data (see Attachment 1, page 17) were reduced using the DAT61MK2 software (Version 2.40, 2011) provided by Geonics. This software allows the user to reduce the "raw" data files saved in the data-logger to files containing the UTM coordinates of the data points, in meters, and the four channels of data generated by the EM61-MK2A. All location data was converted to the project standard UTM 11 North American Datum (NAD) 27 coordinate system using ArcMap Version 10 by ESRI (ESRI, 2012). The EM61-MK2A response data, matched to the UTM 11 NAD 27 coordinates, was then imported into ArcMap for visualization.

General Information Regarding the EM31-MK2 and EM61-Mk2A Instrument Response Data

The strength of the instrument response is relative. It is a function of the ability of the field generated by the coils to excite a response in an object. The instrument response is affected by the size of the object, its conductivity and iron content, and the distance of the object from the coils (i.e., depth of burial). As such, a small piece of highly ferrous material at ground surface would yield a stronger response than a larger non-ferrous but conductive object also on the surface. In addition, the same piece of highly ferrous material will yield a stronger instrument response on the surface than it will if buried and is consequently further from the coils.

The field PC and Hemisphere XF101 GPS unit recorded the survey data while the GPS unit was in motion during the conduct of the surveys. The location of surface debris was determined using a Trimble GeoXT running ArcPad held stationary at each location. Each debris location was calculated using an averaging of 20 GPS epochs resulting in sub-meter positional resolution. Under optimal GPS surveying conditions, the locations reported for the surface debris measured with the Trimble and the survey response data corroborate one another within a meter or so. Under less than optimal GPS surveying conditions, the two surveys, due to the difference in the manner with which the GPS data were collected (i.e., stationary versus in motion) may be different by several meters.

The Trimble collected the data directly in UTM 11 NAD 27 (m). The survey data using the Archer field PC were collected in UTM 11 World Geodetic System (WGS) 84 coordinates, in meters. As noted above, the data were converted to the project standard of UTM 11 NAD 27 coordinates, in meters, prior to use.

Conduct of the Geophysical Surveys

The EM61-MK2A was used to survey the area of the CA. The EM31-MK2 was used to survey both the CA and the area around it, particularly to the east. The area to the east of the CA was included in the survey because some metallic debris was on the surface there. The focus of the surveys using both instruments was the search for potential disposal areas containing metallic debris. The results are used to delineate general areas for investigation/excavation or to determine that no significant buried metal is present.

As part of the survey process, surficial metallic debris and man-made structures/materials which might be detected by the instruments were identified. The locations of these items were recorded using a Trimble GEO Explorer 2008 series GPS unit running ArcPad. In addition to the locations, short descriptions of the items found were recorded as well.

Survey Results

The EM31-MK2 Surveys

The EM31-MK2 was used on March 22, 2017 to survey both within and without the CA. A total of five files were collected. The files with dates collected and descriptions of the file contents are shown in Table 1.

Table 1 EM31-MK2 Survey Files and Descriptions		
Filename	**Date of Collection**	**Description of File Content**
032209A .R31	March 22, 2017	Pre-survey instrument check
032210A.R31	March 22, 2017	Survey walked generally north-south in the CA
032210B.R31	March 22, 2017	Survey walked generally east-west in the CA
032213C.R31	March 22, 2017	Survey walked generally north-south on the west, north, and east sides of the CA
032213D.R31	April 13, 2017	Post-survey instrument check
CAU576_EM31_surveys_22MAR17_wgs84_m.xlsx	July 25, 2017	Excel workbook containing the EM31-MK2 survey data collected March 22, 2017 with WGS 84 coordinates only
CAU576_032210A-032210B_032213C_NAD27_m.xlsx	July 25, 2017	Excel workbook containing the EM31-MK2 survey data with both the WGS 84 and NAD 27 coordinates
CAU576_Metal Points_NAD27_m.xlsx	July 24, 2017	Excel worksheet listing points (e.g. fence posts and metal debris at the surface) surveyed in using a Trimble GEO Explorer 2008 series GPS unit

Files 032209A and 032213D are the pre and post-survey instrument check files for March 22, 2017. The pre-survey and post-survey instrument checks are done to verify instrument response under set conditions. For the instrument checks of the EM31-MK2, the instrument was moved to an area without metal and the daily calibration procedure conducted as specified in the instrument operator's manual. Once the daily calibration procedures were completed, the instrument was walked across a length of carbon steel pipe while recording the instrument response. For this check, the instrument was passed over the middle of the pipe with the boom oriented perpendicular to the pipe. Plots of the pre and post-survey instrument response check data are given in the Excel workbook files that accompany this memorandum. Reference to the files shows very similar instrument responses for both the pre and post-survey instrument response checks indicating the instrument response was consistent.

The R31 extension files (e.g. listed in Table 1) are the raw data files from the EM31-MK2 instrument as recorded by the Archer field PC. The DAT31W software by Geonics, Inc. was used to convert these files to first G31 extension files and then to XYZ extension files. The XYZ extension files contain the instrument response data as well as the GPS location of each data point in UTM 11 WGS 84 coordinates in meters. The data in the XYZ extension files was imported into Excel workbooks. The data in the XYZ extension files for each of the survey files (excluding the instrument response checks) was further processed using ArcMap 10.3.1 software to convert the WGS 84 coordinates to the project standard NAD 27 coordinate system.

Results Using the EM31-MK2 Earth Conductivity Meter

Figure 3 shows the combined paths walked for the EM31-MK2 surveys, the individual survey files used to create the figure, and the in-phase instrument response at each data point. Files 032210A and 032210B represent the EM31-MK2 survey files collected within the CA. File 032210A was walked generally north-south. File 032210B was walked generally east-west. File 032213C was walked outside of the CA in a generally north-south pattern. This survey includes areas along the western, northern, and eastern boundaries of the CA. The north arrows appearing on all figures in the report represent grid north, not magnetic.

The results presented in Figure 3 show only one area of relatively higher response and this corresponds to the portable tables and trash bag stand set-up at the entry to the CA. Other than the instrument response to the tables and stand, no significant instrument responses are noted in the data.

Figure 4 shows the combined paths walked for the EM31-MK2 surveys, as well as the quadrature-phase instrument response at each data point. The results presented in Figure 4 are the same as those shown in Figure 3.

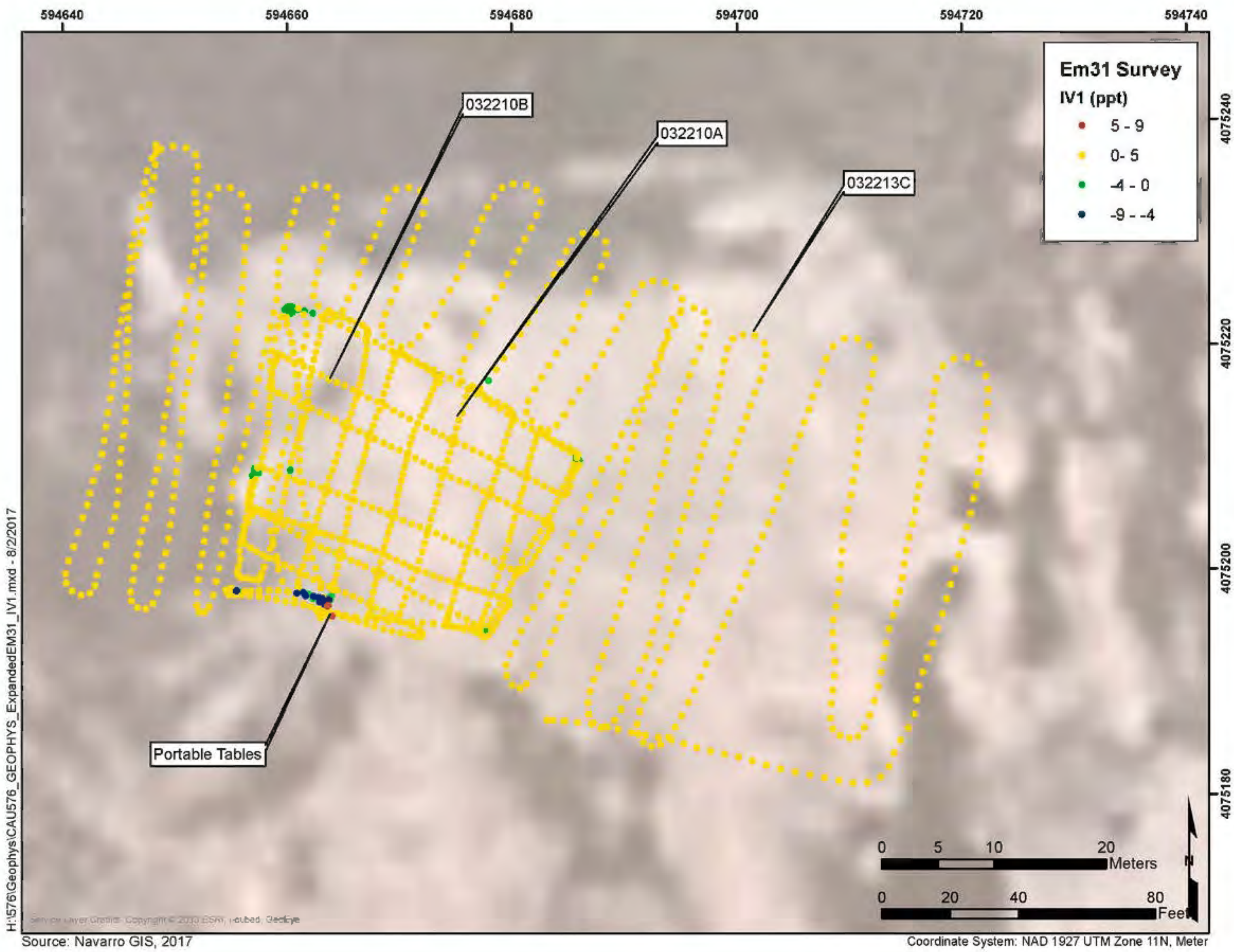


FIGURE 3 – In-Phase Point Data from the EM31-MK2 Surveys

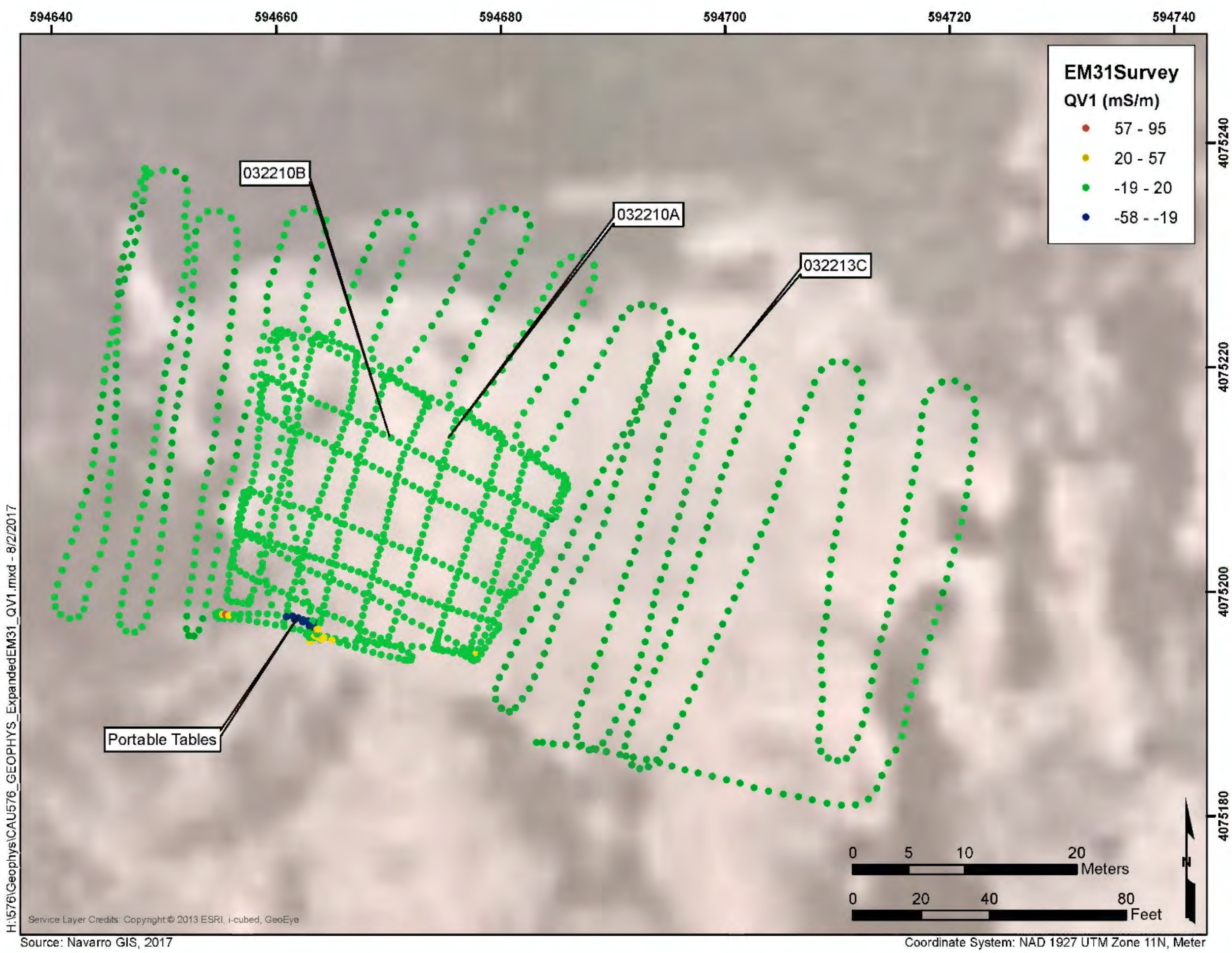


FIGURE 4 – Quadrature-Phase Point Data from the EM31-MK2 Surveys

The EM61-MK2A Surveys

The EM61-MK2A was used to survey within the CA. A total of four files were collected. The files with the associated dates of collection and descriptions of the file contents are shown in Table 2.

Files 032211A and 032214A are the pre and post-survey instrument check files for March 22, 2017. The pre-survey and post-survey instrument checks are done to verify instrument response under set conditions. For the instrument checks of the EM61-MK2A, the instrument was moved to an area without metal and a data file collected while the instrument was held static. A metal test bolt was then dropped within the coils and instrument response recorded.

Plots of the pre and post-survey instrument response check data are given in the data files that accompany this memorandum. The instrument responses for both the pre and post-survey instrument response checks are very similar indicating the instrument response was consistent.

The R61 extension files (e.g. listed in Table 2) are the raw data files from the EM61-MK2A instrument as recorded by the Archer field PC. The DAT61MK2 software by Geonics, Inc. was used to convert these files first to M61 extension files and then to XYZ extension files. The XYZ extension files contain the instrument response data as well as the GPS location of each data point in UTM 11 WGS 84 coordinates in meters. The data in the XYZ extension files was imported into Excel workbooks. The data in the XYZ extension files for each of the survey files (excluding the instrument response checks) was further processed using ArcMap 10.3.1 software to convert the WGS 84 coordinates to the project standard NAD 27 coordinate system. All of the files described above are listed with descriptions in Attachment 1 and are included with this memorandum.

Table 2 EM61-MK2A Survey Files and Descriptions		
Filename	**Date of Collection**	**Description of File Content**
032211A.R61	March 22, 2017	Pre-survey instrument check
032211B.R61	March 22, 2017	Survey walked generally north-south within the CA
032211C.R61	March 22, 2017	Survey walked generally east-west within the CA.
032214A.R61	March 22, 2017	Post-survey instrument check
CAU576_EM61_all_chan_22MAR17_WGS84_m.xlsx	July 14, 2017	Excel workbook containing the EM61-MK2A survey data collected March 22, 2017 with WGS 84 coordinates only
CAU576_EM61_032211B-032211C_all_chan_22MAR17_WGS84_NAD27_m.xlsx	July 14, 2017	Excel workbook containing the EM61-MK2 survey data with both the WGS 84 and NAD 27 coordinates
CAU576_Metal Points_NAD27_m.xlsx	July 24, 2017	Excel worksheet listing points (e.g. fence posts and metal debris at the surface) surveyed in using a Trimble GEO Explorer 2008 series GPS unit

Results Using the EM61-MK2A Four Channel Time Domain Metal Detector

Figure 5 shows the combined paths walked for the EM61-MK2A surveys, as well as the Channel 1 instrument response at each data point. Reference to Figure 5 shows the individual survey files used to create the figure. Files 032211B and 032211C represent the EM61-MK2A survey files collected within the CA. File 032211B was walked generally north-south and file 032211C was walked generally east-west.

Reference to Figure 5 shows scattered points of relatively higher instrument response. The highest Channel 1 response recorded during these surveys is 1,315 millivolts (mV) and corresponds to a metal t-post. The area interrogated by the EM61-MK2A is focused vertically; as such, it is less likely to show a strong response to metal items located to the side of it than the

EM31-MK2. Reference to Figure 5 shows that although the presence of the portable tables and trash bag stand were detected, the relative response as compared to the EM31-MK2 is muted. There is no indication of any significant buried metal at this site. Therefore, no estimated depths were calculated.

FIGURE 5 – Channel 1 Point Data from the EM61-MK2A Surveys

Conclusions

Geophysical surveys were conducted in the CA at CAS 05-19-04 belonging to CAU 576. The surveys were conducted using both an EM31-MK2 earth conductivity meter and EM61-MK2A four channel time domain metal detector produced by Geonics Limited of Mississauga, Ontario, Canada. The pre and post-survey instrument check runs were normal indicating that both instruments were functioning properly.

The instruments detected some minor metal at the surface (e.g. metal t-post, debris) however, the anomalies were explained by the surface debris. The highest instrument response is due to a metal t-post installed within the CA as noted in Figure 5. The conclusion is there is no disposal pit containing metallic debris at this site.

References

DAT31W Software, 2001-2012, Version 2.08
http://geonics.com/

DAT61MK2 Software, 2011, Version 2.40
http://geonics.com/

ESRI, 2012. ArcMap Version 10.
http://www.esri.com/software/arcgis

Geonics, 2012.
http://geonics.com/

Golden Software, 2012. Surfer Version 11.6.1159 (64-bit)
http://www.goldensoftware.com/products/surfer/surfer.shtml

Poole, F.G. 1965. *Geologic Map of the Frenchman Flat Quadrangle, Nye, Lincoln, and Clark Counties, Nevada*, TEI-848, Map GQ-456, scale 1:24,000. Washington, DC: U.S. Geological Survey.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2016. *Corrective Action Investigation Plan for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site*, *Nevada*, Rev. 1, DOE/NV—1551-REV1. Las Vegas, NV

ATTACHMENT 1	
EM31-MK2 Files	
032209A .R31	EM31-MK2 raw data file containing pre-survey instrument check
032210A.R31	EM31-MK2 raw data file containing survey walked generally north-south in the CA
032210B.R31	EM31-MK2 raw data file containing survey walked generally east-west in the CA
032213C.R31	EM31-MK2 raw data file containing survey walked generally north-south on the west, north, and east along the sides of the CA
032213D.R31	EM31-MK2 raw data file containing post-survey instrument check
032209A .G31	Intermediate process file produced using the 31DATW software
032210A.G31	Intermediate process file produced using the 31DATW software
032210B.G31	Intermediate process file produced using the 31DATW software
032213C.G31	Intermediate process file produced using the 31DATW software
032213D.G31	Intermediate process file produced using the 31DATW software
032209A_WGS84_m.xyz	Final process file produced using the 31DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
032210A_WGS84_m.xyz	Final process file produced using the 31DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
032210B_WGS84_m.xyz	Final process file produced using the 31DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
032213C_WGS84_m.xyz	Final process file produced using the 31DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
032213D_WGS84_m.xyz	Final process file produced using the 31DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
CAU576_EM31_surveys_22MAR17_wgs84_m.xlsx	Excel workbook containing the EM31-MK2 survey data collected March 22, 2017 with UTM 11 WGS 84 (m) coordinates only
CAU576_032210A-032210B_032213C_NAD27_m.xlsx	Excel workbook containing the EM31-MK2 survey data with both the WGS 84 and NAD 27 coordinates

ATTACHMENT 1 (Continued…)	
EM31-MK2 Files	
CAU576_Metal Points_NAD27_m.xlsx	Excel worksheet listing points (e.g. fence posts and metal debris at the surface) surveyed in using a Trimble GEO Explorer 2008 series GPS unit. Coordinates are in UTM 11 NAD 27 (m)
EM61-MK2A Files	
032211A.R61	EM61-MK2A raw data file containing pre-survey instrument check
032211B.R61	EM61-MK2A raw data file containing survey walked generally north-south within the CA
032211C.R61	EM61-MK2A raw data file containing survey walked generally east-west within the CA.
032214A.R61	EM61-MK2A raw data file containing post-survey instrument check
032211A.M61	Intermediate process file produced using the 61DATW software
032211B.M61	Intermediate process file produced using the 61DATW software
032211C.M61	Intermediate process file produced using the 61DATW software
032214A.M61	Intermediate process file produced using the 61DATW software
032211A_WGS84_m.xyz	Final process file produced using the 61DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
032211B_WGS84_m.xyz	Final process file produced using the 61DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
032211C_WGS84_m.xyz	Final process file produced using the 61DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).
032214A_WGS84_m.xyz	Final process file produced using the 61DATW software. File contains the instrument response as well as the location data for each data point. Coordinates in UTM 11 WGS 84 (m).

ATTACHMENT 1 (Continued…)	
EM61-MK2A Files	
CAU576_EM61_all_chan_22MAR17_WGS84_m.xlsx	Excel workbook containing the EM61-MK2A survey data collected April 12-13, 2017 with UTM 11 WGS 84 (m) coordinates only
CAU576_EM61_032211B-032211C_all_chan_22MAR17_WGS84_NAD27_m.xlsx	Excel workbook containing the EM61-MK2 survey data with both the WGS 84 and NAD 27 coordinates
CAU576_Metal Points_NAD27_m.xlsx	Excel worksheet listing points (e.g. fence posts and metal debris at the surface) surveyed in using a Trimble GEO Explorer 2008 series GPS unit. Coordinates are in UTM 11 NAD 27 (m).

Appendix J

Nevada Division of Environmental Protection Comments

(9 Pages)

NEVADA ENVIRONMENTAL MANAGEMENT OPERATIONS ACTIVITY
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Revision 0, November 2018	2. Document Date: November 2018
3. Revision Number: 0	4. Originator/Organization: Navarro
5. Responsible DOE EM Nevada Program Activity Lead: Kevin Cabble	6. Date Comments Due: December 3, 2018
7. Review Criteria: Full	
8. Reviewer/Organization Phone No.: Chris Andres (702) 486-2850 ext. 232	9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
1.	Section 1.0, Page 1, 2nd Paragraph		There is a minor typographical error in the first sentence. The second "is" should be removed.	The second "is" was removed as suggested.
2.	Figure 1-1, Page 3		If possible, please add the CAS numbers to the individual text boxes containing the names of the CASs for ease of reference.	The CAS numbers were added to the text boxes in Figure 1-1 as requested.
3.	Figure 1-2, Page 4		If possible, please add the CAS number under the title of this Figure for ease of reference. Also, this Figure and Figure A.6-3 should probably be identical in labeling.	The CAS numbers were added to all study group figure titles. Figure titles for Figures 1-2 and A.6-3 were made consistent in labeling but show different features.
4.	Section 2.1.1, Page 10, 3rd Paragraph, 1st and 2nd Sentences and 4th Paragraph		Please add the sample location numbers in parenthesis in the text of each of these sentences as this will greatly aid the reader when reading through this main part of the CADD/CR.	Sample location numbers were added as suggested.
5.	Section 2.1.2, Page 11, Kennebec, 2nd and 3rd Paragraphs		See Comment No. 4, above. Additionally, the "pipe joint near the pipe termination" location does not appear to be shown on Figure A.4-6 (see Comment No. 15, below).	Sample location numbers were added as requested. The term "pipe joint" was changed to "large pipe flange" throughout the document. The large flange is labeled on Figure A.4-6.

[a]Comment Types: M = Mandatory, S = Suggested.
Return Document Review Sheets to NNSA/NFO Environmental Management Operations Activity, Attn: QAC, M/S NSF 505

NEVADA ENVIRONMENTAL MANAGEMENT OPERATIONS ACTIVITY
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Revision 0, November 2018	2. Document Date: November 2018
3. Revision Number: 0	4. Originator/Organization: Navarro
5. Responsible DOE EM Nevada Program Activity Lead: Kevin Cabble	6. Date Comments Due: December 3, 2018
7. Review Criteria: Full	
8. Reviewer/Organization Phone No.: Chris Andres (702) 486-2850 ext. 232	9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
6.	Section 2.1.2, Page 12, Area 3 Piping, 2nd and 3rd Paragraphs		See Comment No. 4, above. Additionally, the additional TLD mentioned in the second paragraph, last sentence does not appear to be shown on Figure A.4-7. Or, is it A21? Regarding the conclusions stated in the third paragraph, what were the results of the additional TLD mentioned in the last sentence of the preceding paragraph?	Sample location numbers were added as suggested. The results from the additional TLD at location A21 were added to the text.
7.	Section 2.1.2, Page 13, Allegheny, 3rd and 4th Paragraphs		See Comment No. 4, above.	Sample location numbers were added as suggested.
8.	Section 2.1.3, Page 14, 1st Partial Paragraph, 1st Partial Sentence		How are the four composite soil samples from each of the two sample plots shown on Figure A-5.1? Also, the sample number for the TLD should be added to the text of this paragraph.	Sample location numbers for the two sample plots were added as suggested. The TLD samples were collected from the same locations as the sample plots. See response to Comment #18 concerning revised descriptions of sample plots.
9.	Section 2.1.4, Pages 14 and 15, 2nd Paragraph, 3rd and 4th Sentences		See Comment No. 4, above.	Sample location numbers were added as suggested.

[a]Comment Types: M = Mandatory, S = Suggested.
Return Document Review Sheets to NNSA/NFO Environmental Management Operations Activity, Attn: QAC, M/S NSF 505

NEVADA ENVIRONMENTAL MANAGEMENT OPERATIONS ACTIVITY
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Decision Document/Closure Report for Corrective Action Unit 576: Miscellaneous Radiological Sites and Debris, Nevada National Security Site, Nevada, Revision 0, November 2018	2. Document Date: November 2018
3. Revision Number: 0	4. Originator/Organization: Navarro
5. Responsible DOE EM Nevada Program Activity Lead: Kevin Cabble	6. Date Comments Due: December 3, 2018
7. Review Criteria: Full	
8. Reviewer/Organization Phone No.: Chris Andres (702) 486-2850 ext. 232	9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
10.	Section 2.1.4, Page 15, 1st Full Paragraph, 3rd Sentence		The phrase "verification plot samples" is used in this sentence in reference to verification samples that were collected beneath each lead item. However, throughout the document various phrases are used in reference to the "verification plot samples" (e.g., Figure A.6-3, the first phrase on Page A-49, etc.). It is suggested that a consistent phrase be used throughout the document whenever the "verification plot samples" are being discussed.	Terminology discussing the verification plot samples at SG4 was made consistent throughout the document.
11.	Section 2.2, Page 15, 2nd Paragraph, 1st Sentence		Although this sentence does reference the reader to Appendix C, as this is the main part of the CADD/CR, a short explanation of how the determination to use the OU vs IA scenario should be provided.	Added the following text to the end of the paragraph: "In the DQO meeting on June 14, 2016, the most exposed individual (MEI) (based on current and future land use at the NNSS) was defined as a worker who could occupy these locations on an occasional and temporary basis, such as a military exercise. Release locations in CAU 576 are remote locations without any site improvements and where no regular work is performed. Therefore, the potential exposure to the MEI who uses locations within CASs in CAU 576 is conservatively represented by the OU exposure scenario. Additional discussion on the selection of the exposure scenario is provided in Appendix C. Although DQO decisions are resolved based on this scenario, dose is also presented in this document based on the Industrial Area (IA) scenario for informational purposes only."

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3. Revision Number: 0	4. Originator/Organization: Navarro
5. Responsible DOE EM Nevada Program Activity Lead: Kevin Cabble	6. Date Comments Due: December 3, 2018
7. Review Criteria: Full	
8. Reviewer/Organization Phone No.: Chris Andres (702) 486-2850 ext. 232	9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
12.	Sections 2.2.1.1 to 2.2.1.4, Pages 16 - 19		Please add the sample numbers in parenthesis throughout these paragraphs where appropriate. Also, as this overall section (2.2) is "Results," please add the actual results of the TLDs, soils samples, ISOCS in the appropriate places in the paragraphs in lieu of only stating all these results did not exceed a FAL. Or at least reference the sections of this document where actual results may be found.	Sample location numbers were added as suggested. Added results tables to Section 2.2.1 and TLD results to Appendix G. Added cross references in text to results tables and Appendix G. Added the following text to the end of Section 2.1 and following the first sentence of Section A.2.2.1: "The ISOCS measurements were used as informational data per the Soils Activity QAP (NNSA/NSO, 2012). Informational data do not directly affect DQOs, but provide information to support conceptual models and guide investigations. ISOCS estimates are highly dependent upon the modeled geometry of the contaminated material and the piping containing the contamination. As such, the dose estimates are approximations that are useful for providing information but will not be used to make corrective action decisions."
13.	Section A.2.3.2, Page A-8, 1st Paragraph		Please provide a description of each of the four elements or a reference where such a description may be found.	Added a reference to the Soils RBCA document (NNSA/NFO, 2014).
14.	Section A.4.1.2, Page A-22, 1st and Second Full Paragraphs		Are there figures on which the areas of detected elevated radiological readings are shown?	Radiological survey results were added to Figure A.4-7.

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15. Section A.4.1.3, Page A-22, 1st Paragraph, 2nd Sentence		The last measurement is said to have been taken "within the pipe termination area (location A10)." The last paragraph on Page 11 states " ... and at a pipe joint near the pipe termination." Figure A.4-6 states "Pipe Termination" in the text box. Please make the wording in all these references to the same location consistent so the reader is confident of the actual location of the sample.	Reference to ISOCS location A10 at Kennebec was changed to "at a large pipe flange near the pipe termination" throughout the document. In Figure A.4-6, there is a reference to the "large flange" at location A10. No change was made to the figure.
16. Section A.4.1.6, Page A-27, 1st Paragraph, 2nd Paragraph, and Figure A.4-7		Is it possible to overlay the black TLD cross over a red ground zero star on the figure. The current depiction docs not clearly indicate a TLD location.	Figure A.4-7 was revised to make the symbols clearer.
17. Section A.5.1.2.1, Page A-39, 1st Full Paragraph, 3rd Sentence and Figure A-5-1		The phrase "in the inset" should be added between "shown" and "on" in the sentence. Also, "Background Location" should be added to the title of the Figure.	The sentence and figure title were revised as suggested.

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18.	Section A.5.1.2.3, Page A-41		The size of the sample plots should be added to this paragraph.	Inserted the following in the second paragraph of Section 2.1: "Sampling was conducted from 10-by-10-m sample plots as prescribed in the CAIP (NNSA/NFO, 2016) and the Soils RBCA document (NNSA/NFO, 2014) except for verification samples described in Section 2.1.4." Inserted the following in the third paragraph of Section 2.1.4: "Verification samples at the two lead-acid battery locations were from 3-by-3-ft plots, and all other verification samples were collected from 2-by-2-ft plots."
19.	Section A.5.3, Page A-43		A reference to Sections C.1.4, C.1.7 and C.1.10 should be added to this section so the reader will be able to understand the significance, or lack thereof, of the value of 26 for the 95 percent UCL of the average TED for the IA-yr. This value is referenced on Page A-58 in the first full paragraph and on Page D-3 as being addressed by a BMP but the full explanation of the OU vs IA scenarios is given in Sections C.1.4 and C.1.7 and C. l. l 0. As stated in Comment No. 11, above, an explanation of the differences and/or use of the OU vs IA scenarios should be added to the main section of this CADD/CR document and not be explained only in the Appendices given that the appendices move back and forth between discussions of the use of OU and IA scenarios.	See response to Comment #11.
20.	Section A.6.1.4, Page A-49, 3rd Paragraph		There is a minor typographical error at the end of the second sentence. The period is missing.	A period was added to the end of the sentence as suggested.

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21.	Section A.9.0, Page A-57, 4th Paragraph, 4th Sentence		There is a minor typographical error at the beginning of this sentence. The "B" should be capitalized.	The "b" was capitalized as suggested.
22.	Section B.1.1.3.1, Page B-3, 1st Paragraph, 1st Sentence		The verb tense in this sentence should be corrected.	The sentence was modified to: "...assumption that subsurface piping exceeds the radiological FAL and requires corrective action."
23.	Section B.1.1.3.1, Page B-3, 3rd Paragraph, 2nd Sentence		"...one ISOCS sampling locations..." should be "...one ISOCS sampling location..."	The tense was corrected to be singular, as suggested.
24.	Page B-4		The sentence beginning with "Decision II was resolved..." does not make sense and it does not answer the question posed in the first sentence of Section B.1.1.2. Also, the sentence, "No Decision II samples were required to resolve the physical extent of the piping." does not really make sense. I believe the intent of these sentences could be stated more clearly, perhaps with the wording used in the last sentence of the first bullet (Results) under Section B.1.6.3 on Page B-15.	The first sentence in question was replaced with: "Decision II was resolved as the physical extent of the piping." The second paragraph under "SG2 (Subsurface Rad-Chem Piping)" was replaced with: "Samples were collected at the pipe terminations for both the Kennebec and Allegheny sites to determine whether COC contamination is present that extends beyond the extent of the piping. The Kennebec sample location was determined visually, and the Allegheny location was determined by a geophysical survey. Decision II for both sites was resolved as the physical extent of the piping."

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25.	Section C.1.10, Page C-7, 3rd Paragraph, 4th Sentence		The wording of this sentence is a bit awkward in the use of the last phrase. It should be reworded as appropriate.	The sentence was replaced with: "The facility managers responsible for the area of CAU 576 identified the activities of fencing, posting, maintenance, and military use as the general types of work activities that are currently conducted at the site."
26.	Section C.2.0, Page C-10, 1st Paragraph, Last Sentence		Please explain what "for FFACO decision-making purposes only" means.	The text: "FFACO decision-making purposes only" was replaced with: "resolving corrective action DQO decisions."
27.	Attachment D-1, Page 1 of 2 for CAS 02-99-12, Contaminants Table		It is not clear why "Metallic lead bricks" is listed in the "Maximum Concentration" column for "Lead." It seems that the entry in this block should be either '"unknown" or a specific value.	That text is not in the current UR form that replaced the referenced UR form.
28.	Attachment D-1, Page 1 of 2 of CAS 03-99-20, Basis for FFACO UR(s), Summary Statement		It is suggested that "in subsurface piping" be added between "...be present" and "that exceed…" in the second sentence.	This is standard text in the new UR form.

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The following two comments were received in a Jan. 22, 2019, email from Christine Andres.			
29.		Is the ending depth of 5 centimeters correct for the Rad Waste Dump? All the other forms list "meters."	The Rad Waste Dump was investigated as a potential landfill, but it was determined that there is no buried waste present. The 5-cm depth is sufficient to encompass the contamination, as it is only on the surface. To clarify, the following text was added to the end of Section A.5.3: "However, contamination is present in surface soil (less than 5 cm) that warrants a best management practice (BMP) of an administrative UR, as the estimated dose at location A27 could exceed 25 mrem/IA-yr if full-time industrial activities were to occur at this site."
30.		What is the reason that there is no General Location of Site Features map for the Rad Waste Dump and Rad-Chem Piping URs? The supplemental map is really quite helpful, I believe.	Based upon previous discussions, the supplemental information maps are not part of the URs and will not be included in closure documents. When requested, a supplemental information report will be generated that contains a supplemental information map and contaminant information as available. In this case, there is no other information in the vicinity of these CASs that is not already shown on the UR maps. Therefore, no supplemental information map was created.
In additional to comments received from NDEP, the following changes were made to the CADD/CR document.			
Appendix D, Attachment D-1	The UR forms in the draft document were replaced with updated UR forms from the new UR Module within the FFACO Database. The UR maps were also updated to standards used in this new module.		
General	Editorial corrections were incorporated within the document, as necessary.		

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