Nevada
Environmental
Management
Operations Activity

DOE/NV--1512

National Nuclear Security Administration

Corrective Action Decision Document/ Closure Report for Corrective Action Unit 570: Area 9 Yucca Flat Atmospheric Test Sites Nevada National Security Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

November 2013

UNCLASSIFIED

/s/ Joseph P. Johnston 11/21/2013
Joseph P. Johnston, N-I CO Date

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U.S. Department of Energy
National Nuclear Security Administration
Nevada Field Office

DOE/NV--1512

CORRECTIVE ACTION DECISION DOCUMENT/ CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 570: AREA 9 YUCCA FLAT ATMOSPHERIC TEST SITES NEVADA NATIONAL SECURITY SITE, NEVADA

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

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CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 570: AREA 9 YUCCA FLAT ATMOSPHERIC TEST SITES NEVADA NATIONAL SECURITY SITE, NEVADA

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List of Acronyms and Abbreviations

AF	Additivity Factor
ags	Above ground surface
Am	Americium
ANPR	Advanced 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
CD	Certificate of Disposal
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
cm	Centimeter
COC	Contaminant of concern
COPC	Contaminant of potential concern
CPM	Counts per minute
CPS	Counts per second
CR	Closure report
CrVI	Hexavalent chromium
Cs	Cesium
CSM	Conceptual site model

List of Acronyms and Abbreviations *(Continued)*

day/yr	Days per year
DCB	Default contamination boundary
DOE	U.S. Department of Energy
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
Eu	Europium
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FIDLER	Field instrument for the detection of low-energy radiation
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
gal	Gallon
GIS	Geographic Information Systems
GPS	Global Positioning System
GZ	Ground zero
HCA	High-contamination area
hr/day	Hours per day
in.	Inch
kt	Kiloton
LCS	Laboratory control sample
LLW	Low-level waste
LVF	Load Verification Form

List of Acronyms and Abbreviations *(Continued)*

m	Meter
m^2	Square meter
m^3	Cubic meter
MDC	Minimum detectable concentration
mg/L	Milligrams per liter
MLLW	Mixed low-level waste
M&O	Management and operating
mrem/IA-yr	Millirem per Industrial Area year
mrem/OU-yr	Millirem per Occasional Use Area year
mrem/RW-yr	Millirem per Remote Work Area year
mrem/yr	Millirem per year
mV	Millivolt
N/A	Not applicable
NAC	*Nevada Administrative Code*
NAD	North American Datum
NaI	Sodium iodide
NDEP	Nevada Division of Environmental Protection
NIST	National Institute of Standards and Technology
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
PAL	Preliminary action level
PC	Personal computer
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
PPE	Personal protective equipment

List of Acronyms and Abbreviations *(Continued)*

PRG	Preliminary Remediation Goal
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAP	Quality Assurance Plan
QC	Quality control
r^2	Coefficient of determination
RadCon	Radiological Control
RALLW	Regulated asbestos low-level waste
RBCA	Risk-based corrective action
RCRA	*Resource Conservation and Recovery Act*
RMA	Radioactive material area
RPD	Relative percent difference
RRMG	Residual radioactive material guideline
RSL	Regional screening level
RWMC	Radioactive Waste Management Complex
SCL	Sample collection log
SDG	Sample delivery group
Sr	Strontium
SVOC	Semivolatile organic compound
TBD	To be determined
Tc	Technetium
TED	Total effective dose
TLD	Thermoluminescent dosimeter
TMMC	Toxco Materials Management Center
TRS	Terrestrial radiological survey

List of Acronyms and Abbreviations *(Continued)*

U	Uranium
UCL	Upper confidence limit
UGTA	Underground test area
UR	Use restriction
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
WCL	Waste Container Log
WGS	World Geodetic System
yd^3	Cubic yard
μR/hr	Microroentgens per hour

Executive Summary

This Corrective Action Decision Document/Closure Report presents information supporting the closure of Corrective Action Unit (CAU) 570: Area 9 Yucca Flat Atmospheric Test Sites, Nevada National Security Site, Nevada. This 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; U.S. Department of Defense; and DOE, Legacy Management. CAU 570 comprises the following six corrective action sites (CASs) located in Area 9 of the Nevada National Security Site:

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 570 based on the implementation of the corrective action listed in Table ES-1.

Table ES-1
CAU 570 CASs

CAS Number	CAS Name	Corrective Action
02-23-07	Atmospheric Test Site - Tesla	Clean Closure
09-23-10	Atmospheric Test Site T-9	Closure in Place
09-23-11	Atmospheric Test Site S-9G	Closure in Place
09-23-14	Atmospheric Test Site - Rushmore	No Further Action
09-23-15	Eagle Contamination Area	Closure in Place
09-99-01	Atmospheric Test Site B-9A	Clean Closure

Corrective action investigation (CAI) activities were performed from October 12, 2012, through September 18, 2013, as set forth in the *Corrective Action Investigation Plan for Corrective Action Unit 570: Area 9 Yucca Flat Atmospheric Test Sites* 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 locations and types of releases present. To facilitate site investigation and DQO decisions, all identified releases (i.e., CAS components) were organized into study groups as listed in Table ES-2.

Table ES-2
CAU 570 Study Groups

Number	Description	FFACO CASs
Group 1	Atmospheric Tests	02-23-07, 09-23-14, 09-99-01
Group 2	Safety/Low-Yield Tests	09-23-10, 09-23-11
Group 3	Debris/Spills	02-23-07, 09-23-10, 09-23-11, 09-23-14, 09-23-15, 09-99-01
Group 4	Migration/Mechanical Disturbance	02-23-07, 09-23-10, 09-23-11, 09-23-14, 09-23-15, 09-99-01

The investigation results and the evaluation of DQO decisions are reported at the study group level. The corrective action alternatives (CAAs) were evaluated at the FFACO CAS level.

The purpose of the CAI was to fulfill the data needs as defined during the DQO process. The CAU 570 dataset of investigation results was evaluated based on a data quality assessment. This assessment determined the dataset is complete and acceptable for use in fulfilling the DQO data needs.

Investigation results were evaluated against final action levels (FALs) established in this document. A radiological dose FAL of 25 millirem per year was established based on the Occasional Use Area exposure scenario (80 hours of annual exposure). As a result of the CAI, it was determined that radiological doses exceeding the FAL were present at CAS 02-23-07, thus requiring corrective action. It was assumed that radionuclides were present at levels that require corrective action within a fenced mound of soil and debris located east of the U9av crater associated with CAS 09-23-15 and underground radioactive material areas associated with CASs 09-23-10 and 09-23-11. It is also assumed that potential source material (PSM) in the form of lead bricks/plates and a lead-acid battery at CAS 09-99-01 exceeds the FAL.

During the CAI, two clean closure activities were conducted. A small area of soil located at sample location A137 was identified as containing radiological contamination exceeding the FAL. Subsequently, during the CAI, this soil was removed to reduce the radiological contamination to below the FAL. Additionally, it was determined during the CAI that lead bricks/plates and a lead-acid battery were PSM. Therefore, corrective actions were undertaken to remove the PSM and affected soil.

Recommended corrective actions were developed based on an evaluation of analytical data from the CAI and the detailed and comparative analysis of the potential CAAs. The preferred CAAs were evaluated 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 DOE, National Nuclear Security Administration Nevada Field Office provides the following recommendations:

- No further corrective actions are necessary for CAU 570.
- The Nevada Division of Environmental Protection should issue a Notice of Completion to DOE, National Nuclear Security Administration Nevada Field Office for CAU 570 closure.
- CAU 570 should be moved from Appendix III to Appendix IV of the FFACO.

1.0 Introduction

This Corrective Action Decision Document (CADD)/Closure Report (CR) presents information supporting closure of Corrective Action Unit (CAU) 570, Area 9 Yucca Flat Atmospheric Test Sites, located at the Nevada National Security Site (NNSS), Nevada. The corrective actions described in this document were implemented 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; U.S. Department of Defense; and DOE, Legacy Management. The NNSS is located approximately 65 miles northwest of Las Vegas, Nevada.

CAU 570 comprises the six corrective action sites (CASs) shown on Figure 1-1 listed below:

- 02-23-07, Atmospheric Test Site - Tesla
- 09-23-01, Atmospheric Test Site T-9
- 09-23-11, Atmospheric Test Site S-9G
- 09-23-14, Atmospheric Test Site - Rushmore
- 09-23-15, Eagle Contamination Area
- 09-99-01, Atmospheric Test Site B-9A

A detailed CAU history is presented in the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 570: Area 9 Yucca Flat Atmospheric Test Sites, Nevada National Security Site, Nevada* (NNSA/NSO, 2012a).

1.1 Purpose

This CADD/CR provides documentation and justification for the closure of CAU 570. This includes a description of investigation activities, data evaluations, and corrective actions performed. For details on scope and planning, refer to the CAIP (NNSA/NSO, 2012a)

CAU 570 consists of six inactive CASs on the NNSS. CAS 02-23-07 (referred to as Tesla in this document), the third of the Teapot series, was a weapons-related test detonated at the T-9b tower site atop a 300-foot (ft) tower. The test was detonated on March 1, 1955, and had a yield of 7 kilotons (kt) (Maag et al., 1981).

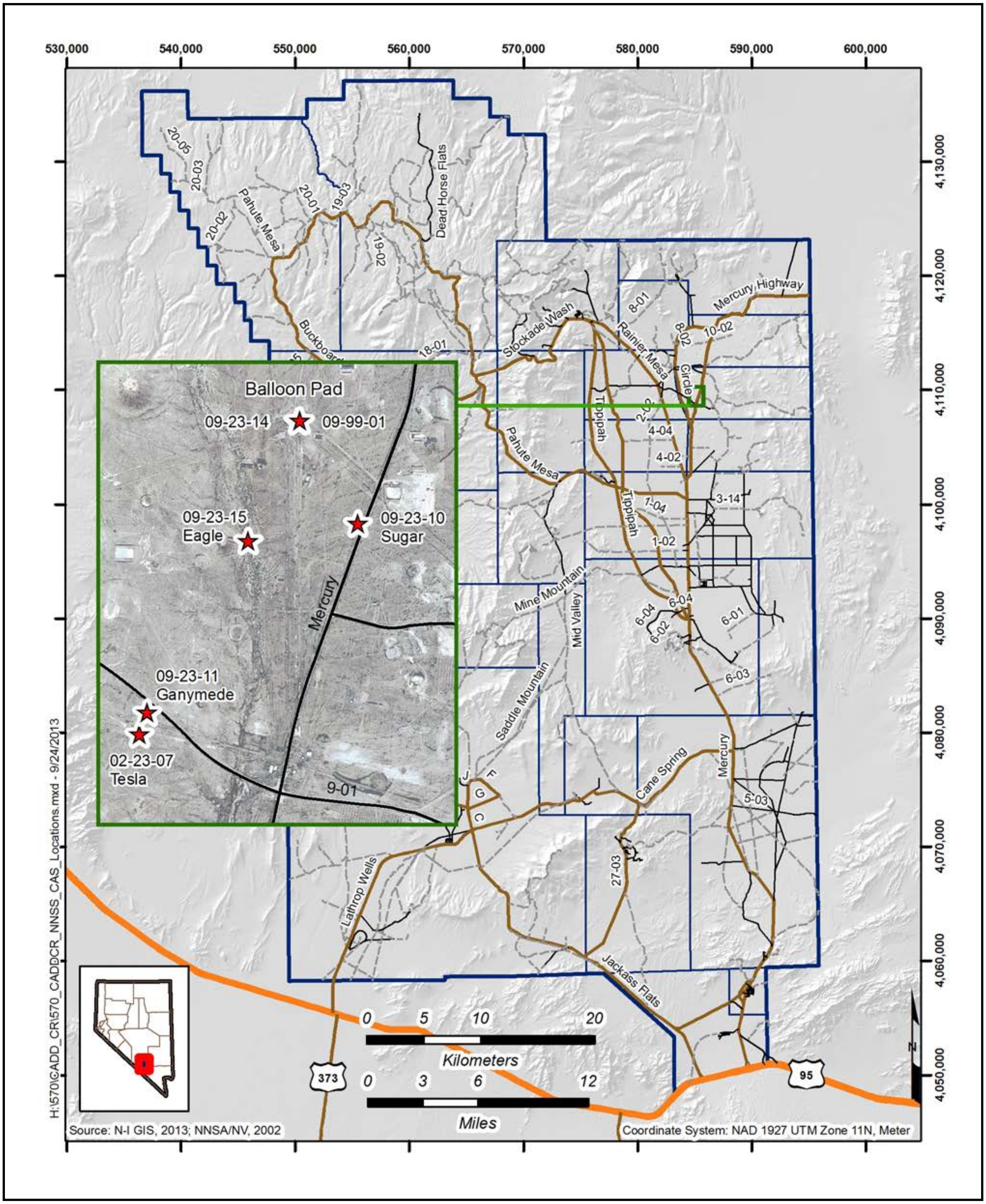

Figure 1-1
CAU 570, CAS Location Map

CAS 09-23-10 (referred to as Sugar in this document), the sixth nuclear test of Operation Buster-Jangle, the first of the Jangle phase, was a weapons-effects test detonated from a 1-meter (m) platform. The detonation created a crater 28 m in diameter by 6.4 m deep. Test objectives included evaluating civil or military effects of a nuclear detonation on various targets such as military hardware. The test was detonated on November 19, 1951, and had a yield of 1.2 kt (GE, 1979).

CAS 09-23-11 (referred to as Ganymede in this document), the 36th test of Operation Hardtack II, was a safety experiment detonated at ground level inside a gravel containment that consisted of a wooden structure covered with 20 ft of gravel. The test took place on October 30, 1958, and had zero yield (H&N, 1959). Ganymede was previously investigated under the Industrial Sites CAU 139 and was identified as CAS 09-23-01. As a result of that investigation, an FFACO use restriction (UR) was established at the fence line of the radioactive material area (RMA) that surrounds the site.

CAS 09-23-14 (referred to as Rushmore or Balloon Pad in this document), the 23rd test of Operation Hardtack II, had a device detonated at the B-9A balloon pad after rehabilitation of the pad. (***Note:*** It is impossible to separate the contamination generated as a result of the Rushmore test from the other tests conducted at the B-9A balloon pad; therefore, CAS 09-23-14 is often referred to as Balloon Pad in this document along with CAS 09-99-01.) The device was suspended 500 ft in the air from a 67-ft-diameter balloon tethered to the B-9A pad. The weapons-related test took place on October 22, 1958, and had a yield of 188 tons (H&N, 1959).

CAS 09-23-15 (referred to as Eagle in this document), is a fenced mound of soil and debris located east of the U9av crater. The fenced area is less than 0.5 acres and is posted as a high-contamination area (HCA). Eagle, the 17th test of Operation Niblick, was a weapons-related test that took place on December 12, 1963, and had a yield of 5.3 kt (DOE/NV, 2000). During the Eagle test, the line-of-sight pipe ruptured, venting nuclear material to the atmosphere while damaging and scattering the pipe cap as well as associated structures and experiments (Olsen, 1964). The contaminated debris and soil from the Eagle test were collected in a mound, and later fenced and identified as an HCA.

CAS 09-99-01 (referred to as Balloon Pad in this document) was the site of seven weapons-related balloon tests in 1957 as part of Operation Plumbbob. The contamination from the tests was due primarily to induced activity in the soil (GE, 1979). Specifics regarding the seven tests are listed below:

- **Lassen**. A test anchored 152 m above ground surface (ags) detonated on June 5, 1957, with a yield of 0.0005 kt.
- **Wilson**. A test anchored 152 m ags detonated on June 18, 1957, with a yield of 10 kt.
- **Hood**. A test anchored 457 m ags detonated on July 5, 1957, with a yield of 74 kt.
- **Owens**. A test anchored 152 m ags detonated on July 25, 1957, with a yield of 9.7 kt.
- **Wheeler**. A test anchored 152 m ags detonated on September 6, 1957, with a yield of 0.197 kt.
- **Charleston**. A test anchored 457 m ags detonated on September 28, 1957, with a yield of 12 kt.
- **Morgan**. A test anchored 152 m ags detonated on October 7, 1957, with a yield of 8 kt.

Tests that are also included and evaluated in the closure of CAU 570 are underground tests throughout the area with a documented release to surface soils (referred to as Underground Test Area [UGTA] Releases in this document). These include Ajax, Eagle, Pleasant, Brazos, Eel, and Hod-B (Red). The releases from these tests occurred from 1962 to 1970 and consisted of atmospheric deposition of radionuclides.

1.2 Scope

The corrective action investigation (CAI) for CAU 570 was completed by demonstrating, through environmental soil and thermoluminescent dosimeter (TLD) sample analytical results, the nature and extent of contaminants of concern (COCs) at any study group (defined in the CAIP [NNSA/NSO, 2012a] and in Section 2.1). For radiological releases, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding a final action level (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 CAI activities were completed in accordance with the CAIP, except as noted in Appendix A; and in accordance with the *Soils Activity Quality Assurance Plan* (QAP) (NNSA/NSO, 2012b), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the *Soils Risk-Based Corrective Action* (RBCA) *Evaluation Process* (NNSA/NSO, 2012c).

In accordance with the graded approach described in the Soils QAP (NNSA/NSO, 2012b), the dataset quality is determined by its intended 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 classified as decision supporting and are not used, by themselves, to make corrective action decisions. As presented in Appendix C, the radiological and chemical FALs are based on the site-specific exposure scenario (Occasional Use Area).

The RBCA dose evaluation does not address the potential for removable contamination to be transported to other areas. A discussion on the risks associated with removable radioactive contamination is presented in the Soils RBCA document (NNSA/NSO, 2012c). This requires corrective action for areas that exceed HCA criteria even though the area may not present a potential radiation dose to a receptor that exceeds the FAL. Therefore, it is assumed that removable contamination that exceeds HCA criteria requires corrective action.

An assumption was made that corrective action is required within the established radiologically posted HCA at Eagle and in the subsurface soil within the Sugar crater. For the remainder of the site, the activities used to identify, evaluate, and recommend preferred corrective action alternatives (CAAs) for CAU 570 included the following:

- Visual inspections
- Geophysical and terrestrial radiological surveys (TRSs)
- Collection of environmental soil and TLD samples
- Collection of step-out samples to define the lateral and vertical extent of contamination
- Collection of waste management samples to determine the proper disposal of waste
- Collection of quality control (QC) samples
- Evaluation of corrective action objectives based on the results of the CAI and the CAA screening criteria
- Recommendation and justification of preferred CAAs

1.3 CADD/CR Contents

This document is divided into the following sections and appendices:

Section 1.0, "Introduction," summarizes the purpose, scope, and contents of this document.

Section 2.0, "Corrective Action Investigation Summary," summarizes the investigation field activities, the results of the investigation, and justifies that no further corrective action is needed.

Section 3.0, "Recommendation," provides the basis for requesting that the CAU be moved from Appendix III to Appendix IV of the FFACO.

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 CAU 570 objectives, field investigation and sampling activities, investigation results, waste management, and quality assurance (QA).

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

Appendix C, *Risk Assessment*, provides documentation of the chemical and radiological RBCA processes as applied to CAU 570.

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

Appendix E, *Evaluation of Corrective Action Alternatives*, provides a discussion of the results of the CAI, the alternatives considered, and the rationale for the recommended alternative.

Appendix F, *Sample Location Coordinates*, presents the CAI sample location coordinates.

Appendix G, *Geophysical Survey Report*, presents the results of the geophysical survey conducted at various locations within CAU 570.

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

1.3.1 Applicable Programmatic Plans and Documents

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

- CAIP for CAU 570, Area 9 Yucca Flat Atmospheric Test Sites (NNSA/NSO, 2012a)
- Soils QAP (NNSA/NSO, 2012b)
- Soils RBCA document (NNSA/NSO, 2012c)
- FFACO (1996, as amended)

1.3.2 Data Quality Assessment Summary

The CAIP (NNSA/NSO, 2012a) contains the DQOs as agreed to by decision makers before the field investigation. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of DQO decisions with an appropriate confidence level. A DQA was conducted that evaluated the degree of acceptability and usability of the data in the decision-making process. This DQA is presented in Appendix B and summarized in Section 2.2.2. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

Based on this evaluation, the nature and extent of COCs at CAU 570 have been adequately identified to implement the corrective actions. Information generated during the investigation supports the conceptual site model (CSM) assumptions, and the data collected met the DQOs and support their intended use in the decision-making process.

2.0 Corrective Action Investigation Summary

The following subsections summarize the investigation activities and investigation results, and justify why no further corrective action is required at CAU 570. Detailed investigation activities and results for individual CAU 570 study groups are presented in Appendix A.

2.1 Investigation Activities

The CAI activities were conducted as set forth in the CAIP (NNSA/NSO, 2012a) from October 12, 2012, through September 18, 2013. The CAI provided additional information needed to resolve the following CAU 570-specific DQOs:

- Determining whether COCs are present in the soils
- Determining the extent of identified COCs
- Ensuring adequate data have been collected to evaluate closure alternatives under the FFACO

The CAI included the following activities:

- Performing visual surveys to identify biasing factors for selecting soil and potential source material (PSM) sample locations
- Performing TRSs to identify biasing factors for selecting soil and PSM sample locations
- Performing TRSs to evaluate the potential for contamination associated with UGTA Releases
- Conducting geophysical surveys
- Establishing sample plot and biased sample locations
- Collecting soil samples at sample plot and biased sampling locations
- Collecting QC soil samples
- Submitting soil samples for analysis
- Staging TLDs at TLD-only, soil sample, and background locations
- Collecting and submitting TLDs for analysis

- Collecting Global Positioning System (GPS) coordinates of sample locations, TLD locations, and points of interest
- Performing limited removal of PSM wastes
- Excavating contaminated soils
- Collecting and analyzing confirmation soil and TLD samples
- Conducting waste management activities (e.g., sampling, disposal)

To facilitate site investigation and the evaluation of 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 study groups and the CASs associated with each study group are described in Table 2-1. Although the need for corrective action is evaluated separately for each study group, CAAs are evaluated for each FFACO CAS.

Table 2-1
CAU 570 Study Groups

Number	Description	FFACO CASs
Study Group 1	Atmospheric Tests	02-23-07, 09-23-14, 09-99-01
Study Group 2	Safety/Low-Yield Tests	09-23-10, 09-23-11
Study Group 3	Debris/Spills	02-23-07, 09-23-10, 09-23-11, 09-23-14, 09-23-15, 09-99-01
Study Group 4	Migration/Mechanical Disturbance	02-23-07, 09-23-10, 09-23-11, 09-23-14, 09-23-15, 09-99-01

The study groups were generally investigated by collecting TLD samples for external radiological dose measurements and collecting soil samples for the calculation of internal radiological dose and chemical risk. The field investigation was completed as specified in the CAIP with minor deviations that are described along with the general investigation and evaluation methodologies in Sections A.2.1 through A.2.5.

For Study Groups 1 and 2, sample locations were established judgmentally based on aerial radiation surveys and TRS results. For Study Groups 3 and 4, judgmental sample locations were determined based on biasing criteria such as elevated radiological readings, sediment accumulation areas, PSM, and stained soil.

Confidence in judgmental sampling decisions was established qualitatively through validation of the CSM and verification that the selected locations meet the DQO criteria (see Appendix B).

Samples within the sample plots were collected and evaluated based on a probabilistic sampling scheme. Confidence in probabilistic sampling scheme decisions was established by validating the CSM, justifying that sampling locations are representative of the plot area, and demonstrating that sufficient samples were collected to justify statistical inferences (e.g., averages and 95 percent upper confidence limits [UCLs]).

The potential external dose at each TLD location was determined from the results of a TLD placed at a height of 1 m above the soil surface. The net external dose was calculated at each of these locations by subtracting the background external dose that was determined from a set of TLDs placed in nearby locations that were unaffected by any test releases. The methods used to calculate external dose are described in Section A.2.2.5.

The potential internal dose at each sample location was determined from the analytical results of soil samples. The method used to calculate internal dose is described in Section A.2.2.4.

The calculated total effective dose (TED) (the sum of internal and external dose) for each sample location is an estimation of the true radiological dose (true TED). The TED is defined in 10 *Code of Federal Regulations* (CFR) Part 835 (CFR, 2013) as the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures).

Because a calculated TED is an estimate of the true (unknown) TED, it is uncertain how well the calculated TED represents the true TED. If the calculated TED were significantly different than the true TED, a decision based on the calculated TED could result in a decision error. The methods used to calculate TED are described in Section A.2.3.

As described in Appendix C, the TED to a receptor from site contamination is a function of the time the receptor is present at the site and exposed to the radioactively contaminated soil. Therefore, TED is reported in this document based on the following three exposure scenarios:

- **Industrial Area.** 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 (8 hours per day [hr/day], 250 days per year [day/yr] for 25 years). The TED values calculated using this exposure scenario equate to the total effective dose that an Industrial Area worker receives during 2,000 hours of annual exposure to site radioactivity and are expressed in terms of millirem per Industrial Area year (mrem/IA-yr).

- **Remote Work Area.** Assumes noncontinuous work activities at a site. This scenario addresses exposure to industrial workers exposed to contaminants in soil during a portion of an average workday. This scenario assumes that this is an area where the worker regularly visits but is not an assigned work area where the worker spends an entire workday. A site worker under this scenario is assumed to be on the site for an equivalent of 336 hr/yr (or 8 hr/day for 42 day/yr) for an entire career (25 years). The TED values calculated using this exposure scenario equate to the total effective dose that a Remote Area worker receives during 336 hours of annual exposure to site radioactivity and are expressed in terms of millirem per Remote Work Area year (mrem/RW-yr).

- **Occasional Use Area.** Assumes occasional work activities at a site. This scenario addresses exposure to industrial workers who are not assigned to the area as a regular worksite but may occasionally use the site. This scenario assumes that this is an area where the worker does not regularly visit but may occasionally use for short-term activities. A site worker under this scenario is assumed to be on the site for an equivalent of 80 hr/yr (or 8 hr/day for 10 day/yr) for five years. The TED values calculated using this exposure scenario equate to the total effective dose that an Occasional Use Area worker receives during 80 hours of annual exposure to site radioactivity and are expressed in terms of millirem per Occasional Use Area year (mrem/OU-yr).

The following subsections describe specific investigation activities conducted at each study group. Additional information regarding the investigation is presented in Appendix A.

2.1.1 Study Group 1, Atmospheric Tests

Study Group 1 consists of three CASs—CAS 02-23-07, located at the T-9b (Tesla) tower site; and CASs 09-23-14 and 09-99-01, located at the B9a (Balloon Pad) site—and the UGTA Releases. Investigation activities at Study Group 1 included conducting GPS-assisted TRSs, staging TLDs, and collecting surface soil plot samples. The TRSs conducted with a PRM-470 were used to determine the spatial distribution of gamma radiation throughout the area. Due to the proximity of underground tests in the area, the TRS conducted at Study Group 1 included the evaluation of UGTA Releases listed in Section 1.1. The results of the TRSs are presented in Section A.3.1.2.

There were 143 TLDs installed at Study Group 1 locations to measure external radiological doses. Sampling activities to determine internal dose at soil plots consisted of the collection of composite surface soil samples from two soil plots. See Section A.3.1 for additional information about investigation activities at Study Group 1. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for Study Group 1 are provided in the CAIP (NNSA/NSO, 2012a). The contamination pattern of the radionuclides at Study Group 1 and UGTA Releases is consistent with the CSM in that the radiological contamination is greatest at or near ground zero (GZ), the historical release point, and generally decreases with distance from the release point. Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.1.2 Study Group 2, Safety/Low-Yield Tests

Study Group 2 comprises two CASs: CAS 09-23-10, located at the T-9 (Sugar) tower site; and CAS 09-23-11, located at the S-9G (Ganymede gravel gertie) site. Investigation activities at Study Group 2 included conducting GPS-assisted TRSs, staging TLDs, and collecting surface soil samples. The TRSs conducted with a field instrument for the detection of low-energy radiation (FIDLER) were used to determine levels alpha/beta radiation throughout the area. The TRS results showed that the highest alpha/beta radiation readings corresponded to locations where the low-yield tests were conducted (Sugar and Ganymede). Two 100-square-meter (m^2) sample plots were established at the areas containing the highest alpha/beta readings as detected during the TRSs (see Figure A.4-2).

The TLDs were installed, and soil plot samples were collected at two locations within Study Group 2 to measure external and internal radiological doses. See Section A.4.1 for additional information about investigation activities at Study Group 2. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for Study Group 2 are provided in the CAIP (NNSA/NSO, 2012a). The contamination pattern of the radionuclides at Study Group 2 is consistent with the CSM inasmuch as the readings are highest in the area of low-yield tests. Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.1.3 Study Group 3, Debris/Spills

Investigation activities at Study Group 3, which comprises all six CASs, included performing visual inspections and collecting surface soil samples. During the visual inspections, the identified PSM included a lead-acid battery, various lead bricks, lead plates, lead pads, a large pile of wax, and a debris field. Probabilistic samples from the area of the debris field and judgmental verification samples from beneath the lead and stained soils were collected and analyzed. See Section A.5.1 for additional information on investigation activities at Study Group 3. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for Study Group 3 are provided in the CAIP (NNSA/NSO, 2012a). Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.1.4 Study Group 4, Migration/Mechanical Disturbance

Investigation activities at Study Group 4, which comprises all six CASs, included performing visual inspections that identified windrows, sediment areas, staked areas, soil piles, and disturbed areas; conducting GPS-assisted TRSs; staging TLDs; and collecting surface and shallow subsurface soil samples. The results of the visual inspections and the TRSs were evaluated and provided bias in the selection of sample locations. Once the general sample locations were identified, they were further refined with a hand-held radiation meter. The locations with the highest radiological readings were chosen as sample locations.

The TLDs were installed at the sample locations within Study Group 4 to measure external radiological doses. Sampling activities to determine internal dose consisted of the collection of surface soil samples from 37 sample locations (5 windrow locations, 8 sediment locations, 4 staked area locations, 13 soil pile locations, and 7 disturbed area locations). See Section A.6.1 for additional information about investigation activities at Study Group 4. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for Study Group 4 are provided in the CAIP (NNSA/NSO, 2012a). The contamination pattern of the radionuclides at Study Group 4 is consistent with the CSM, except investigation results revealed the potential for contaminants to be present in the soil pile that extends east, away from Ganymede, at depths greater that 30 centimeters (cm) below ground surface (bgs). To resolve this issue, further sampling was undertaken. The TLDs were placed and soil samples collected at five sample locations along the soil pile. Soil samples were collected from the surface along with samples from 60 cm bgs and 120 cm bgs. Analytical results revealed that significant contamination was present at depths less than 30 cm bgs. Information gathered during the CAI supports the CSM as presented in the CAIP, so no modifications to the CSM are needed.

2.2 Results

The data summary provided in Section 2.2.1 defines the COCs identified at CAU 570. Section 2.2.2 summarizes the assessment made in Appendix B, which demonstrates that the investigation results satisfy the DQO data requirements.

The preliminary action levels (PALs) and FALs for radioactivity are based on an annual dose limit of 25 mrem/yr. This dose limit is specific to the annual dose a receptor could potentially receive from a CAU 570 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The PALs for radioactivity were established in the CAIP (NNSA/NSO, 2012a) based on a dose limit of 25 mrem/yr over an annual exposure time of 2,000 hours (i.e., the Industrial Area exposure scenario that a site worker would be exposed to site contamination for 8 hr/day and 250 day/yr). The FALs for radioactivity were established in Appendix C based on a dose limit of 25 mrem/yr over an annual exposure time of 80 hours (i.e., the Occasional Use Area exposure scenario indicates that a site worker would be exposed to site contamination for 10 day/yr and 8 hr/day). To be comparable to these action levels, the CAU 570 investigation results are presented in terms of the dose a receptor would receive from site contamination under the Industrial Area (mrem/IA-yr), Remote Work Area (mrem/RW-yr), and Occasional Use Area (mrem/OU-yr) exposure scenarios.

The chemical PALs are based on the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels (RSLs) for chemical contaminants in industrial soils (EPA, 2013) except where natural background concentrations of *Resource Conservation and Recovery Act* (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 Summary of Analytical Data

Chemical and radiological results for environmental samples collected at each of the study groups are summarized in the following subsections. Chemical results are reported as individual analytical results compared to their individual FALs. The FALs as established in Appendix C are based on the annual exposure duration of the Occasional Use Area scenario (80 hr/yr) for radioactive contaminants and the Industrial Area scenario (2,000 hr/yr) for chemical contaminants. The PSM samples are evaluated against the PSM criteria and assumptions defined in Section A.2.5 to determine whether a release of the waste to the surrounding environmental media could cause the presence of a COC in the environmental media. For radioactivity, results are reported as TED comparable to the radiological FAL as established in Appendix C. Calculation of the TED for each sample was accomplished through summation of internal and external dose as described in Section A.2.3.

Judgmental sample results are reported as individual analytical results and as multiple contaminant analyses where the combined effect of contaminants are compared to FALs. Probabilistic sample results are reported as the average and the 95 percent UCL of the average results.

The TED for radionuclide analysis or analytical results for chemical analysis are evaluated against FALs to determine the presence of COCs and the extent of COC contamination, if present. Discussions of the results for samples collected at CAU 570 are grouped by the nature of the release (i.e., study group).

2.2.1.1 Study Group 1

Based on results of TLD and soil samples collected at Study Group 1, radiological contamination exceeded the FAL for the radiological dose (25 mrem/OU-yr) at sample plot A137 (Table 2-2) and sample location A007 (Table A.3-9). Therefore, a corrective action is required. The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios before excavation are presented in Table 2-2.

An interim corrective action was completed during the investigation and verification samples were collected. The sample locations are shown in Figure A.3-4. The analytical results of soil samples collected after corrective action are presented in Table 2-3. Contamination in the remaining soil was below FALs and required no further corrective action. There were no elevated TRS values detected

Table 2-2
Study Group 1 TED at Sample Locations (mrem/yr)

Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
A007	**573.7**	**598.6**	**96.4**	**100.6**	**28.7**	**29.9**
A137	**547.8**	**641.5**	**92.0**	**107.8**	**27.6**	**32.3**

Bold indicates the values exceeding 25 mrem/yr.

Table 2-3
Study Group 1 TED at Sample Locations after Corrective Action (mrem/yr)

Plot or Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
A138	**72.9**	**78.9**	12.3	13.3	3.7	4.0
A139	**53.8**	**63.3**	9.0	10.6	2.7	3.2
A140	**73.1**	**75.6**	12.3	12.7	3.7	3.8
A141	**80.2**	**86.5**	13.5	14.5	4.0	4.3

Bold indicates the values exceeding 25 mrem/yr.

around the UGTA Releases that would indicate the potential presence of COCs originating from any of these release sites.

2.2.1.2 Study Group 2

Based on the results of TLD and surface soil (0 to 5 cm bgs) samples collected at Study Group 2, the TED does not exceed the FAL for the radiological dose (25 mrem/OU-yr) at sample location B01 or B02 (Table 2-4). Figure A.4-2 shows the locations of B01 and B02.

It is assumed that subsurface contamination is present within the crater at Sugar. Therefore, a default contamination boundary (DCB) was established for this area (see Figure A.4-3), and a corrective action is required. The results from the Ganymede site investigation demonstrated that COCs are not present in surface soils. The assumed presence of COCs within the subsurface structure was addressed in the CAU 139 CADD (NNSA/NSO, 2007).

Table 2-4
Study Group 2 TED at Sample Locations (mrem/yr)

Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
B01	**66.8**	**70.3**	11.2	11.8	3.4	3.5
B02	**78.7**	**88.3**	13.2	14.8	4.0	4.5

Bold indicates the values exceeding 25 mrem/yr.

The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table 2-4.

2.2.1.3 Study Group 3

One intact, lead-acid battery was identified at Study Group 3. No indications of a release were identified; therefore, no soil samples were collected below this PSM. The presence of this PSM required corrective action, so the battery was removed and recycled.

Two lead pads were located and left in place as a result of a CAA analysis (see Appendix E). Soil samples were collected (sample locations C01 through C08) from the soil around each lead pad (see Figure A.5-2) to determine whether migration of contamination has occurred. The analysis of the soil samples revealed that no contaminants in concentrations greater than FALs were present around the lead pads, but corrective action is required due to the lead pads remaining as PSM.

Lead bricks and plates were present at multiple locations (Figure A.5-2 sample locations C09, C10, C24, and C25). The presence of this PSM required corrective action, so the lead was removed and recycled. Verification soil samples were collected from the soil beneath the lead at each of the locations after the lead had been removed. No sample results exceeded FALs.

A mound of wax approximately 1 m in diameter and 0.5 m high was located near the Balloon Pad (Figure A.5-2 sample location C11). The wax and the soil beneath the wax were sampled. No analytical results exceeded FALs; therefore, no corrective action was required.

A small debris area was discovered during visual inspections. Random samples were collected from this defined area (Figure A.5-2 sample locations C12 through C23). No analytical results exceeded FALs; therefore, no corrective action was required. Analytical results are presented in Section A.5.3.

An area of stained soil approximately 1 m in diameter was discovered (Figure A.5-2 sample location C26). The area was excavated by hand to a depth of about 0.5 m, and a soil sample from the bottom of the excavation was sampled. No analytical results of the confirmation soil sample exceeded FALs.

2.2.1.4 Study Group 4

Based on the results of TLD and surface soil (0 to 10 cm bgs) samples, radiological contamination does not exceed the FAL for the radiological dose (25 mrem/OU-yr) at any Study Group 4 sample location. Therefore, a corrective action is not required. The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table 2-5. It is assumed that contamination is present within the HCA at Eagle. Therefore, a corrective action is required.

Table 2-5
Study Group 4 TED at Sample Locations (mrem/yr)
(Page 1 of 2)

Plot or Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
D01	**128.6**	**138.0**	21.6	23.2	6.4	6.9
D02	**41.4**	**48.0**	6.9	8.1	2.1	2.4
D03	**28.1**	**30.8**	4.7	5.2	1.4	1.5
D04	**47.1**	**55.9**	7.9	9.4	2.4	2.8
D05	**32.4**	**33.2**	5.4	5.6	1.6	1.7
D06	**49.7**	**53.2**	8.4	8.9	2.5	2.7
D07	**50.4**	**58.7**	8.5	9.9	2.5	3.0
D08	**55.7**	**60.4**	9.4	10.2	2.9	3.1
D09	**46.8**	**49.9**	7.9	8.4	2.4	2.5
D10	**32.6**	**34.5**	5.5	5.8	1.6	1.7
D11	9.2	11.1	1.6	1.9	0.5	0.6

Table 2-5
Study Group 4 TED at Sample Locations (mrem/yr)
(Page 2 of 2)

Plot or Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
D12	14.9	16.2	2.5	2.7	0.8	0.9
D13	7.3	8.0	1.2	1.4	0.4	0.4
D14	7.1	10.1	1.2	1.7	0.4	0.5
D15	**164.5**	**175.5**	**27.6**	**29.5**	8.3	8.9
D16	**153.7**	**173.8**	**25.9**	**29.2**	7.8	8.8
D17	**174.3**	**188.6**	**29.3**	**31.7**	8.9	9.6
D18	**148.1**	**161.4**	24.9	**27.1**	7.4	8.1
D19	**427.7**	**454.6**	**71.9**	**76.4**	21.6	23.0
D20	**95.4**	**104.4**	16.0	17.5	4.9	5.3
D21	**147.5**	**158.7**	24.8	**26.7**	7.5	8.0
D22	**178.3**	**195.5**	**30.0**	**32.9**	9.2	10.1
D23	**47.2**	**50.1**	7.9	8.4	2.4	2.5
D24	**49.5**	**53.3**	8.3	9.0	2.5	2.7
D25	**63.9**	**68.5**	10.7	11.5	3.2	3.4
D26	**81.4**	**90.0**	13.7	15.1	4.2	4.6
D27	**121.4**	**132.5**	20.4	22.3	6.5	7.1
D28	**39.3**	**40.2**	6.6	6.8	2.0	2.0
D29	**41.0**	**43.7**	6.9	7.3	2.1	2.2
D30	**59.0**	**63.8**	9.9	10.7	3.0	3.2
D31	15.2	16.1	2.6	2.7	0.8	0.8
D32	24.1	**28.3**	4.1	4.8	1.2	1.4
D33	**67.3**	**74.0**	11.3	12.4	3.4	3.7
D34	**55.0**	**59.2**	9.2	9.9	2.8	3.0
D35	22.9	24.5	3.9	4.1	1.1	1.2
D36	8.4	11.2	1.4	1.9	0.4	0.6
D37	4.4	6.6	0.7	1.1	0.2	0.3

Bold indicates the values exceeding 25 mrem/yr.

2.2.2 Data Assessment Summary

The DQA is presented in Appendix B and includes an evaluation of the data quality indicators (DQIs) to determine the degree of acceptability and usability of the reported data in the decision-making process. The DQO process defines the type, quality, and quantity of data needed to support the resolution of DQO decisions at an appropriate level of confidence. Using both the DQO and DQA processes help to ensure that DQO decisions are sound and defensible.

The DQA process as presented in Appendix B is composed of the following 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 show that criteria were met in the areas of accuracy, sensitivity, precision, and completeness.

Sample locations that support the presence and/or extent of contamination at each study group are shown in Appendix B. Based on the results of the DQA presented in Appendix B, the nature and extent of COCs at CAU 570 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 and support their intended use in the decision-making process.

2.3 Justification for No Further Action

No further corrective action is needed for the CASs within CAU 570 based on the absence of contamination exceeding risk-based levels (presented in Section 2.3.1) or the implementation of the corrective actions based on an evaluation of risk, feasibility, and cost-effectiveness (the evaluation of CAAs is presented in Appendix E). The need for corrective action is evaluated for each study group through the resolution of the DQO decision as presented in Section 2.3.2. This ensures protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2012a).

2.3.1 Final Action Levels

The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NSO, 2012c). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2012b). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2012c) 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.

This RBCA process defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses. These tiers are defined in Appendix C.

A Tier 1 evaluation was conducted to determine whether contaminant levels satisfy the criteria for a quick regulatory closure or warrant a more site-specific assessment. For chemical contaminants, this was accomplished by comparing individual source area contaminant concentration results to the Tier 1 action levels (the PALs established in the CAIP [NNSA/NSO, 2012a]). For radiological contaminants, this was accomplished by comparing the radiological PAL of 25 mrem/IA-yr to the TED at each sample location calculated using the Industrial Area exposure scenario.

At CAU 570, radiological contaminants exceeded Tier 1 action levels at Study Groups 1, 2, and 4; and lead exceeded Tier 1 action levels at Study Group 3.

The FALs for all nonradiological contaminants were established as the Tier 1 action levels. The FALs for radiological contaminants were passed on to a Tier 2 evaluation.

The Tier 2 evaluation was conducted in accordance with the Soils RBCA document (NNSA/NSO, 2012c). This evaluation (presented in Appendix C) was based on risk to receptors. The risk to receptors from contaminants at CAU 570 is due to chronic exposure to contaminants (e.g., receiving a dose over time). Therefore, the risk to a receptor is directly related to the amount of time a receptor is exposed to the contaminants. A review of the current and projected use of CAU 570 sites determined that workers may be present at these sites for only a limited number of hours per year, and it is not reasonable to assume that any worker would be present at this site on a full-time basis (DOE/NV, 1996).

Based on current site usage, it was determined in the CAU 570 DQOs that the Occasional Use Area exposure scenario would be appropriate in calculating receptor exposure time. In order to quantify the maximum number of hours a site worker may be present at CAU 570, current and anticipated future site activities were evaluated in Appendix C. This evaluation concluded that the most exposed worker under current land usage is an inspection and maintenance worker who has the potential to be present at the site for up to 10 hr/yr. As a result, it was determined that the most exposed worker would not be exposed to site contamination for more time than is assumed under the Occasional Use Area exposure scenario (80 hr/yr). Therefore, the Tier 2 action level and the TEDs at each location were calculated using an exposure time of 80 hr/yr. The 95 percent UCL of the TED measured at each location was used to resolve Decision I, and the average TED was used to resolve Decision II. Additional details of the Tier 2 evaluation for radionuclides are provided in Appendix C.

The FALs for all CAU 570 contaminants of potential concern (COPCs) are shown in Table 2-6.

Table 2-6
Definition of FALs for CAU 570 COPCs

COPCs	Tier 1-Based FALs	Tier 2-Based FALs	Tier 3-Based FALs
VOCs[a]	PALs	None	N/A
SVOCs[a]	PALs	None	N/A
PCBs[a]	PALs	None	N/A
RCRA Metals[b]	PALs	None	N/A
Radionuclides	PALs	25 mrem/OU-yr	N/A

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

N/A = Not applicable
PCB = Polychlorinated biphenyl
PRG = Preliminary Remediation Goal
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

CAAs are evaluated and implemented at the CAS level, while the investigation was conducted based on study groups. Therefore, the study group investigation results are applied to the DQO decisions as described in Sections 2.3.2.1 through 2.3.2.4.

2.3.2 Resolution of DQO Decisions

The following subsections compare the results presented in Section 2.2 to the FALs presented in Section 2.3.1 for the resolution of DQO decisions and the need for corrective action.

2.3.2.1 Study Group 1 Resolution of DQO Decisions

Decision I

Based on analytical results for TLD and soil samples collected during the Study Group 1 investigation, radiological dose was a COC in the surface soil at sample locations A137 and A007 (see Section A.3.0). Therefore, corrective action is required. Based on the results of the TRSs, there was no indication of the potential for COCs originating from the UGTA Releases. Therefore, no further action is needed for these potential releases.

Decision II

Decision II was resolved by placing TLDs in a radial pattern around the areas of highest radiological readings as determined via the TRSs. A radiological survey using a PRM-470 was conducted over an area defined by a 30-m radius from location A137 for the purpose of determining the extent of contamination (see Figure A.3-3 for results). The corrective action boundary was established by determining the areas with gamma readings in excess of 44 multiples of background based on the correlation of TED to TRS values as shown in the graph displayed in Figure A.3-3. Soil samples and field screening confirmed that the extent of COC contamination is limited to the surface and shallow subsurface. A total of 77 cubic yards (yd^3) of soil was removed and disposed of as low-level waste.

After the interim corrective action was completed, the remaining contamination at the site was evaluated for the DQO decisions.

Decision I (after the interim corrective action)

A second radiological survey using a PRM-470 was conducted in a circular pattern over the same 30-m-radius area to select locations for verification samples (see Figure A.3-4). The verification samples consisted of TLDs and soil samples. The DQO decision on the presence of COCs was resolved based on verification sample results that did not exceed the radiological FAL. Therefore, no further corrective action is required at this site.

2.3.2.2 Study Group 2 Resolution of DQO Decisions

Radionuclide levels detectable by radiation surveys have not migrated from the Ganymede or Sugar test areas. Any migration at detectable levels would appear as elongations of the contamination plume in the downgradient drainages.

The relatively flat topography and the physical characteristics of the geologic material in the vicinity of Study Group 2 are indicative of a low-migration potential. Physical characteristics include medium to high adsorptive capacities, low moisture content, and a long distance to groundwater. Based on these physical factors and the absence of significant migration in the past, the defined extent of contamination is not expected to increase in the future.

Based on analytical results for TLD and soil samples collected at Study Group 2, no COCs are present with the exception of the contaminants assumed to be present within the DCB at Sugar (see Section A.4.0).

Decision I

The DQO decision on the presence of COCs from safety or low-yield tests was resolved based on the analytical and TLD results of samples collected at soil plots. While no COCs were identified in CAI samples, the DCB at Sugar requires corrective action.

Decision II

The extent of the DCB was defined in the CAIP.

2.3.2.3 Study Group 3 Resolution of DQO Decisions

Based on analytical results for soil samples collected at Study Group 3, no radiological or chemical COCs are present with the exception of the contaminants assumed to be present within the DCB at Eagle. PSM in the form of lead pads was also identified. Because the pads will not be removed, samples from the surrounding soil were collected and analyzed to define the extent of the corrective action. Analysis showed no COCs in concentrations greater than FALs (see Section A.5.0).

During the investigation, PSM in the form of 30 lead bricks/plates, a single lead-acid battery, and a small soil stain was discovered. As part of the investigation, the lead bricks/plates were removed and sent for recycling, and the soil beneath was analyzed for RCRA metals. The lead-acid battery was recovered and sent for recycling; the stained soil area was excavated; and a confirmation soil sample was collected and analyzed for chemical contaminants.

Also during the investigation, a debris field was located. Soil samples of the area were collected and analysis revealed no contaminants in concentrations greater than FALs were present. As a best management practice (BMP) the debris within the debris field was removed and disposed of in the Area 5 Radioactive Waste Management Center (RWMC).

Decision I

The DQO decision on the presence of COCs from debris and/or spills was resolved based on the presence of PSM. At Study Group 3, PSM was identified in the form of one intact lead-acid battery, three locations containing lead bricks/plates, and one location containing two lead pads. Corrective action is required for PSM.

Decision II

There was no indication of a release at the battery; therefore, the extent was defined by the physical dimensions of the battery. Decision II for the lead pads was resolved by collecting and analyzing soil samples adjacent to the pads. These samples did not contain COCs and defined the extent of the corrective action. The extent for the remaining lead bricks/plates was defined as the physical dimensions of the lead objects. The extent of the DCB was defined in the CAIP.

Decision I (after the interim corrective action)

An interim corrective action was completed that involved removing the battery and lead bricks/plates for recycling. Verification samples were collected from locations of lead bricks/plates and the excavated stained soil area. These samples did not contain COCs; no further corrective action is required at these locations.

2.3.2.4 Study Group 4 Resolution of DQO Decisions

Based on observations made and analytical results for TLD and soil samples collected at Study Group 4, no COCs are present (see Section A.6.0).

Decision I

The DQO decision on the presence of COCs at Study Group 4 was resolved based on the analytical and TLD results of samples collected at biased locations (windrows, staked areas, soil piles, sediment areas, and disturbed areas). These results demonstrate that no COCs are present at Study Group 4, and no corrective actions are necessary.

Decision II

As no COCs were identified, Decision II does not need to be resolved.

3.0 Recommendation

Corrective actions for each CAS were based on the risk assessment presented in Appendix C and the corrective action evaluation presented in Appendix E. During the risk assessment, it was determined to use the Occasional Use Area exposure scenario (with an exposure duration of 80 hr/yr for site workers) as the basis for radiological FAL DQO decisions.

At CAU 570, COCs were detected in environmental samples from only two locations: A137 and A007. The extent of COC contamination was defined, and this material was removed under an interim corrective action. Verification samples from the remaining soil showed that all COCs were removed, and no further corrective action is needed at this release site. However, it is assumed that radioactivity within the Eagle and Sugar DCBs exceeds FALs and requires corrective action. The selected corrective action (based on the corrective action evaluation presented in Appendix E) is closure in place with an FFACO UR for the DCBs and the lead pads near Eagle. There were no elevated TRS values detected around the UGTA Releases that would indicate the potential presence of COCs originating from any of these release sites.

The FFACO URs that are implemented will protect site workers from inadvertent exposure. The FFACO URs are defined and shown in Attachment D-1. These FFACO URs require annual inspections to certify that postings are in place, intact, and readable.

No further corrective action is required at CAU 570 based upon implementation of the above-defined corrective actions. The corrective actions for CAU 570 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 necessary.

In accordance with the Soils RBCA document (NNSA/NSO, 2012c) and Section 3.3 of the CAIP (NNSA/NSO, 2012a), an administrative UR was established as a BMP for the area around Tesla and the Balloon Pad where an industrial land use of the area could cause a future site worker to receive an annual dose exceeding 25 mrem/yr. This assumes the worker would be exposed to site contamination for a period of 2,000 hr/yr (Section 2.2). This administrative UR is implemented as a BMP and is not part of any FFACO corrective action.

All URs are recorded in the FFACO database; the Management and Operating (M&O) Contractor Geographic Information Systems (GIS); and the DOE, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) CAU/CAS files. The development of URs for CAU 570 are based on current land use. Any proposed activity within a use-restricted area that would result in a more intensive use of the site would require NDEP approval.

The NNSA/NFO requests that NDEP issue a Notice of Completion for CAU 570 and approve transferring CAU 570 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 these actions (USC, 2012).

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Appendix A

Corrective Action Investigation Results

A.1.0 Introduction

This appendix presents the CAI activities and analytical results for CAU 570. CAU 570 consists of the following six CASs located in Area 9 of the NNSS (Figure A.1-1):

- 02-23-07, Atmospheric Test Site - Tesla
- 09-23-01, Atmospheric Test Site T-9
- 09-23-11, Atmospheric Test Site S-9G
- 09-23-14, Atmospheric Test Site - Rushmore
- 09-23-15, Eagle Contamination Area
- 09-99-01, Atmospheric Test Site B-9A

CAS 02-23-07 (referred to as Tesla in this document), the third of the Teapot series, was a weapons-related test detonated at the T-9b tower site atop a 300-ft tower. The test was detonated on March 1, 1955, and had a yield of 7 kt (Maag et al., 1981).

CAS 09-23-10 (referred to as Sugar in this document), the sixth nuclear test of Operation Buster-Jangle, the first of the Jangle phase, was a weapons-effects test detonated from a 1-m platform. The detonation created a crater 28 m in diameter by 6.4 m deep. Test objectives included evaluating civil or military effects of a nuclear detonation on various targets such as military hardware. The test was detonated on November 19, 1951, and had a yield of 1.2 kt (GE, 1979).

CAS 09-23-11 (referred to as Ganymede in this document), the 36th test of Operation Hardtack II, was a safety experiment detonated at ground level inside a gravel containment that consisted of a wooden structure covered with 20 ft of gravel. The test took place on October 30, 1958, and had zero yield (H&N, 1959). Ganymede was previously investigated under the Industrial Sites CAU 139 and was identified as CAS 09-23-01. As a result of the CAU 139 investigation (NNSA/NSO, 2007), an FFACO UR was established at the fence line of the RMA that surrounds the site due to the assumed presence of contamination at exceeding FALs within the structure.

CAS 09-23-14 (referred to as Rushmore or Balloon Pad in this document), the 23rd test of Operation Hardtack II, was detonated at the B-9A balloon pad after rehabilitation of the pad. The device was suspended 500 ft in the air by a 67-ft-diameter balloon tethered to the B-9A pad. The weapons-related test took place on October 22, 1958, and had a yield of 188 tons (H&N, 1959)

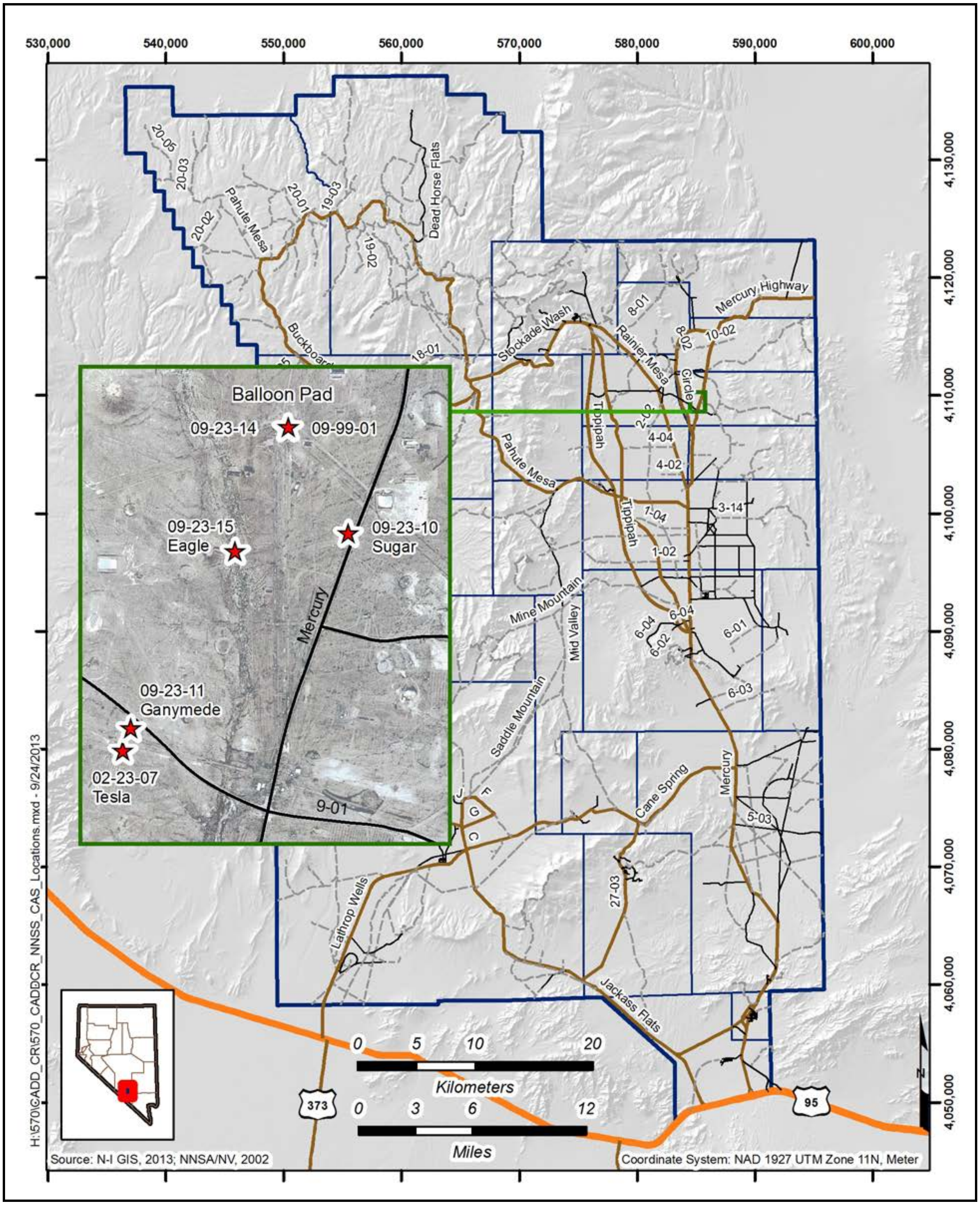


Figure A.1-1
CAU 570, CAS Location Map

CAS 09-23-15 (referred to as Eagle in this document), is a fenced mound of soil and debris located east of the U9av crater. The fenced area is less than 0.5 acres and is posted as an HCA. Eagle, the 17th test of Operation Niblick, was a weapons-related test that took place on December 12, 1963, and had a yield of 5.3 kt (DOE/NV, 2000). During the Eagle test, the line-of-sight pipe ruptured, venting nuclear material to the atmosphere while damaging and scattering the pipe cap as well as associated structures and experiments (Olsen, 1964). The contaminated debris and soil from the Eagle test were collected in a mound and later fenced and identified as an HCA.

CAS 09-99-01 (referred to as Balloon Pad in this document) was the site of seven weapons-related balloon tests in 1957 as part of Operation Plumbbob. The contamination from the tests was due primarily to induced activity in the soil (GE, 1979). Specifics regarding the seven tests are listed below:

- **Lassen**. A test anchored 152 m ags detonated on June 5, 1957, with a yield of 0.0005 kt.
- **Wilson**. A test anchored 152 m ags detonated on June 18, 1957, with a yield of 10 kt.
- **Hood**. A test anchored 457 m ags detonated on July 5, 1957, with a yield of 74 kt.
- **Owens**. A test anchored 152 m ags detonated on July 25, 1957, with a yield of 9.7 kt.
- **Wheeler**. A test anchored 152 m ags detonated on September 6, 1957, with a yield of 0.197 kt.
- **Charleston**. A test anchored 457 m ags detonated on September 28, 1957, with a yield of 12 kt.
- **Morgan**. A test anchored 152 m ags detonated on October 7, 1957, with a yield of 8 kt.

Tests that are also included and evaluated in the closure of CAU 570 are underground tests throughout the area with a documented release to surface soils (referred to as UGTA Releases in this document). These include Ajax, Eagle, Pleasant, Brazos, Eel, and Hod-B (Red). The releases from these tests occurred from 1962 to 1970 and consisted of atmospheric deposition of radionuclides.

Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the CAU 570 CAIP (NNSA/NSO, 2012a).

A.1.1 Investigation Objectives

The objective of the investigation was to provide sufficient information to complete corrective actions and support the recommendation for closure of each CAS in CAU 570. This objective was achieved by identifying the nature and extent of COCs and by evaluating, selecting, and implementing acceptable CAAs.

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 other types of contamination, a COC is defined as the presence of a contaminant at a concentration exceeding its corresponding FAL concentration (see Section A.2.5).

A.1.2 Contents

This appendix describes the investigation and presents the results in the following sections:

- 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 (see Section A.2.0) information regarding the field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section A.7.0 summarizes waste management activities.
- Section A.8.0 discusses the QA and QC processes that were followed and the results of those QA/QC activities.
- Section A.9.0 provides a summary of the investigation results.
- Section A.10.0 lists the cited references.

The complete field documentation and laboratory data—including field activity daily logs, sample collection logs (SCLs), analysis request/chain-of-custody forms, soil sample descriptions, laboratory certificates of analyses, and analytical results—are retained in CAU 570 files as hard copy files or electronic media.

A.2.0 Investigation Overview

The following CAU 570 CAI activities were conducted from October 12, 2012, through September 18, 2013:

- Performed visual surveys to identify biasing factors for selecting soil and PSM sample locations.
- Performed radiological surveys to identify biasing factors for selecting soil and PSM sample locations.
- Performed TRSs to evaluate the potential for contamination associated with UGTA Releases.
- Conducted geophysical surveys.
- Established sample plot and biased sample locations.
- Collected soil samples at probabilistic and judgmental sampling locations.
- Collected QC soil samples.
- Submitted soil samples for analysis.
- Staged TLDs at environmental sample and background locations.
- Collected and submitted TLDs for analysis.
- Collected GPS coordinates of sample locations, TLD locations, and points of interest.
- Performed limited removal of PSM wastes.
- Removed contaminated soil.
- Collected and submitted confirmation samples for analysis.
- Conducted waste management activities (e.g., sampling, disposal).

The investigation and sampling program adhered to the requirements set forth in the CAIP (NNSA/NSO, 2012a) (except any deviations described herein); and in accordance with the Soils QAP (NNSA/NSO, 2012c), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the Soils RBCA document (NNSA/NSO, 2012d).

In accordance with the graded approach described in the Soils QAP (NNSA/NSO, 2012c), the quality required of a dataset will be determined by its intended 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 classified as decision supporting and are not used, by themselves, to make corrective action decisions. As presented in Appendix C, the radiological and chemical FALs are based on the appropriate site-specific exposure scenario (Occasional Use Area).

To facilitate site investigation and the evaluation of DQO decisions for different CSM components, the reporting of investigation results and the evaluation of DQO decisions for different CSM components were organized into study groups. The study groups and the CASs or CAS components associated with each study group are described in Table A.2-1. The need for corrective action is evaluated for each study group, and the CAAs are evaluated by CAS.

Table A.2-1
CAU 570 Study Groups

Number	Description	FFACO CASs
Study Group 1	Atmospheric Tests	02-23-07, 09-23-14, 09-99-01
Study Group 2	Safety/Low-Yield Tests	09-23-10, 09-23-11
Study Group 3	Debris/Spills	02-23-07, 09-23-10, 09-23-11, 09-23-14, 09-23-15, 09-99-01
Study Group 4	Migration/Mechanical Disturbance	02-23-07, 09-23-10, 09-23-11, 09-23-14, 09-23-15, 09-99-01

The study groups were investigated by collecting TLD samples for external radiological dose estimates and collecting soil samples for the calculation of internal radiological dose and to determine the presence of chemical contaminants. The field investigation was completed as specified in the CAIP (NNSA/NSO, 2012a) with minor deviations as described in Sections A.2.1 through A.2.6, which provide the general investigation and evaluation methodologies.

A.2.1 Sample Locations

Sample locations were selected based on interpretation of site-specific TRSs, information obtained during site visits, and site conditions as provided in the CAIP (NNSA/NSO, 2012a). Sample plots for Study Group 1 and Study Group 2 were located judgmentally based on the highest radiological readings. Soil sample locations within sample plots were selected and evaluated using a probabilistic approach. Four composite samples were collected within each sample plot, and TLDs were located at the center of each sample plot. The aliquot locations were identified using a predetermined random-start, triangular grid pattern.

Judgmental sample locations for Study Group 3 were selected based on biasing factors such as the presence of debris or soil staining. A debris field was identified during the visual surveys and characterized using probabilistic soil sampling by collecting 12 samples from unbiased locations.

Judgmental sample locations for Study Group 4 were selected based on biasing factors such as visual identification of soil piles, signs of ground disturbance, sedimentation areas, and locations of previous site operations coupled with elevated radiological readings.

The center of each sample plot in Study Groups 1 and 2 and grab sample locations in Study Groups 3 and 4 were also characterized for external radionuclide contamination using TLDs. Sample locations of all four study groups and points of interest throughout CAU 570 were surveyed with a GPS instrument. Appendix F presents the coordinates for each sample location in tabular format. Specific sample locations and the rationale for selecting sample locations are shown in the study group-specific sections (Sections A.3.0 through A.6.0).

A.2.2 Investigation Activities

The investigation activities as listed in Section A.2.0 and performed at CAU 570 were consistent with the field investigation activities specified in the CAIP (NNSA/NSO, 2012a). The investigation strategy provided the necessary information to establish the nature and extent of contamination associated with each study group. The following subsections describe the specific investigation activities that took place at CAU 570.

A.2.2.1 Radiological Surveys

Aerial surveys and TRSs were conducted at the CAU 570 CASs. Aerial radiological surveys were performed at the sites in 1994 at an altitude of 200 ft with 500-ft flight-line spacing (BN, 1999). Other aerial surveys of the area were conducted in 2008 and 2012 at an altitude of 50 ft with 23-m flight line spacing (BN, 1999; NSTec, 2012) that provided better resolution of the distribution of site radioactivity.

TRSs were performed to identify specific locations for sample plots and biased sample locations. The TRSs were also conducted around UGTA Release sites to identify if any contaminant plumes are present that originate from these sites. Count-rate data were collected with a TSA Systems PRM-470 model plastic scintillator, sodium iodide (NaI) detectors, and a FIDLER. 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 held at a height of approximately 24 inches (in.) ags.

A.2.2.2 Field Screening

The study group-specific sections of this document identify the locations where field screening was conducted and how the field-screening levels (FSLs) were used to aid in the selection of samples submitted for analysis. Field-screening results (FSRs) are recorded on SCLs that are retained in project files.

Site-specific FSLs are determined before investigational soil sampling begins each day. An area is selected in the vicinity of the site that has a minimal probability of being impacted from releases or site operations. Ten or more surface soil aliquots are collected from the top 5 cm of soil at unbiased locations within the selected area. The aliquots are then mixed, and 10 one-minute static counts are obtained for both alpha and beta/gamma measurements. The FSLs for both alpha and beta/gamma are calculated by multiplying the sample standard deviation by 2 and adding that value to the sample average.

Field screening was used as part of the CAI to evaluate the potential for buried contamination at Study Group 4 locations and to aid in the selection of biased samples for laboratory analyses. Field screening was limited to radiological parameters and was conducted using an NE Electra instrument. The FSRs for samples at each sample location were used to determine whether a subsurface contamination layer(s) could be distinguished from surface contamination. Buried contamination was considered to potentially be present only if the depth interval readings were greater than FSLs and exceeded the surface soil reading by greater than 20 percent. Subsurface samples D029, D030, D031, D033, D034, and D039 met this screening criteria and were sent for offsite laboratory analyses in addition to the corresponding surface sample.

A.2.2.3 Soil Sampling

Soil sampling at CAU 570 included the collection of surface soil samples within sample plots and grab sample locations. Within each sample plot, four composite samples were collected. Each composite sample was composed of nine randomly located aliquots, resulting in a total of 36 randomly located aliquots collected from each plot. Each aliquot was collected using a "vertical-slice cylinder and bottom-trowel" method. This required the insertion of a 3.5-in. 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.

After collection, each aliquot was carefully placed into a pan (with a plastic bag lining the pan, which limited dust generation during transfer to a sample container). After field screening, each sample was transferred to an empty 1-gallon (gal) metal can. Each metal can was then sealed with a lid and a locking ring.

At grab sample locations, samples were collected from the surface and shallow subsurface using a disposable scoop. Subsurface samples were collected at predetermined depth intervals and field screened as described in Section A.2.2.2.

A.2.2.4 Internal Dose Estimates

Internal dose was estimated using the radionuclide analytical results from soil samples and the corresponding contaminant residual radioactive material guideline (RRMG) (NNSA/NSO, 2012d). Soil concentrations of Pu isotopes are inferred from gamma spectroscopy results as described in Section B.1.1.1.1.

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 the appropriate exposure scenario (NNSA/NSO, 2012d).

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/NSO, 2012d) to yield a fraction of the 25-mrem/yr dose. The fractions for all radionuclides detected in a soil sample were summed to yield a total fraction for that sample. The total fraction was then multiplied by 25 to yield an internal dose estimate (in mrem/yr) at that sample location. For probabilistic samples, a 95 percent UCL was calculated for the internal dose in a sample plot using the results of all soil samples collected in that plot (NNSA/NSO, 2012d). For judgmental sample locations where only one sample was collected, statistical inferences could not be calculated, and the single analytical result was used to calculate the internal dose.

For TLD locations where soil samples were not collected, the internal dose was estimated using the external dose measurement from the TLD and the internal-to-external dose ratio from the soil sample with the maximum internal dose within the same study group. The internal dose for each of these locations was calculated by multiplying this ratio by the external dose value specific to each TLD location using the following formula:

$$Internal\ dose_{est} = External\ dose_{est}\ x\ [Internal\ dose\ /\ External\ dose]_{max}$$

where

est = location for the estimate of internal dose
max = location of maximum internal dose

Use of this method to estimate internal dose will overestimate the internal dose (and therefore TED) as the internal-to-external dose ratio generally decreases with decreasing TED values.

A.2.2.5 External Dose Measurements

TLDs (Panasonic UD-814) were staged at CAU 570 with the objective of collecting *in situ* measurements to determine the external radiological dose. TLDs were placed in background areas (beyond the influence of CAS releases), at radial grid locations, at the approximate center of each sample plot, and at other biased locations. Each TLD was placed at a height of 1 m ags, which is consistent with TLD placement in the NNSS routine environmental monitoring program (see Section A.8.5). Once retrieved from the field locations, the TLDs were analyzed by automated TLD readers that are calibrated and maintained by the NNSS M&O contractor. The TLD results are discussed in Sections A.3.3.1, A.4.3.1, and A.6.3.1

This approach allowed for the use of existing QC procedures for TLD processing. Details of the environmental monitoring TLD program and TLD QC are presented in Section A.8.5. All readings conformed to the approved QC program and are considered representative of the external radiological dose at each location.

The TLDs used at CAU 570 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 to be 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.

For locations where external dose measurements were not available (e.g., subsurface sample locations), a TLD-equivalent external dose was calculated using the subsurface sample results. This was accomplished by establishing a correlation between RESRAD-calculated external dose from surface samples and the corresponding TLD readings. The RESRAD-calculated external dose from the subsurface samples was then adjusted to TLD-equivalent values using the following formula:

$$Equivalent\ Subsurface_{TLD} = Subsurface_{RR}\ x\ (Surface_{TLD} / Surface_{RR})$$

where

TLD = external dose based on TLD readings
RR = external dose based on RESRAD calculation from analytical soil concentrations

Estimates of external dose at the CAU 570 sites are presented as net values (i.e., background radiation dose has been subtracted from the raw result). The background TLDs measure (1) the dose the TLDs were exposed to while not deployed in the field and (2) the dose from natural sources in areas unaffected by the CAU-related releases during field deployment.

The background TLDs were placed in areas beyond the influence of CAS releases. The background dose at CAU 570 was determined to be the average of the background TLD results from locations H01, H02, H03, and H04 (23.9 mrem/IA-yr).

The 1994 aerial radiation survey (BN, 1999) was used to verify that TLDs placed to measure background radiation were located outside the influence of man-made radiation sources to be measured at CAU 570 TLD locations (Figure A.2-1). It was determined that the background TLD locations are representative of the general area and can be used as a good estimate of true average background dose for all of the environmental TLDs.

A.2.3 Total Effective Dose

The calculated TED represents the sum of the internal dose (calculated from soil sample results) and the external dose (calculated from TLD measurements) 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. 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/NSO, 2012a) 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 UCLs of the internal and external doses. For grab sample locations where a TLD sample was collected, this is calculated as the sum of the 95 percent UCL of the external dose and the single internal dose estimate.

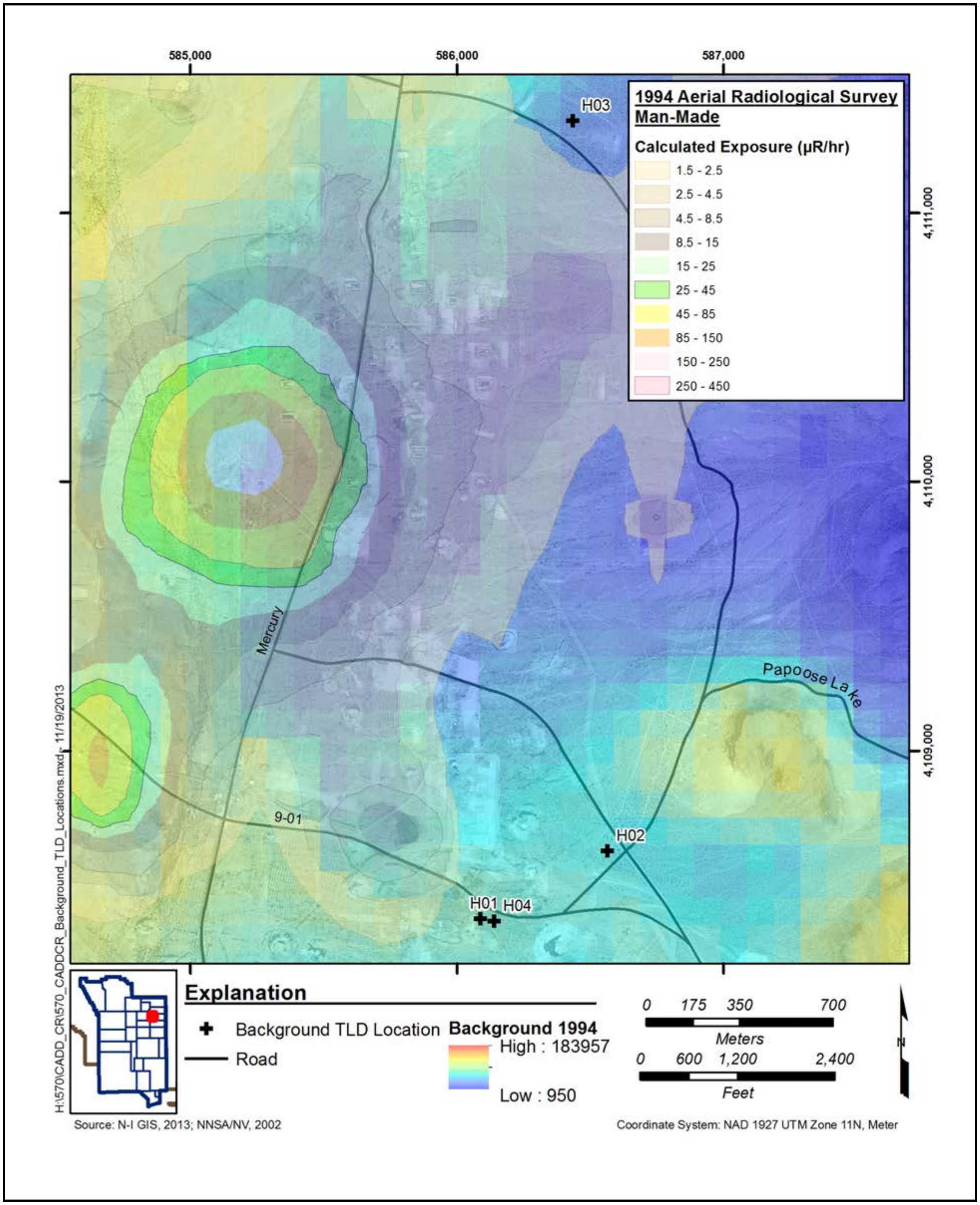


Figure A.2-1
CAU 570 Background TLD Locations

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.1.1.1.1.

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 those 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 Laboratory Analytical Information

Radiological analyses of the collected soil samples were performed by General Engineering Laboratory, LLC of Charleston, South Carolina. The analytical suites and laboratory analytical methods used to analyze investigation samples are listed in the CAIP (NNSA/NSO, 2012a). Analytical results are reported in this appendix if they were detected above the minimum detectable concentrations (MDCs). The complete laboratory data packages are available in the project files.

Validated analytical data for CAU 570 investigation samples have been compiled and evaluated to determine the presence of COCs and to define the extent of COC contamination if present. The analytical results for each study group are presented in Sections A.3.0 through A.6.0.

The analytical parameters were selected through the application of site process knowledge as described in the CAIP.

A.2.5 Comparison to Action Levels

The radiological PALs and FALs are based on an annual dose limit of 25 mrem/yr. This dose limit is specific to the annual dose a receptor could potentially receive from a CAU 570 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The PALs were established in the CAIP (NNSA/NSO, 2012a) based on a dose limit of 25 mrem/yr over an annual exposure time of 2,000 hours (i.e., the Industrial Area exposure scenario in which a site worker is exposed to site contamination for 8 hr/day and 250 day/yr). The FALs were established in

Appendix C based on a dose limit of 25 mrem/yr over an annual exposure time of 80 hours (i.e., the Occasional Use Area exposure scenario in which a site worker is exposed to site contamination for 10 day/yr and 8 hr/day).

Results for each of the study groups are presented in Sections A.3.3, A.4.3, A.5.3, and A.6.3. Radiological results are reported as doses that are comparable to the dose-based FAL as established in Appendix C. Chemical results are reported as individual concentrations that are comparable to the individual chemical FALs as established in Appendix C. Results that are equal to or greater than FALs are identified by bold text in the study group-specific results tables (see Sections A.3.0 through A.6.0).

A COC is defined as any contaminant present in environmental media exceeding a FAL. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2012d). If COCs are present, corrective action must be considered.

A corrective action may also be required if a waste material present within a study group contains contaminants that, if released, could cause the surrounding environmental media to contain a COC. Such waste would be considered PSM. To evaluate wastes for their potential to result in the introduction of a COC to the surrounding environmental media, the conservative assumption was made that any physical waste containment would fail at some point and release contaminants to the surrounding media. The following criteria are used for determining whether a waste is PSM:

- A waste material, regardless of concentration or configuration, may be assumed to be PSM and handled under a corrective action.
- Based on process knowledge and/or professional judgment, some waste may be assumed to not be PSM if it is clear that it could not result in soil contamination exceeding a FAL.
- If assumptions about the waste cannot be made, then the waste material will be sampled, and the results will be compared to FALs based on the following criteria:
    - For non-liquid wastes, the concentration of any chemical contaminant in soil (following degradation of the waste and release of contaminants into the soil) would be equal to the mass of the contaminant in the waste divided by the mass of the waste. If the resulting soil concentration exceeds the FAL, then the waste would be considered to be PSM.

- For non-liquid wastes, the dose resulting from radioactive contaminants in soil (following degradation of the waste and release of contaminants into soil) would be calculated using the activity of the contaminant in the waste divided by the mass of the waste (for each radioactive contaminant) and calculating the combined resulting dose using the RESRAD code (Murphy, 2004). If the resulting dose exceeds the FAL, then the waste would be considered to be PSM.

- For liquid wastes, the resulting concentration of contaminants in the surrounding soil will be calculated based on the concentration of contaminants in the waste and the liquid holding capacity of the soil. If the resulting soil concentration exceeds the FAL, then the liquid waste would be considered to be PSM.

A.2.6 Correlation of Dose to Radiation Survey Isopleths

A boundary for a corrective action or an administrative UR for a particular release site may be established by using radiation survey isopleths if it can be shown that a sufficient correlation exists between TED and radiation survey values. This is accomplished by pairing each TED value with a radiation survey value from the corresponding geographic location. Correlation statistics are then used to establish the relationship between the paired values as well as an indicator of the strength of the relationship (i.e., the coefficient of determination, or r^2). The minimum strength of the relationship for a valid correlation was defined in the DQOs as an r^2 of 0.8.

The TED values used in the correlation were the average TED for probabilistic samples or the calculated TED for judgmental samples from biased sample locations. The values from the radiation surveys were based on interpolated values at the TED location. These interpolated values were generated from a continuous spatial distribution (i.e., interpolated surface) that was estimated using an inverse distance-weighted interpolation technique.

A correlation for each radiation survey was established to identify the radiation survey that has the best correlation to Occasional Use Area exposure scenario TED values. This correlation was used to establish a radiation survey value corresponding to the FAL. An isopleth of this value from the radiological survey that correlated the best with the calculated TED was used to define corrective action boundaries. A similar correlation of radiation survey values to Industrial Area exposure scenario TED values was used to establish administrative UR boundaries.

A.3.0 Study Group 1, Atmospheric Tests

Study Group 1, Atmospheric Tests, addresses the atmospheric deposition of radionuclides from atmospheric tests to surface soils throughout the area of CAU 570. Additional detail on the history of Study Group 1 is provided in the CAIP (NNSA/NSO, 2012a). At one release site (Tesla), sample results identified the presence of COCs. This contamination was removed under an interim corrective action and additional samples were collected from the excavated area. Therefore, investigation results from Tesla representing conditions before the interim corrective action are presented in Section A.3.3, and the investigation results from the excavated area following the interim corrective action are presented in Section A.3.4.

A.3.1 Corrective Action Investigation Activities

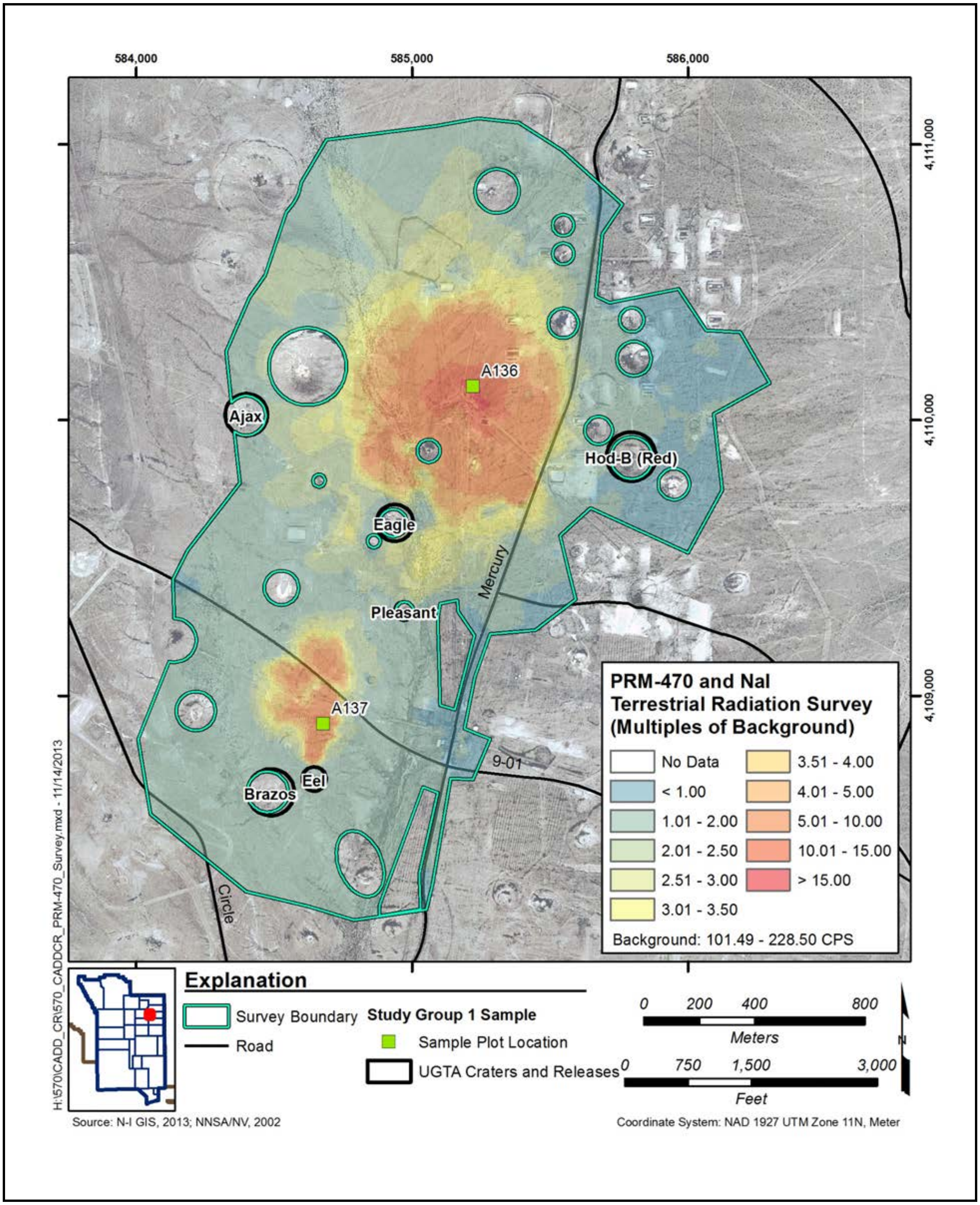
The specific CAI activities conducted to satisfy the CAIP requirements at Study Group 1 (NNSA/NSO, 2012a) are described in the following subsections.

A.3.1.1 Visual Inspections

Visual inspections of Study Group 1—including site walks, sampling efforts, and TRSs—were conducted over the course of the field investigation. The presence of scattered debris was identified and noted. However, no biasing factors (indicating the potential release of contamination) were identified, and no additional samples were collected as a result of the visual inspection. The visual inspection for drainages is presented in Section A.6.1.1.1.

A.3.1.2 Radiological Surveys

GPS-assisted TRSs were performed at CAU 570 in support of the Study Group 1 investigation as part of the CAI. The TRSs were conducted over the CAU 570 area suspected of containing radioactive contamination (outside Eagle and test craters in the area) to identify the spatial distribution of radiological readings and to identify the location of the highest gamma radiological readings. The two locations of the highest gamma radiological readings were east of the Tesla site and north of the Balloon Pad. Sample plots were established at these two locations. Figure A.3-1 presents a graphic representation of the data from the TRS and the location of UGTA Releases. The TRSs were also



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.3-1
TRSs at Study Group 1

conducted around UGTA Release sites to identify if any contaminant plumes are present that originate from these sites.

A.3.1.3 Sample Collection

Soil and TLD samples were collected to satisfy the CAIP requirements at Study Group 1 (NNSA/NSO, 2012a). The TLD and soil sample purpose and location information is provided in the following subsections.

A.3.1.3.1 TLD Samples

The two TLD sample plot locations were selected based on the results of TRSs conducted throughout the areas of Tesla and the Balloon Pad as determined with a PRM-470 handheld radiological meter. Once the general areas of highest readings were determined, the final sample locations were determined using the same equipment and surveying the area until the locations with the highest readings were identified. TLDs were placed at and retrieved from two sample plot locations, four background locations, and 135 TLD-only locations. The 135 TLDs were located on four separate vectors at the Tesla site and the Balloon Pad site. Each of the four vectors at Tesla passed through a location near the location of the highest reading at Tesla. Each of the four vectors at the Balloon Pad passed through the Balloon Pad GZ. These vectors were located approximately 45 degrees from each other and formed a radial pattern. This design provided greater TLD density near the locations where the radiological readings were indicated to be the highest. TLDs were repositioned when their position on the vector placed them in restricted locations such as test craters. Table A.3-1 contains TLD information organized by sample type. The TLDs were placed at 141 Study Group 1 locations (A001 through A137 and H01 through H04) to measure external dose (see Figure A.3-2). Six TLDs (H101 through H106) were placed to measure “field” background. The TLDs listed in Table A.3-2 were used to measure external dose as part of the Study Group 1 investigation. TLDs were placed at the center of the Study Group 1 soil sample plots A136 and A137. All TLDs were measured by the NNSS environmental TLD monitoring program. Details of the environmental monitoring TLD program and TLD QC are presented in Section A.8.0.

Table A.3-1
Study Group 1 TLD Sample Summary

Sample Type	Number of Locations	Number of TLDs	Analyses (Method)
Plot	2	2	*Nevada Test Site Routine Radiological Environmental Monitoring Plan*[b]
TLD Only	135	135	
Background	4	6[a]	
Total	141	143	

[a] Two TLDs each were placed at locations H01 and H04.
[b] BN, 2003

Table A.3-2
TLDs at Study Group 1
(Page 1 of 6)

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Tesla	A001	6399	10/15/2012	01/22/2013	Radial vector
	A002	6237	10/15/2012	01/22/2013	Radial vector
	A003	6342	10/15/2012	01/22/2013	Radial vector
	A004	6312	10/15/2012	01/22/2013	Radial vector
	A005	6135	10/15/2012	01/23/2013	Radial vector
	A006	4414	10/15/2012	01/23/2013	Radial vector
	A007	6233	10/15/2012	01/23/2013	Radial vector
	A008	6427	10/15/2012	01/23/2013	Radial vector
	A009	4545	10/15/2012	01/23/2013	Radial vector
	A010	6392	10/15/2012	01/23/2013	Radial vector
	A011	6328	10/15/2012	01/23/2013	Radial vector
	A012	6458	10/15/2012	01/23/2013	Radial vector
	A013	3830	10/15/2012	01/23/2013	Radial vector
	A014	6239	10/15/2012	01/23/2013	Radial vector
	A015	6355	10/15/2012	01/23/2013	Radial vector
	A016	6290	10/15/2012	01/23/2013	Radial vector
	A017	6298	10/15/2012	01/23/2013	Radial vector
	A018	6362	10/15/2012	01/23/2013	Radial vector
	A019	4532	10/15/2012	01/23/2013	Radial vector
	A020	6236	10/15/2012	01/23/2013	Radial vector

Table A.3-2
TLDs at Study Group 1
(Page 2 of 6)

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Tesla (continued)	A021	6146	10/15/2012	01/23/2013	Radial vector
	A022	6286	10/15/2012	01/23/2013	Radial vector
	A023	6397	10/15/2012	01/23/2013	Radial vector
	A024	6329	10/15/2012	01/23/2013	Radial vector
	A025	6331	10/15/2012	01/23/2013	Radial vector
	A026	6157	10/15/2012	01/23/2013	Radial vector
	A027	6448	10/15/2012	01/23/2013	Radial vector
	A028	6376	10/15/2012	01/23/2013	Radial vector
	A029	6324	10/15/2012	01/23/2013	Radial vector
	A030	6451	10/15/2012	01/23/2013	Radial vector
	A031	6161	10/15/2012	01/23/2013	Radial vector
	A032	5014	10/15/2012	01/23/2013	Radial vector
	A033	6263	10/15/2012	01/23/2013	Radial vector
	A034	6386	10/15/2012	01/23/2013	Radial vector
	A035	6445	10/15/2012	01/23/2013	Radial vector
	A036	6322	10/15/2012	01/23/2013	Radial vector
	A037	6278	10/15/2012	01/23/2013	Radial vector
	A038	6160	10/15/2012	01/23/2013	Radial vector
	A039	6281	10/15/2012	01/23/2013	Radial vector
	A040	6158	10/15/2012	01/23/2013	Radial vector
	A041	6006	10/15/2012	01/23/2013	Radial vector
	A042	6147	10/15/2012	01/23/2013	Radial vector
	A043	6450	10/15/2012	01/23/2013	Radial vector
	A044	6310	10/15/2012	01/23/2013	Radial vector
	A045	6449	10/15/2012	01/23/2013	Radial vector
	A046	6447	10/15/2012	01/22/2013	Radial vector
	A047	6444	10/15/2012	01/22/2013	Radial vector
	A048	6145	10/15/2012	01/22/2013	Radial vector
	A049	6453	10/15/2012	01/22/2013	Radial vector

Table A.3-2
TLDs at Study Group 1
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Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Tesla (continued)	A050	6314	10/16/2012	01/23/2013	Radial vector
	A051	6117	10/16/2012	01/23/2013	Radial vector
	A052	6005	10/16/2012	01/22/2013	Radial vector
	A053	6377	10/16/2012	01/22/2013	Radial vector
	A054	6455	10/16/2012	01/22/2013	Radial vector
	A055	6007	10/16/2012	01/22/2013	Radial vector
	A056	6191	10/16/2012	01/22/2013	Radial vector
Balloon Pad	A057	3651	10/16/2012	01/22/2013	Radial vector
	A058	3714	10/16/2012	01/22/2013	Radial vector
	A059	4474	10/16/2012	01/22/2013	Radial vector
	A060	6479	10/16/2012	01/22/2013	Radial vector
	A061	5276	10/16/2012	01/22/2013	Radial vector
	A062	5040	10/16/2012	01/22/2013	Radial vector
	A063	4604	10/16/2012	01/22/2013	Radial vector
	A064	4843	10/16/2012	01/22/2013	Radial vector
	A065	4500	10/16/2012	01/22/2013	Radial vector
	A066	1474	10/16/2012	01/22/2013	Radial vector
	A067	4563	10/16/2012	01/22/2013	Radial vector
	A068	6446	10/16/2012	01/22/2013	Radial vector
	A069	4666	10/16/2012	01/22/2013	Radial vector
	A070	5129	10/16/2012	01/22/2013	Radial vector
	A071	4009	10/16/2012	01/22/2013	Radial vector
	A072	4885	10/16/2012	01/22/2013	Radial vector
	A073	4348	10/16/2012	01/22/2013	Radial vector
	A074	5110	10/16/2012	01/22/2013	Radial vector
	A075	4990	10/16/2012	01/22/2013	Radial vector
	A076	5299	10/16/2012	01/22/2013	Radial vector
	A077	6360	10/16/2012	01/22/2013	Radial vector
	A078	4686	10/16/2012	01/22/2013	Radial vector

Table A.3-2
TLDs at Study Group 1
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Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Balloon Pad (continued)	A079	4890	10/16/2012	01/22/2013	Radial vector
	A080	6291	10/16/2012	01/22/2013	Radial vector
	A081	3623	10/16/2012	01/22/2013	Radial vector
	A082	6113	10/16/2012	01/22/2013	Radial vector
	A083	4777	10/16/2012	01/22/2013	Radial vector
	A084	6353	10/16/2012	01/22/2013	Radial vector
	A085	4032	10/16/2012	01/22/2013	Radial vector
	A086	4340	10/16/2012	01/22/2013	Radial vector
	A087	4310	10/16/2012	01/22/2013	Radial vector
	A088	5167	10/16/2012	01/22/2013	Radial vector
	A089	6118	10/16/2012	01/22/2013	Radial vector
	A090	5051	10/16/2012	01/22/2013	Radial vector
	A091	6121	10/16/2012	01/22/2013	Radial vector
	A092	1960	10/16/2012	01/22/2013	Radial vector
	A093	4557	10/16/2012	01/22/2013	Radial vector
	A094	4572	10/16/2012	01/22/2013	Radial vector
	A095	6279	10/16/2012	01/22/2013	Radial vector
	A096	4371	10/16/2012	01/22/2013	Radial vector
	A097	4355	10/16/2012	01/22/2013	Radial vector
	A098	5016	10/16/2012	01/22/2013	Radial vector
	A099	6154	10/16/2012	01/22/2013	Radial vector
	A100	4771	10/16/2012	01/22/2013	Radial vector
	A101	3116	10/16/2012	01/22/2013	Radial vector
	A102	6133	10/16/2012	01/22/2013	Radial vector
	A103	4386	10/16/2012	01/22/2013	Radial vector
	A104	6246	10/16/2012	01/22/2013	Radial vector
	A105	4606	10/16/2012	01/22/2013	Radial vector
	A106	4442	10/16/2012	01/22/2013	Radial vector
	A107	4618	10/16/2012	01/22/2013	Radial vector

Table A.3-2
TLDs at Study Group 1
(Page 5 of 6)

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Balloon Pad (continued)	A108	6384	10/16/2012	01/22/2013	Radial vector
	A109	4506	10/16/2012	01/22/2013	Radial vector
	A110	6043	10/16/2012	01/22/2013	Radial vector
	A111	4673	10/16/2012	01/22/2013	Radial vector
	A112	5257	10/16/2012	01/22/2013	Radial vector
	A113	4530	10/16/2012	01/22/2013	Radial vector
	A114	6243	10/16/2012	01/22/2013	Radial vector
	A115	6004	10/16/2012	01/22/2013	Radial vector
	A116	6315	10/16/2012	01/22/2013	Radial vector
	A117	4746	10/16/2012	01/22/2013	Radial vector
	A118	6371	10/16/2012	01/22/2013	Radial vector
	A119	5162	10/16/2012	01/22/2013	Radial vector
	A120	4576	10/16/2012	01/22/2013	Radial vector
	A121	5264	10/16/2012	01/22/2013	Radial vector
	A122	4571	10/16/2012	01/22/2013	Radial vector
	A123	6372	10/16/2012	01/22/2013	Radial vector
	A124	4216	10/16/2012	01/22/2013	Radial vector
	A125	4289	10/16/2012	01/22/2013	Radial vector
	A126	4112	10/17/2012	01/22/2013	Radial vector
	A127	6105	10/17/2012	01/22/2013	Radial vector
	A128	6129	10/17/2012	01/22/2013	Radial vector
	A129	4956	10/17/2012	01/22/2013	Radial vector
	A130	3534	10/17/2012	01/22/2013	Radial vector
	A131	3795	10/17/2012	01/22/2013	Radial vector
	A132	4477	10/17/2012	01/22/2013	Radial vector
	A133	1234	10/17/2012	01/22/2013	Radial vector
	A134	6065	10/17/2012	01/22/2013	Radial vector
	A135	6471	10/17/2012	01/22/2013	Radial vector
	A136	6003	10/17/2012	01/22/2013	Sample Plot

Table A.3-2
TLDs at Study Group 1
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Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Tesla	A137	6180	10/17/2012	01/23/2013	Sample Plot
Background	H01	6248	10/15/2012	01/23/2013	Background
		6054	11/14/2012	01/23/2013	Background
	H02	4717	10/16/2012	01/23/2013	Background
	H03	6473	10/17/2012	01/22/2013	Background
	H04	4308	04/17/2013	09/16/2013	Background
		6469	06/19/2013	09/16/2013	Background

A.3.1.3.2 Soil Samples

Soil sampling consisted of four composite soil samples collected from each of the two plot locations with the highest field screening readings determined during TRSs. All Study Group 1 soil samples were analyzed for gamma spectroscopy; isotopic uranium (U), plutonium (Pu), and americium (Am); and Pu-241. One sample (A607) was analyzed for strontium (Sr)-90 and technetium (Tc)-99 based on the field readings for alpha and beta levels as determined using hand-held instruments during sample collection. Analysis for each soil sample is specified in Table A.3-3. Additional information including depth and purpose for each soil sample collected for Study Group 1 is provided in Table A.3-4. Sample locations are shown on Figure A.3-2.

Table A.3-3
Study Group 1 Soil Sample Summary

Sample Type	Number of Locations	Number of Soil Samples	Analyses (Method)
Plot	2	8	Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241
Total	2	8	

A.3.2 Deviations/Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2012a) were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

Table A.3-4
Samples Collected at Study Group 1

Release	Location	Sample Number	Depth (cm bgs)	Matrix	Purpose
Balloon Pad	A136	A601	0.0 - 5.0	Soil	Environmental
		A602	0.0 - 5.0	Soil	Environmental
		A603	0.0 - 5.0	Soil	Environmental
		A604	0.0 - 5.0	Soil	Environmental
Tesla	A137	A605	0.0 - 5.0	Soil	Environmental
		A606	0.0 - 5.0	Soil	Environmental
		A607	0.0 - 5.0	Soil	Environmental
		A608	0.0 - 5.0	Soil	Environmental

A.3.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2012a). The radiological results are reported as doses and are comparable to the dose-based FAL of 25 mrem/OU-yr. For chemical contaminants, the results are reported as individual concentrations that are comparable to their corresponding FALs. Results that are equal to or greater than FALs are identified by bold text in the results tables. The analytical parameters and laboratory methods used during this investigation were discussed in the CAIP.

The internal dose calculated from soil sample results and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.3.3.1. Internal doses for each sample plot are summarized in Section A.3.3.2. The TEDs for each sampled location are summarized in Section A.3.3.3. There were no elevated TRS values detected around the UGTA Releases that would indicate the potential presence of COCs originating from any of these release sites.

A.3.3.1 External Radiological Dose Measurements

Estimates for the external dose that a receptor would receive at each Study Group 1 TLD sample location were determined as described in Section A.2.2.5. Measurements for the external dose were

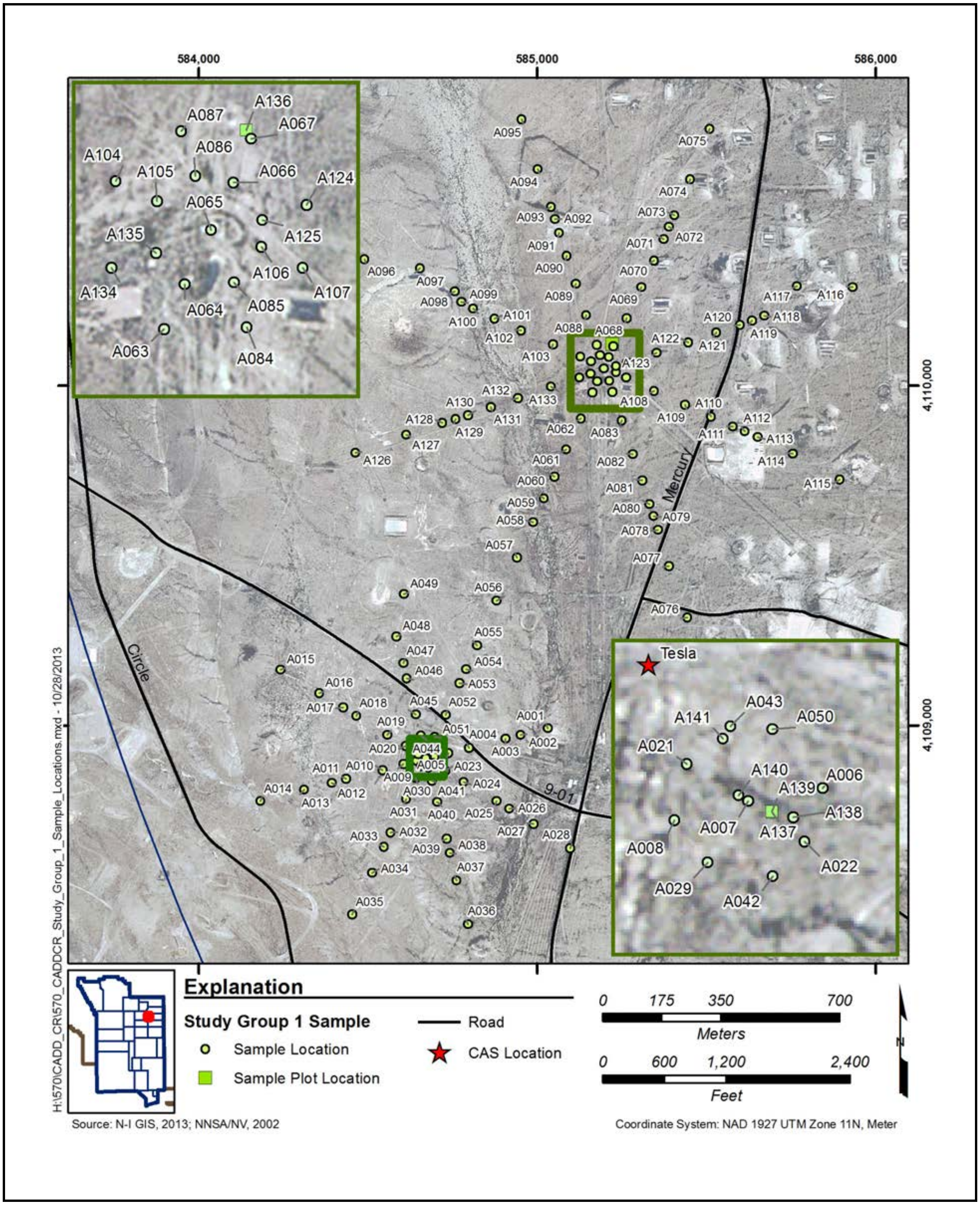

Figure A.3-2
Study Group 1 Sample Locations

calculated for the Industrial Area exposure scenario. Dose values for the Remote Work Area and Occasional Use Area scenarios were calculated by dividing the dose value of the Industrial Area scenario by the 2,000 hours of exposure to get an hourly dose rate and then multiplying by the 336 and 80 hours of annual exposure assumed by the two scenarios. As the resolution of Decision I requires a 95 percent UCL, the standard deviation, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.3-5.

Table A.3-5
Study Group 1 95% UCL External Dose for Each Exposure Scenario
(Page 1 of 5)

Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum[a] Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Tesla	A001	0.1	3	3	9.1	1.5	0.5
	A002	0.1	3	3	11.9	2.0	0.6
	A003	0.1	3	3	9.9	1.7	0.5
	A004	0.1	3	3	19.5	3.3	1.0
	A005	0.1	3	3	**41.0**	6.9	2.1
	A006	0.2	3	3	**72.3**	12.1	3.6
	A007	0.7	3	3	**493.1**	**82.8**	24.7
	A008	0.3	3	3	**77.9**	13.1	3.9
	A009	0.2	3	3	**48.9**	8.2	2.4
	A010	0.1	3	3	21.8	3.7	1.1
	A011	0.1	3	3	17.5	2.9	0.9
	A012	0.1	3	3	14.2	2.4	0.7
	A013	0.0	3	3	8.5	1.4	0.4
	A014	0.1	3	3	9.7	1.6	0.5
	A015	0.1	3	3	8.4	1.4	0.4
	A016	0.1	3	3	9.6	1.6	0.5
	A017	0.1	3	3	19.7	3.3	1.0
	A018	0.1	3	3	22.2	3.7	1.1
	A019	0.1	3	3	**55.1**	9.3	2.8
	A020	0.4	3	3	**79.9**	13.4	4.0
	A021	0.1	3	3	**90.1**	15.1	4.5
	A022	0.1	3	3	**71.4**	12.0	3.6
	A023	0.0	3	3	**29.5**	4.9	1.5
	A024	0.2	3	3	**46.9**	7.9	2.3

Table A.3-5
Study Group 1 95% UCL External Dose for Each Exposure Scenario
(Page 2 of 5)

Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum[a] Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Tesla (continued)	A025	0.1	3	3	9.6	1.6	0.5
	A026	0.1	3	3	10.5	1.8	0.5
	A027	0.0	3	3	6.5	1.1	0.3
	A028	0.1	3	3	4.6	0.8	0.2
	A029	0.1	3	3	**81.5**	13.7	4.1
	A030	0.5	3	3	**131.0**	22.0	6.6
	A031	0.2	3	3	**59.5**	10.0	3.0
	A032	0.0	3	3	11.4	1.9	0.6
	A033	0.1	3	3	12.6	2.1	0.6
	A034	0.0	3	3	6.3	1.1	0.3
	A035	0.1	3	3	9.2	1.5	0.5
	A036	0.1	3	3	6.7	1.1	0.3
	A037	0.0	3	3	8.5	1.4	0.4
	A038	0.1	3	3	13.5	2.3	0.7
	A039	0.1	3	3	20.9	3.5	1.0
	A040	0.0	3	3	**32.2**	5.4	1.6
	A041	0.2	3	3	**93.1**	15.6	4.7
	A042	0.4	3	3	**106.6**	17.9	5.3
	A043	0.2	3	3	**80.8**	13.6	4.0
	A044	0.2	3	3	**75.2**	12.6	3.8
	A045	0.1	3	3	19.6	3.3	1.0
	A046	0.2	3	3	**53.6**	9.0	2.7
	A047	0.1	3	3	**38.4**	6.4	1.9
	A048	0.1	3	3	17.9	3.0	0.9
	A049	0.1	3	3	8.9	1.5	0.4
	A050	0.2	3	3	**74.8**	12.6	3.7
	A051	0.2	3	3	**131.9**	22.2	6.6
	A052	0.2	3	3	**47.5**	8.0	2.4
	A053	0.1	3	3	**31.4**	5.3	1.6
	A054	0.1	3	3	21.2	3.6	1.1
	A055	0.3	3	3	21.8	3.7	1.1
	A056	0.1	3	3	12.2	2.1	0.6

Table A.3-5
Study Group 1 95% UCL External Dose for Each Exposure Scenario
(Page 3 of 5)

Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum[a] Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Balloon Pad	A057	0.1	3	3	12.2	2.1	0.6
	A058	0.0	3	3	10.4	1.8	0.5
	A059	0.0	3	3	17.0	2.9	0.8
	A060	0.1	3	3	24.2	4.1	1.2
	A061	0.1	3	3	**40.7**	6.8	2.0
	A062	0.3	3	3	**85.5**	14.4	4.3
	A063	0.3	3	3	**103.1**	17.3	5.2
	A064	0.2	3	3	**64.5**	10.8	3.2
	A065	0.1	3	3	**43.4**	7.3	2.2
	A066	0.3	3	3	**138.8**	23.3	6.9
	A067	0.2	3	3	**145.0**	24.4	7.2
	A068	0.2	3	3	**87.1**	14.6	4.4
	A069	0.1	3	3	**39.6**	6.7	2.0
	A070	0.0	3	3	5.0	0.8	0.3
	A071	0.1	3	3	18.1	3.0	0.9
	A072	0.1	3	3	13.9	2.3	0.7
	A073	0.0	3	3	12.3	2.1	0.6
	A074	0.1	3	3	4.2	0.7	0.2
	A075	0.0	3	3	2.8	0.5	0.1
	A076	0.0	3	3	0.7	0.1	0.0
	A077	0.0	3	3	4.9	0.8	0.2
	A078	0.1	3	3	10.1	1.7	0.5
	A079	0.1	3	3	14.2	2.4	0.7
	A080	0.0	3	3	15.8	2.7	0.8
	A081	0.1	3	3	22.9	3.8	1.1
	A082	0.1	3	3	**41.7**	7.0	2.1
	A083	0.1	3	3	**35.3**	5.9	1.8
	A084	0.1	3	3	**113.0**	19.0	5.7
	A085	0.1	3	3	**106.4**	17.9	5.3
	A086	0.1	3	3	**95.2**	16.0	4.8
	A087	0.2	3	3	**145.1**	24.4	7.3

Table A.3-5
Study Group 1 95% UCL External Dose for Each Exposure Scenario
(Page 4 of 5)

Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum[a] Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Balloon Pad (continued)	A088	0.4	3	3	**89.1**	15.0	4.5
	A089	0.1	3	3	**43.6**	7.3	2.2
	A090	0.1	3	3	21.4	3.6	1.1
	A091	0.0	3	3	15.0	2.5	0.8
	A092	0.0	3	3	9.9	1.7	0.5
	A093	0.0	3	3	12.7	2.1	0.6
	A094	0.0	3	3	7.9	1.3	0.4
	A095	0.0	3	3	7.6	1.3	0.4
	A096	0.0	3	3	7.7	1.3	0.4
	A097	0.1	3	3	8.3	1.4	0.4
	A098	0.1	3	3	12.6	2.1	0.6
	A099	0.1	3	3	15.0	2.5	0.8
	A100	0.0	3	3	15.4	2.6	0.8
	A101	0.0	3	3	18.8	3.2	0.9
	A102	0.1	3	3	**38.9**	6.5	1.9
	A103	0.3	3	3	**81.4**	13.7	4.1
	A104	0.2	3	3	**72.2**	12.1	3.6
	A105	0.3	3	3	**75.0**	12.6	3.8
	A106	0.5	3	3	**128.4**	21.6	6.4
	A107	0.3	3	3	**123.9**	20.8	6.2
	A108	0.0	3	3	**67.7**	11.4	3.4
	A109	0.1	3	3	**40.2**	6.7	2.0
	A110	0.1	3	3	13.6	2.3	0.7
	A111	0.0	3	3	4.4	0.7	0.2
	A112	0.0	3	3	1.3	0.2	0.1
	A113	0.0	3	3	0.8	0.1	0.0
	A114	0.0	3	3	1.9	0.3	0.1
	A115	0.0	3	3	0.6	0.1	0.0
	A116	0.0	3	3	1.6	0.3	0.1
	A117	0.1	3	3	4.8	0.8	0.2
	A118	0.0	3	3	6.3	1.1	0.3

Table A.3-5
Study Group 1 95% UCL External Dose for Each Exposure Scenario
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Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum[a] Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Balloon Pad (continued)	A119	0.0	3	3	6.7	1.1	0.3
	A120	0.0	3	3	6.7	1.1	0.3
	A121	0.0	3	3	18.3	3.1	0.9
	A122	0.1	3	3	**26.6**	4.5	1.3
	A123	0.1	3	3	**61.7**	10.4	3.1
	A124	0.2	3	3	**118.5**	19.9	5.9
	A125	0.2	3	3	**81.0**	13.6	4.1
	A126	0.0	3	3	8.7	1.5	0.4
	A127	0.0	3	3	9.7	1.6	0.5
	A128	0.1	3	3	15.2	2.5	0.8
	A129	0.1	3	3	16.0	2.7	0.8
	A130	0.1	3	3	17.8	3.0	0.9
	A131	0.0	3	3	21.3	3.6	1.1
	A132	0.1	3	3	**39.8**	6.7	2.0
	A133	0.2	3	3	**68.7**	11.5	3.4
	A134	0.2	3	3	**95.2**	16.0	4.8
	A135	0.2	3	3	**64.8**	10.9	3.2
	Plot A136	0.5	3	3	**154.7**	**26.0**	7.7
Tesla	Plot A137	2.7	3	3	**623.8**	**104.8**	**31.2**

[a] Minimum number of samples required to calculate sample statistics is three.

Bold indicates the values exceeding 25 mrem/yr.

OU = Occasional use

A.3.3.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each Study Group 1 sample location were determined for each exposure scenario as described in Section A.2.2.4. The estimated internal dose for each sample plot location is presented in Table A.3-6. The calculated internal dose for each TLD only location for each exposure scenario are presented in Table A.3-7.

Table A.3-6
Study Group 1 95% UCL Internal Dose for Each Exposure Scenario

Release	Location	Standard Deviation (OU Scenario)	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Balloon Pad	A136	0.0	4	3	0.6	0.1	0.0
Tesla	A137	0.1	4	3	17.7	3.0	1.1

Table A.3-7
Study Group 1 Calculated Internal Dose at Each TLD Location for Each Exposure Scenario
(Page 1 of 5)

Release	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Tesla	A001	1.5	0.2	0.1
	A002	2.1	0.4	0.1
	A003	1.8	0.3	0.1
	A004	3.5	0.6	0.2
	A005	8.2	1.4	0.4
	A006	14.9	2.5	0.7
	A007	**105.4**	17.7	5.3
	A008	15.5	2.6	0.8
	A009	9.4	1.6	0.5
	A010	4.4	0.7	0.2
	A011	3.3	0.5	0.2
	A012	2.6	0.4	0.1
	A013	1.6	0.3	0.1
	A014	1.8	0.3	0.1
	A015	1.3	0.2	0.1
	A016	1.7	0.3	0.1
	A017	4.0	0.7	0.2
	A018	4.6	0.8	0.2
	A019	11.8	2.0	0.6
	A020	15.1	2.5	0.8

Table A.3-7
Study Group 1 Calculated Internal Dose at Each TLD Location for Each Exposure Scenario
(Page 2 of 5)

Release	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Tesla (continued)	A021	19.3	3.2	1.0
	A022	15.3	2.6	0.8
	A023	6.3	1.1	0.3
	A024	8.8	1.5	0.4
	A025	1.8	0.3	0.1
	A026	1.9	0.3	0.1
	A027	1.2	0.2	0.1
	A028	0.6	0.1	0.0
	A029	17.3	2.9	0.9
	A030	**25.8**	4.3	1.3
	A031	12.3	2.1	0.6
	A032	2.2	0.4	0.1
	A033	2.4	0.4	0.1
	A034	1.1	0.2	0.1
	A035	1.6	0.3	0.1
	A036	1.0	0.2	0.1
	A037	1.9	0.3	0.1
	A038	2.3	0.4	0.1
	A039	3.8	0.6	0.2
	A040	7.2	1.2	0.4
	A041	19.7	3.3	1.0
	A042	21.1	3.5	1.1
	A043	16.4	2.8	0.8
	A044	15.6	2.6	0.8
	A045	3.5	0.6	0.2
	A046	10.6	1.8	0.5
	A047	7.9	1.3	0.4
	A048	3.4	0.6	0.2
	A049	1.5	0.2	0.1

Table A.3-7
Study Group 1 Calculated Internal Dose at Each TLD Location for Each Exposure Scenario
(Page 3 of 5)

Release	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Tesla (continued)	A050	15.5	2.6	0.8
	A051	**27.9**	4.7	1.4
	A052	9.0	1.5	0.5
	A053	6.2	1.0	0.3
	A054	4.4	0.7	0.2
	A055	2.8	0.5	0.1
	A056	2.3	0.4	0.1
Balloon Pad	A057	2.0	0.3	0.1
	A058	0.1	0.0	0.0
	A059	0.1	0.0	0.0
	A060	0.2	0.0	0.0
	A061	0.3	0.1	0.0
	A062	0.7	0.1	0.0
	A063	0.9	0.1	0.0
	A064	0.5	0.1	0.0
	A065	0.4	0.1	0.0
	A066	1.2	0.2	0.1
	A067	1.3	0.2	0.1
	A068	0.7	0.1	0.0
	A069	0.3	0.1	0.0
	A070	0.0	0.0	0.0
	A071	0.1	0.0	0.0
	A072	0.1	0.0	0.0
	A073	0.1	0.0	0.0
	A074	0.0	0.0	0.0
	A075	0.0	0.0	0.0
	A076	0.0	0.0	0.0
	A077	0.0	0.0	0.0
	A078	0.1	0.0	0.0

Table A.3-7
Study Group 1 Calculated Internal Dose at Each TLD Location for Each Exposure Scenario
(Page 4 of 5)

Release	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Balloon Pad (continued)	A079	0.1	0.0	0.0
	A080	0.1	0.0	0.0
	A081	0.2	0.0	0.0
	A082	0.3	0.1	0.0
	A083	0.3	0.0	0.0
	A084	1.0	0.2	0.1
	A085	0.9	0.2	0.0
	A086	0.8	0.1	0.0
	A087	1.3	0.2	0.1
	A088	0.7	0.1	0.0
	A089	0.4	0.1	0.0
	A090	0.2	0.0	0.0
	A091	0.1	0.0	0.0
	A092	0.1	0.0	0.0
	A093	0.1	0.0	0.0
	A094	0.1	0.0	0.0
	A095	0.1	0.0	0.0
	A096	0.1	0.0	0.0
	A097	0.1	0.0	0.0
	A098	0.1	0.0	0.0
	A099	0.1	0.0	0.0
	A100	0.1	0.0	0.0
	A101	0.2	0.0	0.0
	A102	0.3	0.1	0.0
	A103	0.7	0.1	0.0
	A104	0.6	0.1	0.0
	A105	0.6	0.1	0.0
	A106	1.0	0.2	0.1
	A107	1.0	0.2	0.1

Table A.3-7
Study Group 1 Calculated Internal Dose at Each TLD Location for Each Exposure Scenario
(Page 5 of 5)

Release	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Balloon Pad (continued)	A108	0.6	0.1	0.0
	A109	0.3	0.1	0.0
	A110	0.1	0.0	0.0
	A111	0.0	0.0	0.0
	A112	0.0	0.0	0.0
	A113	0.0	0.0	0.0
	A114	0.0	0.0	0.0
	A115	0.0	0.0	0.0
	A116	0.0	0.0	0.0
	A117	0.0	0.0	0.0
	A118	0.0	0.0	0.0
	A119	0.1	0.0	0.0
	A120	0.1	0.0	0.0
	A121	0.2	0.0	0.0
	A122	0.2	0.0	0.0
	A123	0.5	0.1	0.0
	A124	1.0	0.2	0.1
	A125	0.7	0.1	0.0
	A126	0.1	0.0	0.0
	A127	0.1	0.0	0.0
	A128	0.1	0.0	0.0
	A129	0.1	0.0	0.0
	A130	0.1	0.0	0.0
	A131	0.2	0.0	0.0
	A132	0.3	0.1	0.0
	A133	0.6	0.1	0.0
	A134	0.8	0.1	0.0
	A135	0.5	0.1	0.0

Bold indicates the values exceeding 25 mrem/yr.

Table A.3-8 presents a comparison of the internal and external doses at each sample plot. This demonstrates that internal dose at Study Group 1 comprises less than 4 percent of TED.

Table A.3-8
Study Group 1 Ratio of Calculated Internal Dose to External Dose at Each Plot

Release	Location	Average Internal Dose	Average External Dose	Average Total Dose	Internal to External Dose Ratio
		(mrem/OU-yr)			
Balloon Pad	Plot A136	0.0	6.9	6.9	0.00
Tesla	Plot A137	0.9	**26.6**	**27.6**	0.03

Bold indicates the values exceeding 25 mrem/yr.

A.3.3.3 Total Effective Dose

The TED for each sample plot and TLD location was calculated by adding the external dose values and the internal dose values as described in Section A.2.3. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.3-9.

Table A.3-9
Study Group 1 TED at Sample Locations
(Page 1 of 6)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
		(mrem/yr)					
Tesla	A001	7.9	10.5	1.3	1.8	0.4	0.5
	A002	11.5	14.1	1.9	2.4	0.6	0.7
	A003	9.6	11.7	1.6	2.0	0.5	0.6
	A004	18.9	23.0	3.2	3.9	0.9	1.1
	A005	**44.7**	**49.3**	7.5	8.3	2.2	2.5
	A006	**80.9**	**87.2**	13.6	14.6	4.0	4.4
	A007	**573.7**	**598.6**	**96.4**	**100.6**	**28.7**	**29.9**
	A008	**84.4**	**93.5**	14.2	15.7	4.2	4.7
	A009	**50.9**	**58.2**	8.6	9.8	2.5	2.9

Table A.3-9
Study Group 1 TED at Sample Locations
(Page 2 of 6)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
		(mrem/yr)					
Tesla (continued)	A010	24.0	**26.2**	4.0	4.4	1.2	1.3
	A011	17.7	20.8	3.0	3.5	0.9	1.0
	A012	14.1	16.8	2.4	2.8	0.7	0.8
	A013	8.9	10.2	1.5	1.7	0.4	0.5
	A014	9.7	11.5	1.6	1.9	0.5	0.6
	A015	7.0	9.6	1.2	1.6	0.3	0.5
	A016	9.4	11.3	1.6	1.9	0.5	0.6
	A017	21.5	23.7	3.6	4.0	1.1	1.2
	A018	**25.2**	**26.9**	4.2	4.5	1.3	1.3
	A019	**64.0**	**66.9**	10.8	11.2	3.2	3.3
	A020	**82.0**	**95.0**	13.8	16.0	4.1	4.8
	A021	**105.1**	**109.4**	17.7	18.4	5.3	5.5
	A022	**83.1**	**86.7**	14.0	14.6	4.2	4.3
	A023	**34.1**	**35.7**	5.7	6.0	1.7	1.8
	A024	**48.1**	**55.7**	8.1	9.4	2.4	2.8
	A025	9.6	11.3	1.6	1.9	0.5	0.6
	A026	10.2	12.4	1.7	2.1	0.5	0.6
	A027	6.6	7.7	1.1	1.3	0.3	0.4
	A028	3.5	5.3	0.6	0.9	0.2	0.3
	A029	**94.2**	**98.8**	15.8	16.6	4.7	4.9
	A030	**140.3**	**156.8**	23.6	**26.3**	7.0	7.8
	A031	**66.7**	**71.8**	11.2	12.1	3.3	3.6
	A032	12.0	13.6	2.0	2.3	0.6	0.7
	A033	12.9	14.9	2.2	2.5	0.6	0.7
	A034	6.0	7.4	1.0	1.2	0.3	0.4
	A035	8.5	10.7	1.4	1.8	0.4	0.5
	A036	5.5	7.8	0.9	1.3	0.3	0.4
	A037	10.3	10.4	1.7	1.8	0.5	0.5

Table A.3-9
Study Group 1 TED at Sample Locations
(Page 3 of 6)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
		(mrem/yr)					
Tesla (continued)	A038	12.7	15.8	2.1	2.7	0.6	0.8
	A039	20.7	24.7	3.5	4.1	1.0	1.2
	A040	**39.2**	**39.4**	6.6	6.6	2.0	2.0
	A041	**107.3**	**112.9**	18.0	19.0	5.4	5.6
	A042	**114.7**	**127.6**	19.3	21.4	5.7	6.4
	A043	**89.1**	**97.2**	15.0	16.3	4.5	4.9
	A044	**85.0**	**90.8**	14.3	15.3	4.2	4.5
	A045	19.1	23.1	3.2	3.9	1.0	1.2
	A046	**57.6**	**64.2**	9.7	10.8	2.9	3.2
	A047	**43.0**	**46.3**	7.2	7.8	2.2	2.3
	A048	18.3	21.3	3.1	3.6	0.9	1.1
	A049	8.1	10.3	1.4	1.7	0.4	0.5
	A050	**84.3**	**90.3**	14.2	15.2	4.2	4.5
	A051	**151.9**	**159.8**	**25.5**	**26.8**	7.6	8.0
	A052	**49.1**	**56.5**	8.3	9.5	2.5	2.8
	A053	**33.8**	**37.6**	5.7	6.3	1.7	1.9
	A054	23.8	**25.6**	4.0	4.3	1.2	1.3
	A055	15.5	24.7	2.6	4.1	0.8	1.2
	A056	12.5	14.5	2.1	2.4	0.6	0.7
Balloon Pad	A057	10.6	14.2	1.8	2.4	0.5	0.7
	A058	9.8	10.5	1.6	1.8	0.5	0.5
	A059	15.8	17.1	2.7	2.9	0.8	0.9
	A060	21.1	24.4	3.5	4.1	1.1	1.2
	A061	**36.2**	**41.0**	6.1	6.9	1.8	2.1
	A062	**76.8**	**86.2**	12.9	14.5	3.8	4.3
	A063	**93.3**	**103.9**	15.7	17.5	4.7	5.2
	A064	**57.4**	**65.0**	9.6	10.9	2.9	3.2
	A065	**41.8**	**43.7**	7.0	7.3	2.1	2.2

Table A.3-9
Study Group 1 TED at Sample Locations
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Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
		(mrem/yr)					
Balloon Pad (continued)	A066	**131.0**	**140.0**	22.0	23.5	6.6	7.0
	A067	**137.9**	**146.2**	23.2	24.6	6.9	7.3
	A068	**79.6**	**87.9**	13.4	14.8	4.0	4.4
	A069	**35.4**	**40.0**	5.9	6.7	1.8	2.0
	A070	4.4	5.1	0.7	0.9	0.2	0.3
	A071	16.1	18.3	2.7	3.1	0.8	0.9
	A072	12.1	14.0	2.0	2.4	0.6	0.7
	A073	11.1	12.4	1.9	2.1	0.6	0.6
	A074	1.8	4.2	0.3	0.7	0.1	0.2
	A075	1.3	2.8	0.2	0.5	0.1	0.1
	A076	0.0	0.7	0.0	0.1	0.0	0.0
	A077	4.4	4.9	0.7	0.8	0.2	0.2
	A078	8.3	10.1	1.4	1.7	0.4	0.5
	A079	11.5	14.3	1.9	2.4	0.6	0.7
	A080	15.4	16.0	2.6	2.7	0.8	0.8
	A081	21.4	23.1	3.6	3.9	1.1	1.2
	A082	**38.3**	**42.1**	6.4	7.1	1.9	2.1
	A083	**31.7**	**35.6**	5.3	6.0	1.6	1.8
	A084	**112.3**	**114.0**	18.9	19.2	5.6	5.7
	A085	**102.7**	**107.3**	17.2	18.0	5.1	5.4
	A086	**91.5**	**96.0**	15.4	16.1	4.6	4.8
	A087	**139.5**	**146.4**	23.4	24.6	7.0	7.3
	A088	**77.5**	**89.8**	13.0	15.1	3.9	4.5
	A089	**39.6**	**44.0**	6.7	7.4	2.0	2.2
	A090	19.3	21.6	3.2	3.6	1.0	1.1
	A091	13.7	15.1	2.3	2.5	0.7	0.8
	A092	9.3	10.0	1.6	1.7	0.5	0.5
	A093	11.2	12.8	1.9	2.2	0.6	0.6

Table A.3-9
Study Group 1 TED at Sample Locations
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Release	**Location**	**Industrial Area**		**Remote Work Area**		**Occasional Use Area**	
		Average TED	**95% UCL of TED**	**Average TED**	**95% UCL of TED**	**Average TED**	**95% UCL of TED**
		(mrem/yr)					
Balloon Pad (continued)	A094	6.6	7.9	1.1	1.3	0.3	0.4
	A095	6.4	7.7	1.1	1.3	0.3	0.4
	A096	6.2	7.8	1.0	1.3	0.3	0.4
	A097	5.9	8.4	1.0	1.4	0.3	0.4
	A098	9.6	12.7	1.6	2.1	0.5	0.6
	A099	12.3	15.1	2.1	2.5	0.6	0.8
	A100	14.4	15.5	2.4	2.6	0.7	0.8
	A101	18.4	19.0	3.1	3.2	0.9	0.9
	A102	**35.6**	**39.2**	6.0	6.6	1.8	2.0
	A103	**71.8**	**82.1**	12.1	13.8	3.6	4.1
	A104	**66.7**	**72.8**	11.2	12.2	3.3	3.6
	A105	**67.0**	**75.7**	11.3	12.7	3.3	3.8
	A106	**112.5**	**129.4**	18.9	21.7	5.6	6.5
	A107	**115.0**	**124.9**	19.3	21.0	5.8	6.2
	A108	**67.0**	**68.3**	11.3	11.5	3.3	3.4
	A109	**37.7**	**40.5**	6.3	6.8	1.9	2.0
	A110	11.3	13.7	1.9	2.3	0.6	0.7
	A111	2.8	4.4	0.5	0.7	0.1	0.2
	A112	0.0	1.3	0.0	0.2	0.0	0.1
	A113	0.0	0.8	0.0	0.1	0.0	0.0
	A114	0.7	1.9	0.1	0.3	0.0	0.1
	A115	0.0	0.6	0.0	0.1	0.0	0.0
	A116	0.0	1.6	0.0	0.3	0.0	0.1
	A117	3.0	4.9	0.5	0.8	0.2	0.2
	A118	5.3	6.3	0.9	1.1	0.3	0.3
	A119	6.4	6.8	1.1	1.1	0.3	0.3
	A120	6.3	6.7	1.1	1.1	0.3	0.3
	A121	17.4	18.4	2.9	3.1	0.9	0.9

Table A.3-9
Study Group 1 TED at Sample Locations
(Page 6 of 6)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
		(mrem/yr)					
Balloon Pad (continued)	A122	22.1	**26.8**	3.7	4.5	1.1	1.3
	A123	**57.6**	**62.2**	9.7	10.5	2.9	3.1
	A124	**113.2**	**119.5**	19.0	20.1	5.7	6.0
	A125	**75.7**	**81.7**	12.7	13.7	3.8	4.1
	A126	7.7	8.8	1.3	1.5	0.4	0.4
	A127	8.6	9.8	1.4	1.6	0.4	0.5
	A128	12.5	15.3	2.1	2.6	0.6	0.8
	A129	13.7	16.2	2.3	2.7	0.7	0.8
	A130	16.1	17.9	2.7	3.0	0.8	0.9
	A131	20.9	21.5	3.5	3.6	1.0	1.1
	A132	**37.8**	**40.1**	6.3	6.7	1.9	2.0
	A133	**64.0**	**69.3**	10.8	11.6	3.2	3.5
	A134	**90.8**	**96.1**	15.3	16.1	4.5	4.8
	A135	**58.7**	**65.3**	9.9	11.0	2.9	3.3
	Plot A136	**138.4**	**155.2**	23.2	**26.1**	6.9	7.8
Tesla	Plot A137	**547.8**	**641.5**	**92.0**	**107.8**	**27.6**	**32.3**

Bold indicates the values exceeding 25 mrem/yr.

The 95 percent UCL of TED exceeds the FAL of 25 mrem/OU-yr at sample plot A137 and TLD location A007 (Figure A.3-3). A statistical plot for the correlation analysis between TED values and radiation survey values is shown at the lower right corner of the figure.

A.3.4 Nature and Extent of COCs

Based on the data evaluation and the proposed scenario, COCs were identified in Study Group 1 at sample locations A007 and A137 because the 95 percent UCL of TED at these locations was greater than the FAL of 25 mrem/OU-yr. Therefore, corrective action was required. To determine the extent of the corrective action, a TRS was conducted in a dense circular pattern around A137 to a radius of

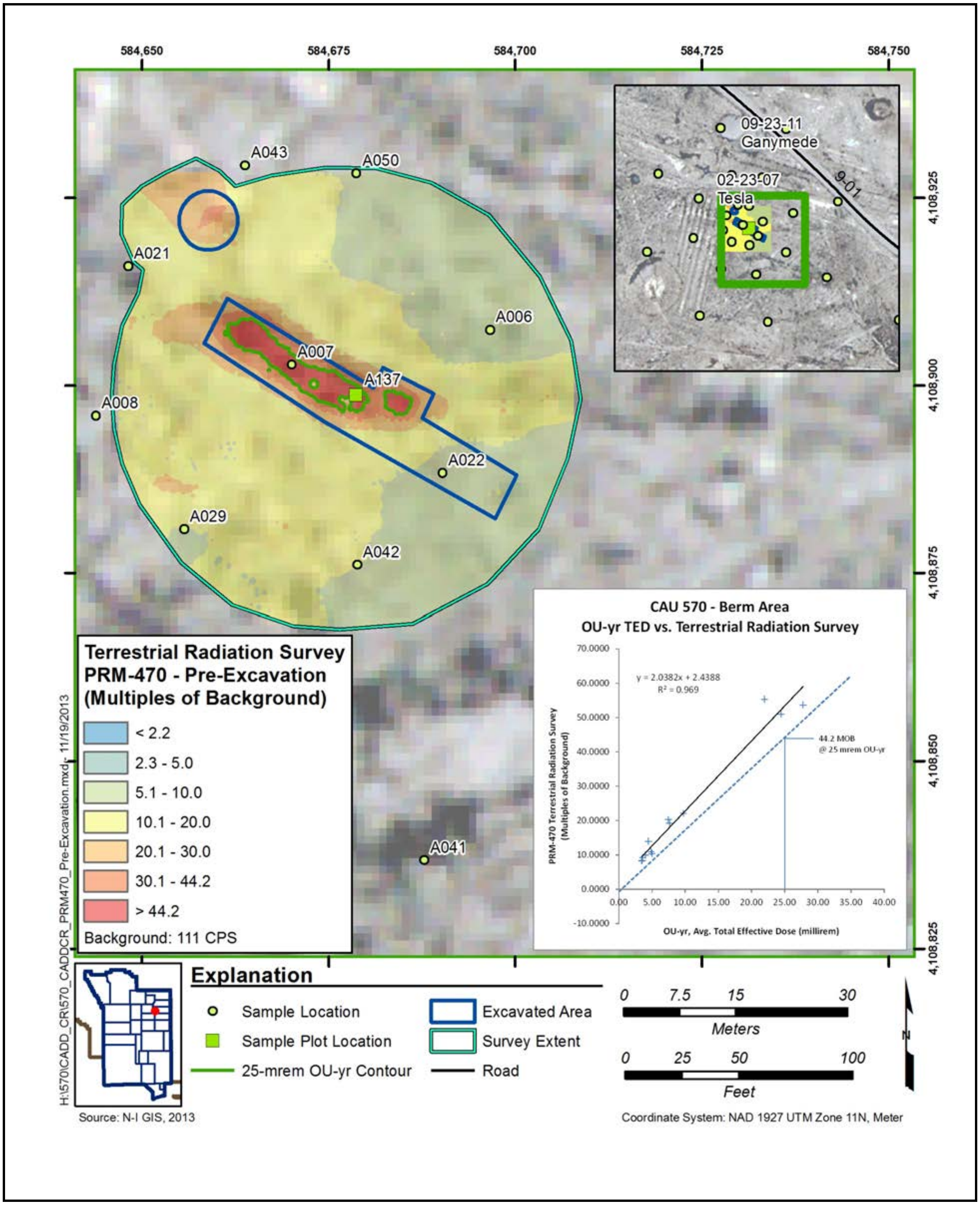


Figure A.3-3
Pre-Excavation Survey Results

about 30 m (Figure A.3-3). A correlation of radiation survey values to TED values as described in Section A.2.6 was conducted. The radiation survey and TED values exhibited a correlation of 0.97. This correlation exceeds the minimum criteria of 0.8 as set in the Soils RBCA document (NNSA/NSO, 2012d). Based on this correlation, the radiation survey value that corresponds to the 25-mrem/OU-yr FAL is 44.2 multiples of background. The corrective action boundary was established to encompass the TRS isopleth of 44.2 multiples of background.

A.3.5 Corrective Actions

An interim corrective action of excavation, removal, and disposal of the soil in the area that exceeds 25 mrem/OU-yr was implemented during the CAI. Excavation resulted in the removal of 77 yd^3 of soil. See Section A.7.0 for information on the management, characterization, and disposal of this waste.

A.3.6 Verification Sample Results

To ensure that all soils exhibiting a dose greater than FALs were removed, verification sampling was conducted. Four locations were selected (A138 through A141) for verification sampling, which consisted of TLD samples (570A238, 570A239, 570A240, and 570A241); three grab soil samples (A009, 010, and 015); and one soil plot sample (A011 through A014). Locations were biased to the highest post-excavation radiation survey readings and analyzed to ensure that soils with a dose greater than the FAL were removed. Figure A.3-4 displays the results of the post-excavation survey and the location of the verification samples. Verification sample analyses results are presented in Table A.3-10. Based on the analytical results of the verification samples, no further corrective action is required.

A.3.7 BMPs

As a BMP, an administrative UR was established to include any area where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr.
To determine the extent of the area where the Industrial Area TED exceeds the PAL (25 mrem/IA-yr), a correlation of radiation survey values to the Industrial Area TED values was conducted for each radiation survey. The radiation survey with the best correlation was the TRS. Based on this correlation, the radiation survey value that corresponds to the 25-mrem/IA-yr FAL is 4.07 multiples

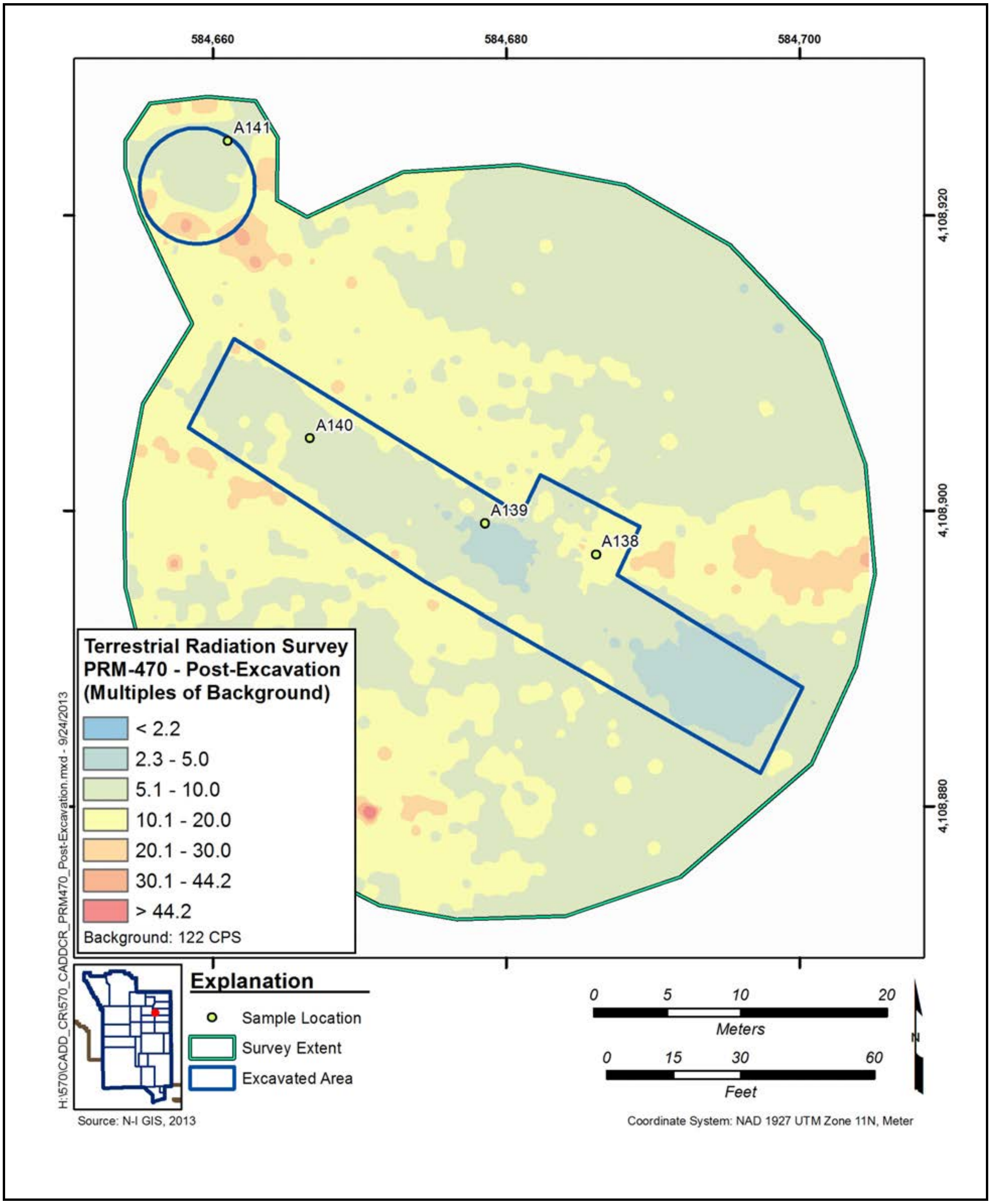


Figure A.3-4
Post-Excavation High-Density Radiological Survey

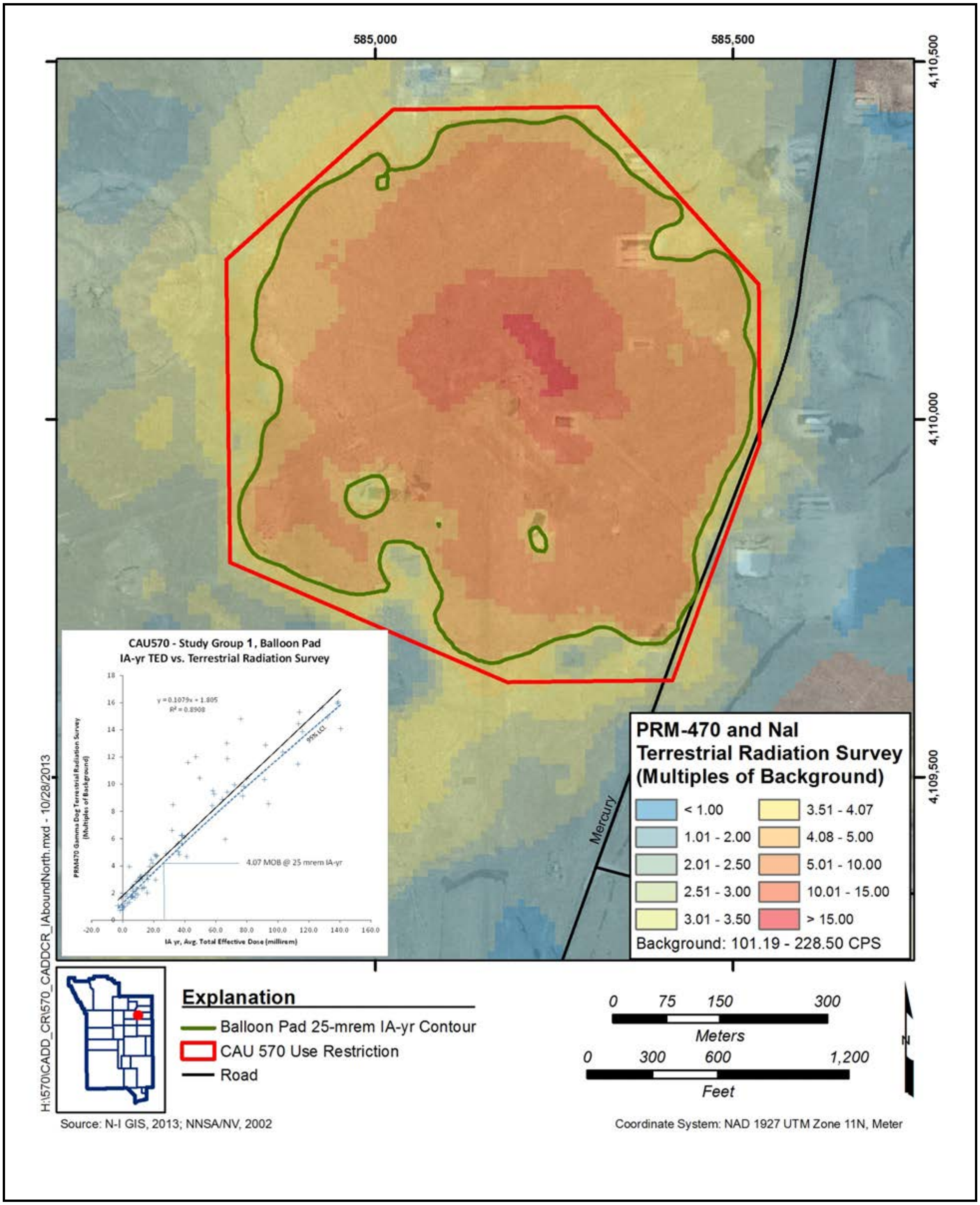
Table A.3-10
Confirmation Sample Results

Release	Location	Sample Number	Industrial Area		Remote Work Area		Occasional Use Area	
			Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Tesla	A138	A009	**72.9**	**78.9**	12.3	13.3	3.7	4.0
	A139	A011– A014	**53.8**	**63.3**	9.0	10.6	2.7	3.2
	A140	A010	**73.1**	**75.6**	12.3	12.7	3.7	3.8
	A141	A015	**80.2**	**86.5**	13.5	14.5	4.0	4.3

Bold indicates the values exceeding 25 mrem/yr.

of background for the area around the Balloon Pad and 2.44 multiples of background for the area around Tesla as shown on Figures A.3-5 and A.3-6 (respectively). An administrative UR was established to encompass these areas. A statistical plot for the correlation analysis between TED values and radiation survey values is shown at the lower left corner of each figure.

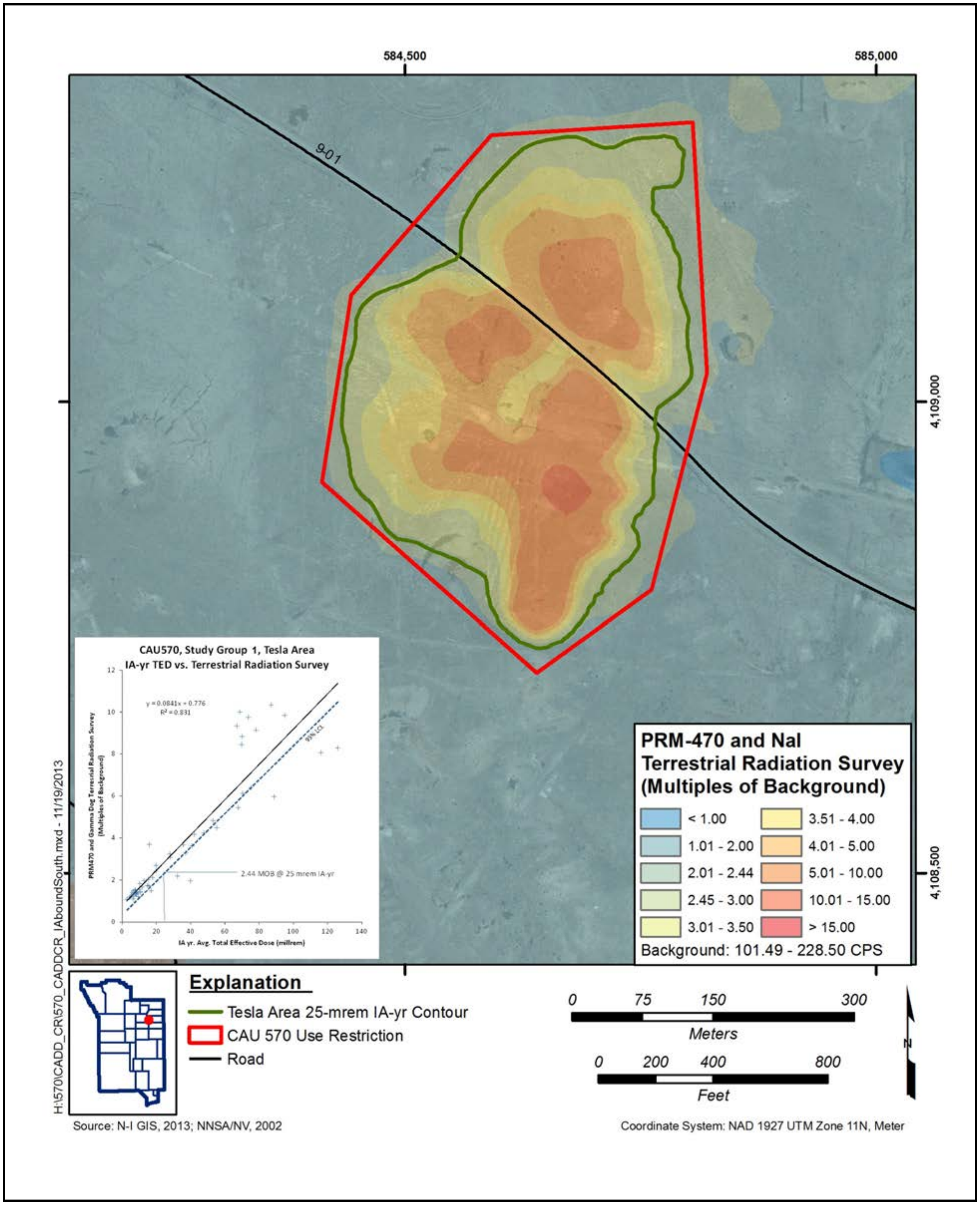
Considering radioactive decay mechanisms only (with contamination erosion and transport mechanisms removed), the sampled location with the maximum TED at Balloon Pad (Location A087) is predicted to decay to less than 25 mrem/IA-yr in approximately 40 years, and the sampled location with the maximum TED at Tesla (Location A051) is predicted to decay to less than 25 mrem/IA-yr in approximately 40 years.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.3-5
25-mrem/IA-yr Contour and Administrative UR (Balloon Pad area)



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.3-6
25-mrem/IA-yr Contour and Administrative UR (Tesla area)

A.4.0 Study Group 2, Safety/Low-Yield Tests

Study Group 2, Safety/Low-Yield Tests, addresses the atmospheric deposition of radionuclides from safety or low-yield experiments throughout the area of CAU 570. As only two of the CASs were safety or low-yield tests, this is defined as the area in the vicinity of Sugar and Ganymede where unfissioned nuclear material has been deposited onto the soil surface and has not subsequently been displaced through excavation or migration. Additional detail on the history of Study Group 2 is provided in the CAIP (NNSA/NSO, 2012a).

A.4.1 Corrective Action Investigation Activities

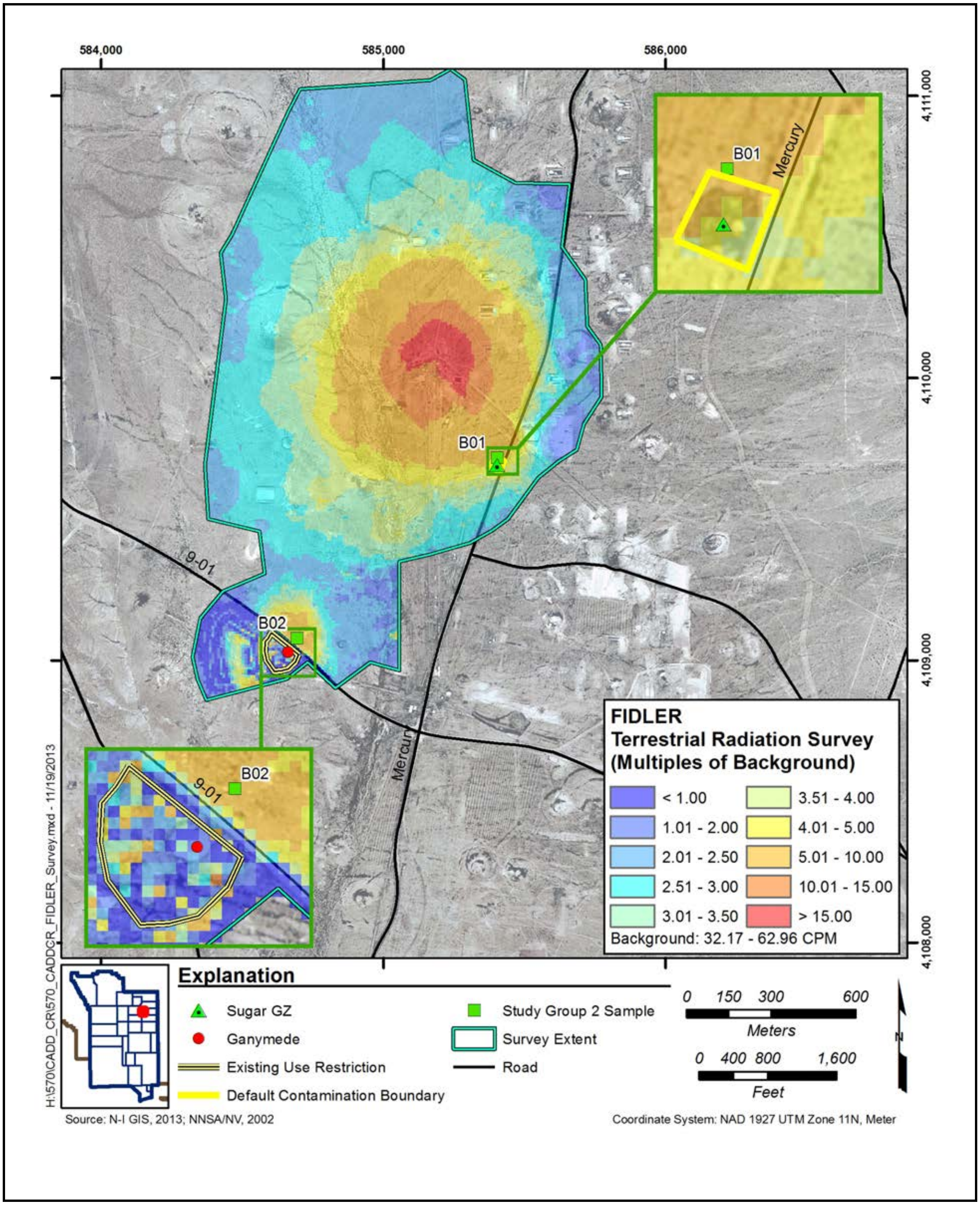
The specific CAI activities conducted to satisfy the CAIP requirements at Study Group 2 (NNSA/NSO, 2012a) are described in the following subsections.

A.4.1.1 Visual Inspections

Visual inspections of Study Group 2—including site walks, sampling efforts, and radiological surveys—were conducted over the course of the field investigation. The presence of scattered debris was identified and addressed in the Study Group 2 investigation. However, no biasing factors indicating the potential release of contamination were identified, and no additional samples were collected as a result of the visual inspection. Visual inspections also included looking for drainages that may have facilitated the migration of contaminants; however, the only visible drainages identified were the ones that flowed along the Old Mercury Highway and into the crater at Sugar.

A.4.1.2 Radiological Surveys

GPS-assisted TRSs were performed at CAU 570 in support of the Study Group 2 investigation.
A FIDLER was used to detect the locations of highest alpha/beta contamination in the areas around Sugar and Ganymede. The highest Study Group 2 radiological readings using the FIDLER were detected north of the Ganymede site and north of the Sugar site. Sample plots were established at the locations with the maximum detected alpha/beta radiological readings. Figure A.4-1 presents a graphic representation of the data from the TRS.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.4-1
TRSs at Study Group 2

A.4.1.3 Sample Collection

Soil plots were located (one in the area of Sugar and one in the area of Ganymede) where the FIDLER results were the highest (B01 and B02, respectively). Samples were collected and analyzed to satisfy the CAIP requirements at Study Group 2 (NNSA/NSO, 2012a). The TLD and soil sample purpose and location information is provided in the following subsections.

A.4.1.3.1 TLD Samples

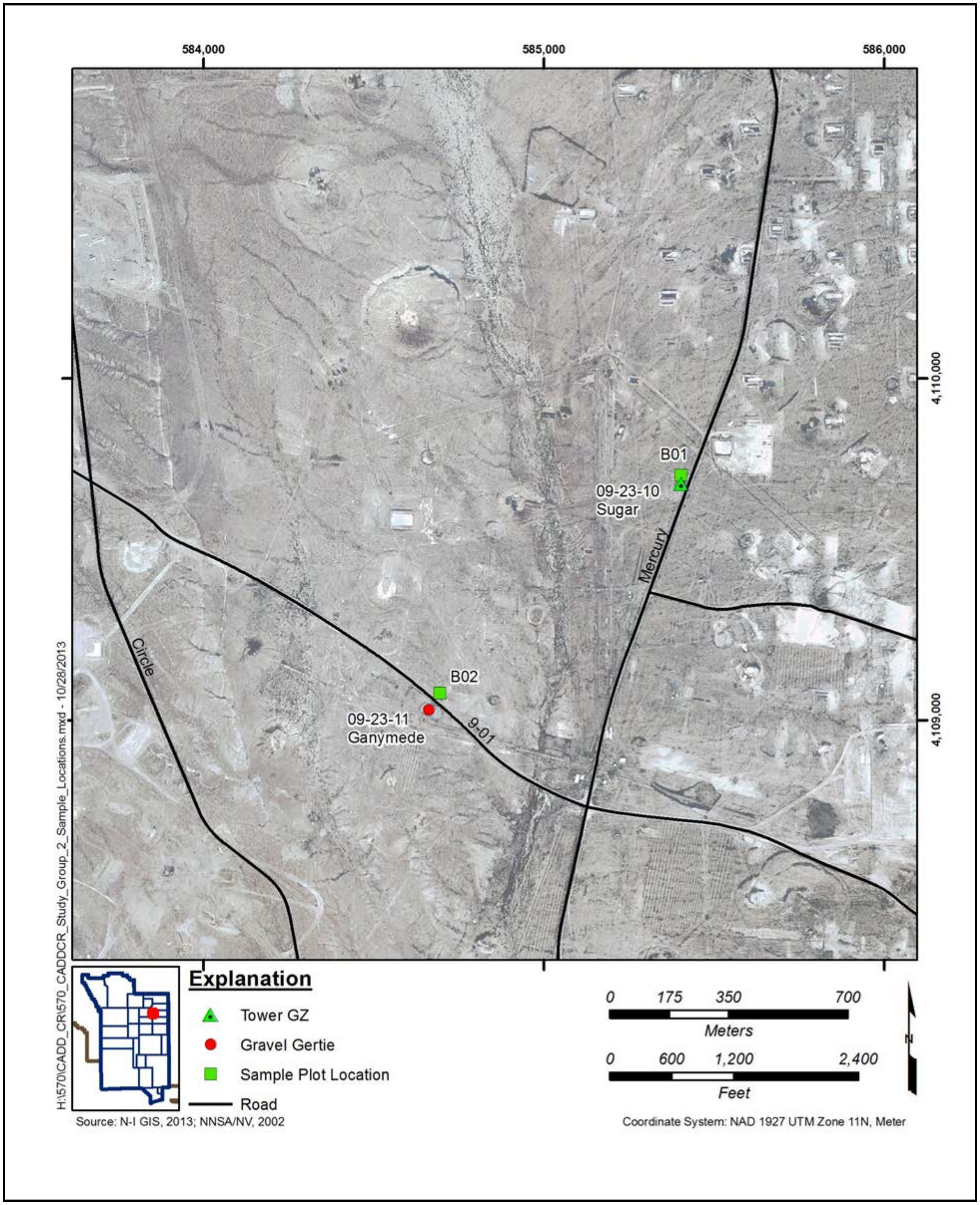
TLDs were placed at sample plot locations B01 and B02 (Figure A.4-2). Once the general areas of highest readings were determined as described in Section A.4.1.2, the final sample locations were determined using the same equipment and surveying the area until the locations with the highest readings were identified. TLDs were used to measure external dose as part of the Study Group 2 investigation. Table A.4-1 contains TLD information organized by sample type. The TLDs listed in Table A.4-2 were used to measure external dose as part of the Study Group 2 investigation.
All environmental monitoring TLD program and TLD QC are presented in Section A.8.5.

A.4.1.3.2 Soil Samples

Soil sampling consisted of four composite soil plot samples collected from each of the two areas with the highest field screening readings (locations B01 and B02) determined during TRSs as described in Section A.4.1.2. All Study Group 2 soil samples were analyzed for gamma spectroscopy; isotopic U, Pu, and Am; and Pu-241. Two samples (B604 and B605) were analyzed for Sr-90 and Tc-99 based on the field readings for alpha and beta levels as determined using hand-held instruments during sample collection. Analysis for each soil sample is specified in Table A.4-3. Additional information including depth and purpose for each soil sample collected for Study Group 2 is provided in Table A.4-4. Sample locations are shown on Figure A.4-2.

A.4.2 Deviations/Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2012a) were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.4-2
Study Group 2 Sample Locations

Table A.4-1
Study Group 2 TLD Sample Summary

Sample Type	Number of Locations	Number of TLDs	Analyses (Method)
Plot	2	2	*Nevada Test Site Routine Radiological Environmental Monitoring Plan*[a]
Total	2	2	

[a] BN, 2003

Table A.4-2
TLDs at Study Group 2

Release	Location	TLD No.	Date Placed	Date Removed	Description
Sugar	B01	6061	10/17/2012	01/22/2013	Sample Plot
Ganymede	B02	5026	10/17/2012	01/22/2013	Sample Plot

Table A.4-3
Study Group 2 Soil Sample Summary

Sample Type	Number of Locations	Number of Soil Samples	Analyses (Method)
Plot	2	8	Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241

Table A.4-4
Samples Collected at Study Group 2

Release	Location	Sample Number	Depth (cm bgs)	Matrix	Purpose
Sugar	B01	B601	0.0 - 5.0	Soil	Environmental
		B602	0.0 - 5.0	Soil	Environmental
		B603	0.0 - 5.0	Soil	Environmental
		B604	0.0 - 5.0	Soil	Environmental
Ganymede	B02	B605	0.0 - 5.0	Soil	Environmental
		B606	0.0 - 5.0	Soil	Environmental
		B607	0.0 - 5.0	Soil	Environmental
		B608	0.0 - 5.0	Soil	Environmental

A.4.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2012a). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. For chemical contaminants, the results are reported as individual concentrations that are comparable to their corresponding FALs. Results that are equal to or greater than FALs are identified by bold text in the results tables. The analytical parameters and laboratory methods used during this investigation were discussed in the CAIP.

The internal dose calculated from soil sample results and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.4.3.1. Internal doses for each sample plot are summarized in Section A.4.3.2. The TEDs for each sampled location are summarized in Section A.4.3.3.

A.4.3.1 External Radiological Dose Measurements

Estimates for the external dose that a receptor would receive at each Study Group 2 TLD sample location were determined as described in Section A.2.2.5. Measurements for the external dose were calculated for the Industrial Area exposure scenario. Dose values for the Remote Work Area and Occasional Use Area scenarios were calculated by dividing the dose value of the Industrial Area scenario by the 2,000 hours of exposure to get an hourly dose rate and then multiplying by the 336 and 80 hours of annual exposure assumed by the two scenarios. As the resolution of Decision I requires a 95 percent UCL, the standard deviation, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.4-5.

A.4.3.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each Study Group 2 sample plot were determined as described in Section A.2.2.4. The standard deviation, number of samples, minimum sample size, and 95 percent UCL of the internal dose for each exposure scenario are presented in Table A.4-6.

Table A.4-5
Study Group 2 95% UCL External Dose for Each Exposure Scenario

Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum[a] Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Sugar	B01	0.1	3	3	**68.6**	11.5	3.4
Ganymede	B02	0.2	3	3	**79.6**	13.4	4.0

[a] Minimum number of samples required to calculate sample statistics is three.

Bold indicates the values exceeding 25 mrem/yr.

Table A.4-6
Study Group 2 95% UCL Internal Dose for Each Exposure Scenario

Release	Location	Standard Deviation (OU Scenario)	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Sugar	B01	0.0	4	3	1.7	0.3	0.1
Ganymede	B02	0.1	4	3	8.8	1.5	0.5

Table A.4-7 presents a comparison of the internal and external doses at each sample plot. This demonstrates that external dose at Study Group 2 comprises a large percentage of TED and exceeds internal dose at both sample plots.

Table A.4-7
Study Group 2 Ratio of Calculated Internal Dose to External Dose at Each Plot (mrem/OU-yr)

Release	Location	Average Internal Dose	Average External Dose	Average Total Dose	Internal to External Dose Ratio
Sugar	B01	0.1	3.3	3.4	0.03
Ganymede	B02	0.4	3.6	4.0	0.11

A.4.3.3 Total Effective Dose

The TED for each sample plot was calculated by adding the external dose values to the internal dose values as described in Section A.2.3. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area and Occasional Use Area exposure scenarios are presented in Table A.4-8.

Table A.4-8
Study Group 2 TED at Sample Locations (mrem/yr)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Sugar	B01	**66.8**	**70.3**	11.2	11.8	3.4	3.5
Ganymede	B02	**78.7**	**88.3**	13.2	14.8	4.0	4.5

Bold indicates the values exceeding 25 mrem/yr.

The 95 percent UCL of TED does not exceed the FAL of 25 mrem/OU-yr at either of the Study Group 2 sample plots.

A.4.4 Nature and Extent of COCs

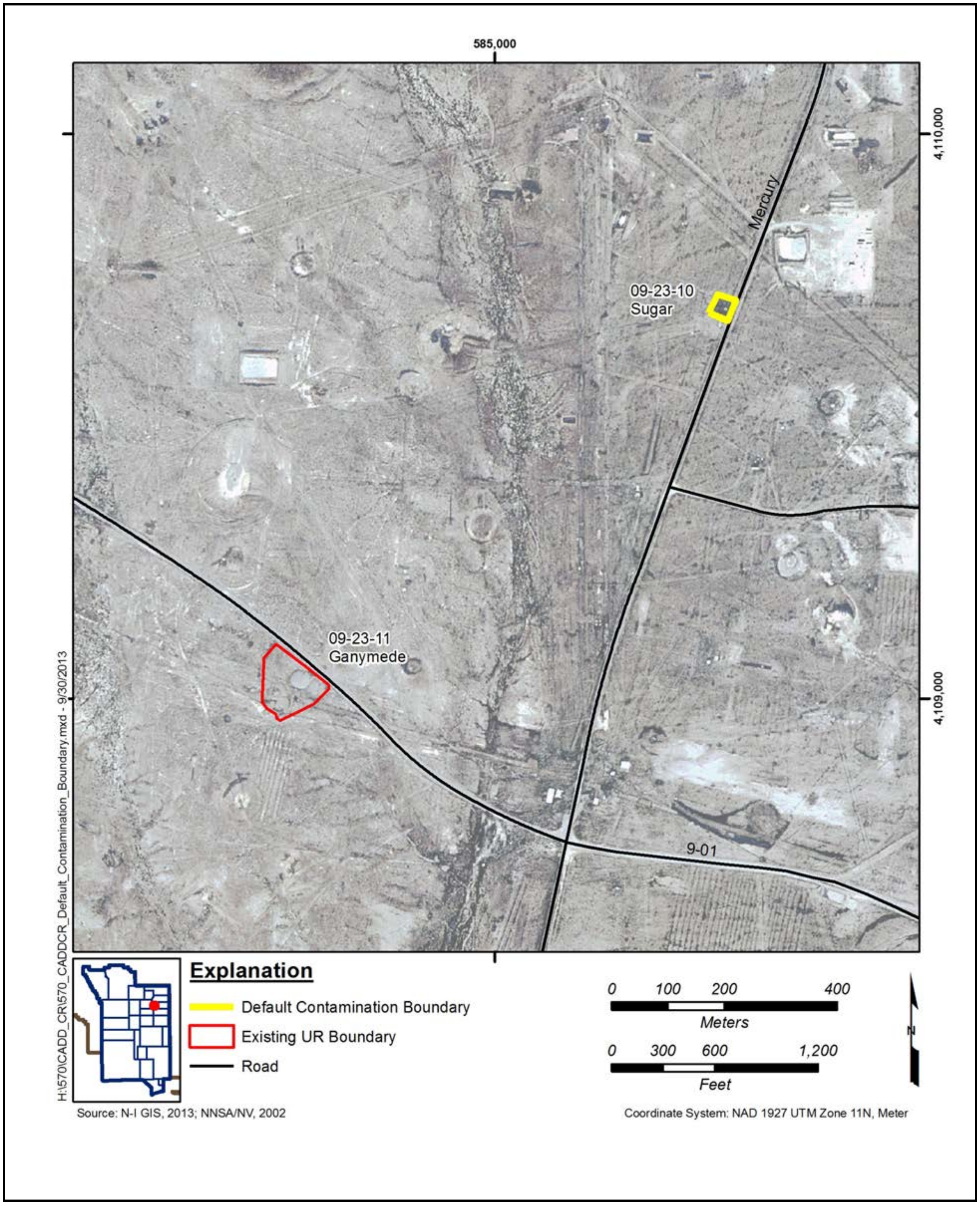
It is assumed that the DCB at Sugar contains COCs. This assumed presence of COCs requires corrective action. The extent of the COC contamination at Sugar is defined by the physical dimensions of the crater at Sugar. The affected volume of contaminated material at Sugar is estimated to be 8,100 cubic meters (m^3) based on the assumption that contamination extends down 25 ft over the contamination area (CA). No radiological contamination associated with Study Group 2 was identified on the ground surface outside Ganymede and Sugar that exceeded 25 mrem/OU-yr. Based on the assumed presence of COCs in the subsurface soil, the CAA of closure in place with an FFACO UR was selected for the Sugar DCB (see Appendix E). This area is shown on Figure A.4-3.

A.4.5 Corrective Actions

An FFACO UR already exists at the Ganymede gravel gertie that is associated with CAS 09-23-01 (an Industrial Sites CAS). The existing UR was for contamination located inside the gravel gertie and was closed with the understanding that the surface contamination was to be evaluated by the Soils Activity (CAU 570). Based on CAU 570 CAI results, no surface contamination exceeding the FALs is present, so the existing UR at Ganymede is sufficient. No further action at Ganymede is required. The documentation defining and establishing the FFACO UR at Sugar is presented in Attachment D-1.

A.4.6 BMPs

No BMPs were conducted for Study Group 2 releases.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.4-3
DCBs at Study Group 2

A.5.0 Study Group 3, Debris/Spills

Study Group 3, Debris/Spills, addresses any chemical and/or radiological contamination associated with debris and/or spills throughout the area of CAU 570. Additional detail on the history of Study Group 3 is provided in the CAIP (NNSA/NSO, 2012a).

A.5.1 Corrective Action Investigation Activities

The specific CAI activities conducted to satisfy the CAIP requirements at Study Group 3 (NNSA/NSO, 2012a) are described in the following subsections.

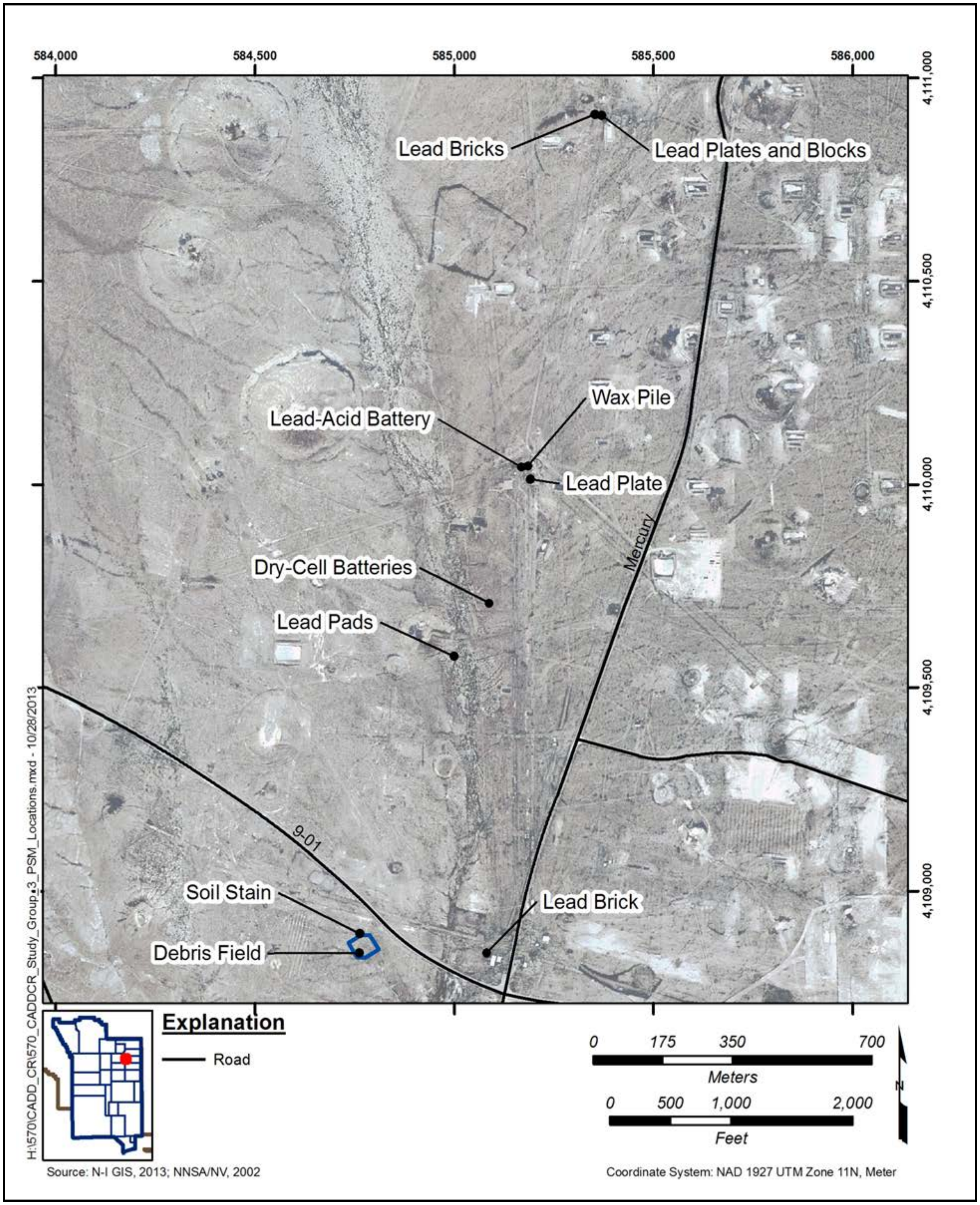
A.5.1.1 Visual Inspections

Visual inspections for Study Group 3—including site walks and sampling efforts—were conducted over the course of the field investigation. Biasing factors indicating the potential release of lead and hydrocarbon contamination were identified during the investigation.

During the visual inspection, the items discovered included a pile of lead pieces containing 34 bricks and plates located approximately 300 m north of Balloon Pad; 1 lead plate alongside a pile of wax approximately 25 m west of Balloon Pad; 2 lead pads approximately 50 m south of Eagle; and 1 lead brick approximately 100 m northwest of the intersection of Old Mercury Highway and the 9-01 Road on the north side of the 9-01 Road. An area containing approximately 10 dry-cell batteries was discovered approximately 100 m northeast of Eagle. A single lead-acid battery was discovered approximately 50 m west of Balloon Pad. A debris field approximately 50 m square and an area of stained soil approximately 2 m in diameter was discovered on the south side of the 9-01 Road near Ganymede (Figure A.5-1). (See Table A.5-1 for a list of the type, number, and analyses of characterization soil samples that were collected.)

A.5.1.2 Geophysical Surveys

Geophysical surveys were conducted as part of the Study Group 3 investigation. Although a considerable amount of surface debris was present, geophysical surveys in the areas of the lead bricks/plates pile, the lead pads, the debris field, and Balloon Pad demonstrate that no landfills are located in those areas that are considered to be the areas of greatest likelihood as determined by visual



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.5-1
Study Group 3 Visual Survey Results

survey. As a result of the geophysical survey, the extent of a debris field located during the visual inspection was determined by surface debris. The complete technical report of the geophysical surveys is located in Appendix G of this document.

A.5.1.3 Sample Collection

Twenty-one soil samples were collected to satisfy the CAIP requirements (NNSA/NSO, 2012a) at Study Group 3. Table A.5-1 shows the type, number, and analysis of soil samples collected. Soil samples for Study Group 3 were analyzed for chemical contaminants including RCRA metals as well as the other analyses listed in Table A.5-1. Additional information, including depth and type of each soil sample collected for each release of Study Group 3, is provided in Table A.5-2. Sample locations are shown on Figure A.5-2.

Table A.5-1
Study Group 3 Soil Sample Summary

Release	Sample Type	Number of Locations	Number of Soil Samples	Analyses (Method)
Debris Field	Plot	1 (1 Plot)	13	RCRA Metals, VOCs, SVOCs, PCBs, Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241
Lead Pads	Grab	8	9	RCRA Metals
Wax Pile	Grab	1	1	RCRA Metals, VOCs, SVOCs, Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241
Total		10	23	

During the preliminary investigations, a lead-acid battery, lead bricks/plates, and lead pads were identified throughout the CAU 570 site. Soil samples were collected to characterize the soil surrounding the items and debris. A total of 20 soil samples and 1 FD were collected.

Soil samples C001 through C009 were collected from around lead pads near Eagle from a depth of 0 to 5 cm to determine whether contaminants had migrated from the lead pads into the surrounding environment. Soil samples C801 through C813 were collected from a depth of 0 to 15 cm from probabilistic locations to characterize the soil within the debris field. A sample was collected from the soil beneath the wax pile, C012, from a depth of 15 to 25 cm. All samples were radiologically field screened and sent to the laboratory for analysis. The analysis for each sample is listed in Table A.5-1.

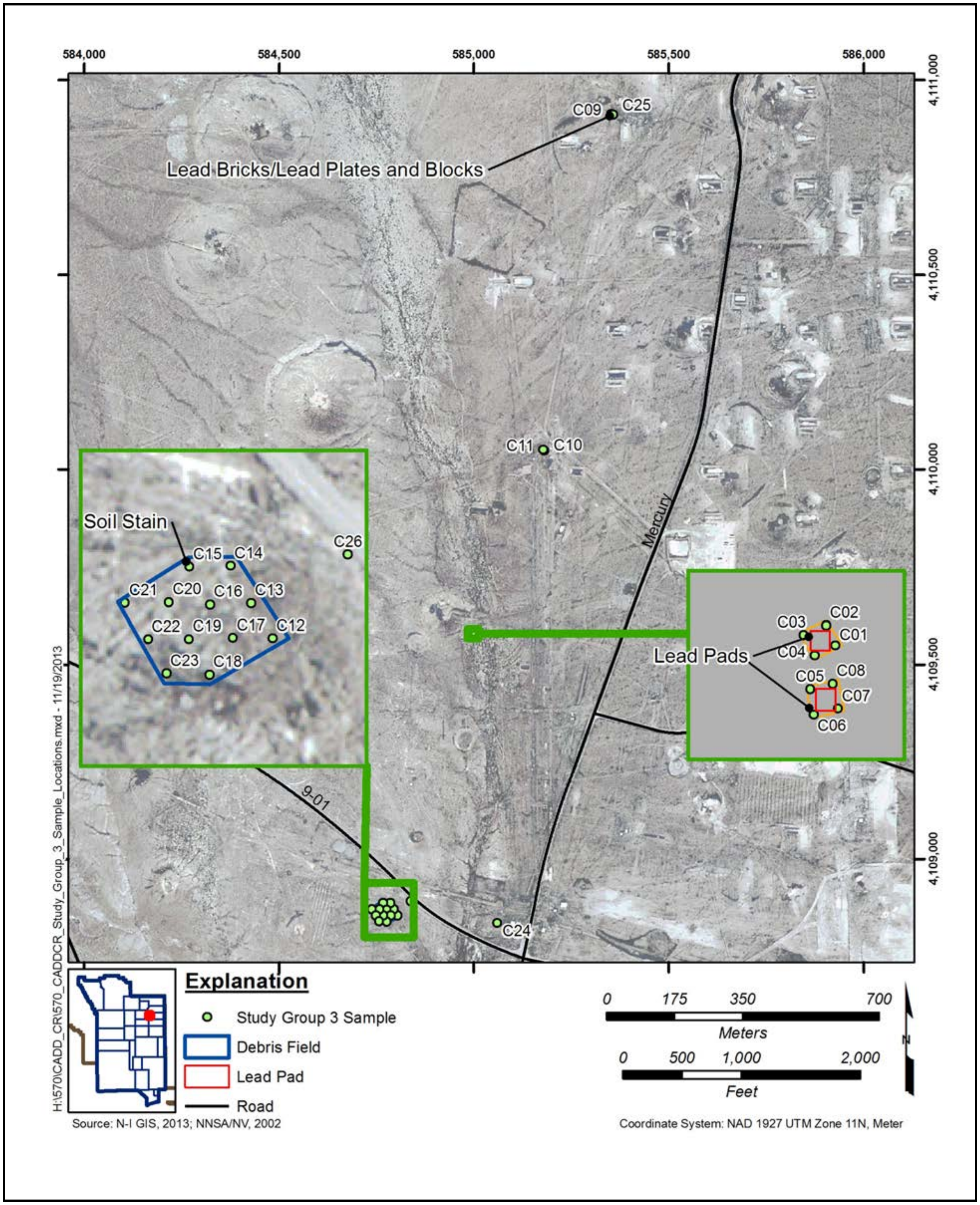
Table A.5-2
Samples Collected at Study Group 3

Release	Location	Sample Number	Depth (cm bgs)	Matrix	Purpose
Lead Pads	C01	C001	0.0 - 5.0	Soil	Grab/Bounding
		C002	0.0 - 5.0	Soil	Grab/Bounding
	C02	C003	0.0 - 5.0	Soil	Grab/Bounding
	C03	C004	0.0 - 5.0	Soil	Grab/Bounding
	C04	C005	0.0 - 5.0	Soil	Grab/Bounding
	C05	C006	0.0 - 5.0	Soil	Grab/Bounding
	C06	C007	0.0 - 5.0	Soil	Grab/Bounding
	C07	C008	0.0 - 5.0	Soil	Grab/Bounding
	C08	C009	0.0 - 5.0	Soil	Grab/Bounding
Wax Pile	C11	C012	5.0 - 10.0	Soil	Grab
Debris Field	C12	C801	0.0 - 5.0	Soil	Probabilistic
		C802	0.0 - 5.0	Soil	FD of C801
	C13	C803	0.0 - 5.0	Soil	Probabilistic
	C14	C804	0.0 - 5.0	Soil	Probabilistic
	C15	C805	0.0 - 5.0	Soil	Probabilistic
	C16	C806	0.0 - 5.0	Soil	Probabilistic
	C17	C807	0.0 - 5.0	Soil	Probabilistic
	C18	C808	0.0 - 5.0	Soil	Probabilistic
	C19	C809	0.0 - 5.0	Soil	Probabilistic
	C20	C810	0.0 - 5.0	Soil	Probabilistic
	C21	C811	0.0 - 5.0	Soil	Probabilistic
	C22	C812	0.0 - 5.0	Soil	Probabilistic
	C23	C813	0.0 - 5.0	Soil	Probabilistic

FD = Field duplicate

A.5.2 Deviations/Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2012a) were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions to the CSM were necessary.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.5-2
Study Group 3 Sample Locations

A.5.3 Investigation Results

The following subsections present the analytical and computational results for the Study Group 3 samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2012a). For chemical contaminants, the results are reported as individual concentrations that are comparable to their corresponding FALs. Results that are equal to or greater than FALs are identified by bold text in the results tables. The analytical parameters and laboratory methods used during this investigation were discussed in the CAIP.

Judgmental sampling was planned and implemented for Study Group 3 by selecting locations of maximum expected contamination and are not intended to be representative of the area. Probabilistic sampling was implemented for the debris field, generating a statistical basis for characterization of the entire area.

A.5.3.1 Total Effective Dose

The TED for the C11 (judgmental sample) and C12-C23 (probabilistic samples) was estimated from TED RRMGs. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.5-3. TED did not exceed the radiological FAL of 25-mrem/OU-yr at any sample locations (Figure A.5-2).

Table A.5-3
Study Group 3, TED at Sample Locations (mrem/yr)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Wax Pile	C11	20.9	--	3.5	--	1.1	--
Debris Field	C12–C23	9.4	11.3	1.6	1.9	0.5	0.6

-- = Not detected

A.5.3.2 Chemical Contaminants

Analytical results exceeding MDCs from the Study Group 3 samples identified in Table A.5-3 are presented in the following subsections. Results from Samples C801 through C813 are reported as an average of the area.

As presented in the following subsections, no chemical contaminants in soil samples exceeded a FAL. However, the lead bricks/plates, the lead-acid battery, and the two lead pads near Eagle were identified as metallic lead and are considered to be PSM. Corrective action is required for these PSM items. The hydrocarbon spill was also assumed to have contaminants at concentrations greater than FALs and requires corrective action.

A.5.3.2.1 RCRA Metals

The analytical results for RCRA metals in samples that exceeded the MDCs are shown in Table A.5-4. No results exceeded the FAL.

Table A.5-4
Study Group 3 Sample Results for Metals
(Page 1 of 2)

Release	Sample		COPCs (mg/kg)							
	Location	Number	Arsenic	Barium	Beryllium	Cadmium	CrVI	Lead	Mercury	Silver
	FALs		23	190,000	6,900	9,300	5.6	800	43	5,100
Lead Pads	C01	C001	2.78	150 (J+)	--	0.351 (J)	--	16.8	0.03	0.452 (J)
		C002	2.85	161 (J+)	--	0.325 (J)	--	15.5	0.037	0.637
	C02	C003	2.32	137 (J+)	--	0.342 (J)	--	14.3	0.026	0.553
	C03	C004	3.14	103 (J+)	--	0.158 (J)	--	17.6	0.026	0.266 (J)
	C04	C005	2.73	123 (J+)	--	0.215 (J)	--	18.1	0.021	0.276 (J)
	C05	C006	2.5	120 (J+)	--	0.134 (J)	--	14.4	0.025	0.298 (J)
	C06	C007	2.98	135 (J+)	--	0.315 (J)	--	23.3	0.033	0.401 (J)
	C07	C008	2.81	152 (J+)	--	0.256 (J)	--	15.7	0.037	0.458 (J)
	C08	C009	3.11	149 (J+)	--	0.339 (J)	--	15.5	0.026	0.481

Table A.5-4
Study Group 3 Sample Results for Metals
(Page 2 of 2)

Release	Sample		COPCs (mg/kg)							
	Location	Number	Arsenic	Barium	Beryllium	Cadmium	CrVI	Lead	Mercury	Silver
	FALs		23	190,000	6,900	9,300	5.6	800	43	5,100
Wax Pile	C11	C012	3.48	114	--	--	--	11.8 (J)	0.016	0.268 (J)
Debris Field	C12–C23	C801–C813[a]	4.73	149.98	0.874	1.164	1.43	221.1	0.023	0.517

[a] The UCL95 was calculated for sample numbers C801–C813.

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

CrVI = Hexavalent chromium

A.5.3.2.2 VOCs

No analytical results for VOCs exceeded the MDCs.

A.5.3.2.3 SVOCs

The analytical results for SVOCs in samples that exceeded the MDCs are shown in Table A.5-5. No results exceeded the FAL.

A.5.3.2.4 PCBs

The analytical results for PCBs in samples that exceeded the MDCs are shown in Table A.5-6. No results exceeded the FAL.

A.5.4 Nature and Extent of COCs

The extent of the PSM was defined by the physical dimensions of each item. This was verified by the absence of COCs in sample results from locations C01 through C09 collected around the lead pads and in verification sample results from locations C010 through C014 collected from soils beneath lead bricks/plates.

Table A.5-5
Study Group 3 Sample Results for SVOCs

Sample Number	COPCs (mg/kg)															
	2-Methylnaphthalene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Carbazole	Chrysene	Dibenzo(a,h)anthracene	Diethyl phthalate	Di-N-butyl phthalate	Fluoranthene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
FAL	**2,200**	**2.1**	**0.21**	**2.1**	**17,000**	**21**	**95.8**	**210**	**0.21**	**490,000**	**62,000**	**22,000**	**2.1**	**18**	**170,000**	**17,000**
C012 (Wax Pile)	--	--	--	--	--	--	--	--	--	0.131 (J)	--	--	--	--	--	--
C801–C813[a] (Debris Field)	0.02	0.04	0.06	0.1	0.05	0.03	0.003	0.07	0.01	--	0.02	0.05	0.04	0.01	0.03	0.05

[a] The UCL95 was calculated for sample numbers C801–C813.

J = Estimated value.
-- = Not detected.

Table A.5-6
Study Group 3 Sample Results for PCBs

Sample Number	COPCs (mg/kg)		
	Aroclor 1254	Aroclor 1260	Aroclor 1268
FALs	**0.740**	**0.740**	**0.740**
C801–C813[a] (Debris Field)	0.126	0.079	0.021

[a] The UCL95 was calculated for sample number C801–C813.

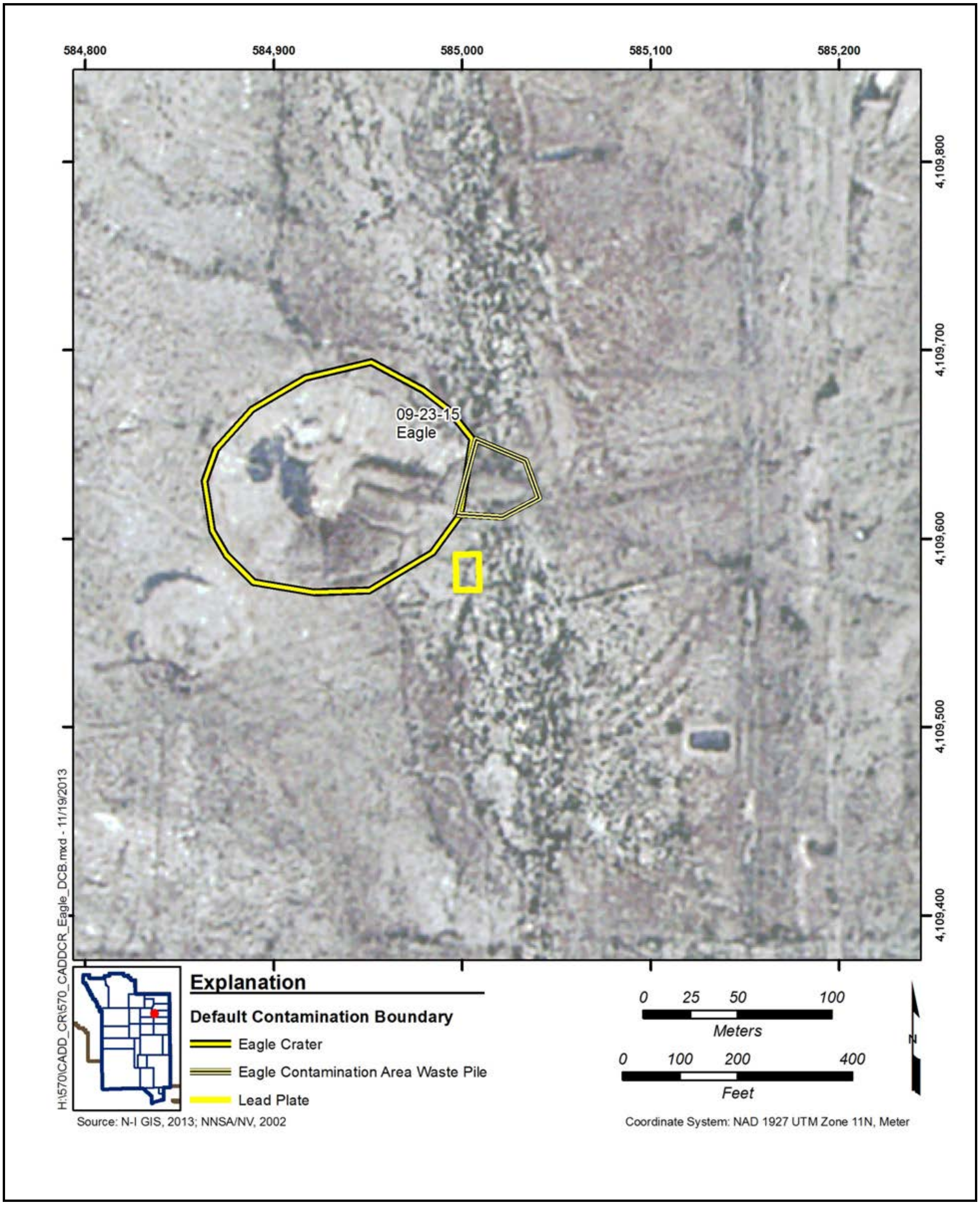
For the stained soil area, the extent of contamination was determined by the presence of discolored soil. This was verified by the absence of COCs in sample results from location C015 collected from the soil at the bottom of the excavation after the corrective action.

A.5.5 Corrective Actions

The presence of lead bricks/plates, lead pads, and a lead-acid battery required corrective action. Because of the ease of accessibility, the lead bricks/plates were collected, double-wrapped in plastic, and prepared for inclusion in a load of other lead objects to be recycled. Any soil that was in direct contact with the lead was removed and placed in a 55-gal drum and prepared for disposal. The lead-acid battery was found in its plastic case, which was still intact and was removed and recycled. In the case of the lead pads, because of the way the lead pads were affixed to large cement foundations and the potential for worker exposure to contaminants, the corrective action of closure in place with an FFACO UR was selected for this area. The area that encompasses the lead pads is shown on Figure A.5-3. The FFACO UR that includes the lead pads is presented in Attachment D-1.

The stained soil also required corrective action. Any soil that appeared stained (approximately 25 gal) was removed and placed in a 55-gal drum and prepared for disposal.

The waste pile located at Eagle is assumed to contain COCs, which necessitates a corrective action. The extent of the COC contamination is defined by the perimeter of the fence encircling Eagle. The affected volume of the contaminated material at Eagle is estimated to be 1,750 m^3.
No radiological contamination associated with the Study Group 1 investigation or debris/spill contamination associated with the Study Group 3 investigation was identified on the ground surface



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.5-3
Study Group 3 Locations

outside Eagle. Based on the assumed presence of COCs at Eagle, the corrective action of closure in place with an FFACO UR was selected for this area (see Appendix E). This area is shown on Figure A.5-3. The FFACO UR is presented in Attachment D-1.

A.5.6 Verification Sample Results

Soil samples C010, C011, C013, and C014 (shown in Table A.5-7) were collected from soil beneath lead bricks/plates to determine whether contaminants had migrated from the lead bricks/plates into the surrounding environment. Soil sample C015 was collected from the soil at the bottom of the excavation after the corrective action.

Table A.5-7
Verification Samples Collected in Support of the Study Group 3 Investigation

Release	Location	Sample Number	Depth (cm bgs)	Matrix	Description
Lead Bricks/Plates	C09	C010	10.0 - 15.0	Soil	Verification
	C10	C011	10.0 - 15.0	Soil	Verification
	C24	C013	12.0 - 18.0	Soil	Verification
	C25	C014	12.0 - 18.0	Soil	Verification
Stained Soil	C26	C015	20.0 - 30.0	Soil	Verification

A.5.6.1 Metals

The analytical results for RCRA metals in verification samples that exceeded the MDCs are shown in Table A.5-8. No analytical results for RCRA metals exceeded MDCs at the stained soil location. No results exceeded the FAL.

A.5.6.2 SVOCs

The analytical results for SVOCs in verification samples that exceeded the MDCs are shown in Table A.5-9. No analytical results for SVOCs exceeded MDCs from samples collected under the lead bricks/plates. No results exceeded the FAL.

Table A.5-8
Study Group 3 Verification Sample Results for Metals

Sample			COPCs (mg/kg)					
Release	**Location**	**Number**	**Arsenic**	**Barium**	**Cadmium**	**Lead**	**Mercury**	**Silver**
FALs			**23**	**190,000**	**9,300**	**800**	**43**	**5,100**
Lead Bricks/Plates	C09	C010	4.15	158	--	36 (J)	0.016	0.701 (J)
	C10	C011	3.9	148	0.121 (J)	12 (J)	0.026	0.16 (J)
	C24	C013	2.97	144	0.4 (J)	42.9 (J)	0.011 (J)	--
	C25	C014	2.68	248	0.28 (J)	31.8 (J)	0.013	--

J = Estimated value.
-- = Not detected

Table A.5-9
Study Group 3 Verification Sample Results for SVOCs

Release	Sample Number	COPCs (mg/kg)	
		2-Methylnaphthalene	**Naphthalene**
FAL		**2,200**	**18**
Stained Soil	C015	0.068	0.012 (J)

J = Estimated value.

A.5.7 BMPs

As a BMP, the debris (e.g., scrap metal, porcelain, wood, nails) from the debris field was collected and disposed of as low-level waste.

A.6.0 Study Group 4, Migration/Mechanical Disturbances

Study Group 4, Migration/Mechanical Disturbances, addresses relocation of contamination throughout the area of CAU 570. This is addressed by investigating soil through the creation of soil piles, windrows, sediment areas, or other excavation or migration. Additional detail on the history of Study Group 4 is provided in the CAIP (NNSA/NSO, 2012a).

A.6.1 Corrective Action Investigation Activities

The specific CAI activities conducted to satisfy the CAIP requirements at Study Group 4 (NNSA/NSO, 2012a) are described in the following subsections.

A.6.1.1 Visual Inspections

Visual inspections were used to identify drainages, windrows, soil piles, staked areas, and disturbed areas.

A.6.1.1.1 Migration in Drainages

Visual inspections of the area of CAU 570 identified areas of contaminant migration and sedimentation. The inspection revealed that due to the lack of slope throughout the area, minimal migration from flowing water is evident, and most apparent migration is into existing test craters located throughout the area, including a small area running east from Ganymede on the south side of the 9-01 Road. The only area of sedimentation is an area near the intersection of the Old Mercury Highway and the 9-01 Road, and is evident on both sides of the 9-01 Road.

A.6.1.1.2 Windrows

Visual inspections identified seven windrows located south of the Tesla GZ. The windrows are about 15 cm tall, 50 cm wide, and extend up to approximately 100 m, terminating at a test crater. There are no signs of any oils identified to have been used to prevent erosion when the windrows were originally created.

A.6.1.1.3 Soil Piles

Visual inspections identified many soil piles that were located randomly throughout the area between Balloon Pad and Tesla. Other soil piles were also identified in the immediate areas surrounding Balloon Pad and Ganymede, including a berm that is approximately 1.5-m tall, 3-m wide, and runs from the area of Ganymede toward the 9-300 bunker located at the intersection of Old Mercury Highway and the 9-01 Road, a distance of approximately 1/2 mile. Other soil piles were identified that extended from the gravel gertie.

A.6.1.1.4 Staked Areas

Visual inspections identified five areas located east of Ganymede on both sides of the 9-01 Road where stakes had been driven into the ground, forming an oblong pattern approximately 30 m long by 10 m wide. The soil within a couple of the staked areas is slightly depressed about 15 cm, but otherwise there is no change from the soil located outside the staked areas.

A.6.1.1.5 Buried Contamination

Visual inspections identified an excavated area southwest of the Balloon Pad that contained non-native surface soil as well as a debris area located southeast of the Tesla area.

A.6.1.2 Radiological Screening

Radiological screening was used at all Study Group 4 sample locations to determine whether contamination was present below the surface. Screening results were used to justify the collection of six soil samples (D029, D030, D031, D033, D034, and D039) collected from five sample locations (D04, D05, D06, D16, and D28)

A.6.1.3 Radiological Surveys

Walkover radiological surveys were performed in support of the Study Group 4 investigation. Surveys were conducted with hand-held instruments (PRM-470 and Electra) to determine the locations within the identified areas with the highest radiological readings, providing the greatest likelihood of finding contaminants in the area.

A.6.1.3.1 Migration in Drainages

A radiological survey was conducted over the sedimentation area near the intersection of the Old Mercury Highway and the 9-01 Road. Survey results were used to select one sample location on the south side of the 9-01 Road (D14) and three sample locations on the north side of the 9-01 Road (D11, D12, and D13).

A radiological survey was also conducted over the identified drainage areas southeast of Tesla. Survey results were used to select four sample locations (D19, D21, D31, and D32)

A.6.1.3.2 Windrows

A radiological survey was conducted over the windrows, and the results were used to select five sample locations (D23, D24, D25, D26, and D27).

A.6.1.3.3 Soil Piles

A radiological survey was conducted over the soil piles, and the results were used to select two sample locations north of Ganymede on the north side of the 9-01 Road (D09 and D10).
Other radiological surveys were conducted over soil piles in the areas of Ganymede and Tesla.
The results were used to select three sample locations on the berm extending from Ganymede toward the intersection (D15, D16, and D17): one sample location in a soil pile north of the windrows (D28) and two sample locations in piles adjacent to the gravel gertie (D29 and D30).

A.6.1.3.4 Staked Areas

A radiological survey was conducted over the staked areas and results were used to select two sample locations northeast of Ganymede on the north side of the 9-01 Road (D07 and D08) and two locations south of Tesla (D20 and D22).

A.6.1.3.5 Buried Contamination

A radiological survey was conducted over disturbed areas, suggesting the possibility of buried contamination around Balloon Pad. The results were used to select six sample locations (D01, D02, D03, D04, D05, and D06) and one location southeast of Tesla (D18).

A.6.1.4 Sample Collection

Soil and TLD samples were collected to satisfy the CAIP investigative requirements at Study Group 4 (NNSA/NSO, 2012a). The TLD and soil sample purpose and location information is provided in the following subsections.

A.6.1.4.1 TLD Samples

Thirty-seven TLDs were identified in Table A.6-1 and placed at each location where a soil sample was collected to measure external dose. Table A.6-2 contains TLD information organized by sample type. All TLDs were measured by the NNSS environmental TLD monitoring program. Details of the environmental monitoring TLD program and TLD QC are presented in Section A.8.0.
See Figure A.6-1 for sample locations.

Table A.6-1
Study Group 4 TLD Sample Summary

Location Type	Number of Locations	Number of TLDs	Analyses (Method)
Co-located with Grab	37	37	*Nevada Test Site Routine Radiological Environmental Monitoring Plan*[a]
Total	37	37	

[a] BN, 2003

Table A.6-2
TLDs at Study Group 4
(Page 1 of 2)

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Sedimentation Area	D11	6009	10/17/2012	01/22/2013	Grab sample
	D12	4931	10/17/2012	01/22/2013	Grab sample
	D13	3726	10/17/2012	01/22/2013	Grab sample
	D14	6280	10/17/2012	01/22/2013	Grab sample
	D19	6016	10/17/2012	01/23/2013	Grab sample
	D21	4440	10/17/2012	01/23/2013	Grab sample
	D31	3954	11/14/2012	01/23/2013	Grab sample
	D32	4247	11/14/2012	01/23/2013	Grab sample

Table A.6-2
TLDs at Study Group 4
(Page 2 of 2)

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Windrow	D23	4693	10/17/2012	01/23/2013	Grab Sample
	D24	4702	10/17/2012	01/23/2013	Grab sample
	D25	6201	10/17/2012	01/23/2013	Grab sample
	D26	4629	10/17/2012	01/23/2013	Grab sample
	D27	4397	10/17/2012	01/23/2013	Grab sample
Soil Piles	D09	6014	10/17/2012	01/22/2013	Grab sample
	D10	6142	10/17/2012	01/22/2013	Grab sample
	D15	4578	10/17/2012	01/23/2013	Grab sample
	D16	4699	10/17/2012	01/23/2013	Grab sample
	D17	4964	10/17/2012	01/23/2013	Grab sample
	D28	4691	10/17/2012	01/23/2013	Grab sample
	D29	6468	10/17/2012	01/23/2013	Grab sample
	D30	6010	10/17/2012	01/23/2013	Grab sample
	D33	3320	04/17/2013	09/16/2013	Grab sample
	D34	3980	04/17/2013	09/16/2013	Grab sample
	D35	4599	04/17/2013	09/16/2013	Grab sample
	D36	4545	04/17/2013	09/16/2013	Grab sample
	D37	4414	04/17/2013	09/16/2013	Grab sample
Staked Areas	D07	6472	10/17/2012	01/22/2013	Grab sample
	D08	6022	10/17/2012	01/22/2013	Grab sample
	D20	4675	10/17/2012	01/23/2013	Grab sample
	D22	5250	10/17/2012	01/23/2013	Grab sample
Disturbed Area	D01	4954	10/17/2012	01/22/2013	Grab sample
	D02	6018	10/17/2012	01/22/2013	Grab sample
	D03	6189	10/17/2012	01/22/2013	Grab sample
	D04	4647	10/17/2012	01/22/2013	Grab sample
	D05	4633	10/17/2012	01/22/2013	Grab sample
	D06	3892	10/17/2012	01/22/2013	Grab sample
	D18	4456	10/17/2012	01/23/2013	Grab sample

A.6.1.4.2 Soil Samples

Fifty-six soil samples were collected from 37 judgmental (defined in Section A.2.0) locations and comprised 8 samples from sediment locations, 5 samples from windrow locations, 10 samples from disturbed area locations, 4 samples from staked locations, 26 samples from soil pile locations, and 3 FDs. All Study Group 4 soil samples were analyzed as identified in Table A.6-3. One sample was analyzed for Sr-90 and Tc-99 based on field readings for alpha and beta levels as determined by using hand-held instruments during sample collection. Additional information, including depth and purpose for each soil sample collected for Study Group 4, is provided in Table A.6-4. Sample locations are shown on Figure A.6-1. All soil samples were sent to an outside laboratory for analysis.

Table A.6-3
Study Group 4 Soil Sample Summary

Sample Type	Number of Locations	Number of Soil Samples	Analyses (Method)
Grab	1	1	Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241, Sr-90, Tc-99
	23	41	Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241
	8	8	Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241, PCBs
	5	6	Gamma Spectroscopy, Isotopic U, Isotopic Pu, Isotopic Am, Pu-241, PCBs, SVOCs, VOCs
Total	37	56	

At windrow sample locations, samples were composed of full-height, vertical cross-sections from ground surface to windrow peak.

At drainage, staked area, soil pile, and disturbed area sample locations, samples were collected at 10-cm intervals vertically from the surface to a maximum depth of 30 cm. Samples were then radiologically field screened, and the surface sample and identified interval samples were collected.

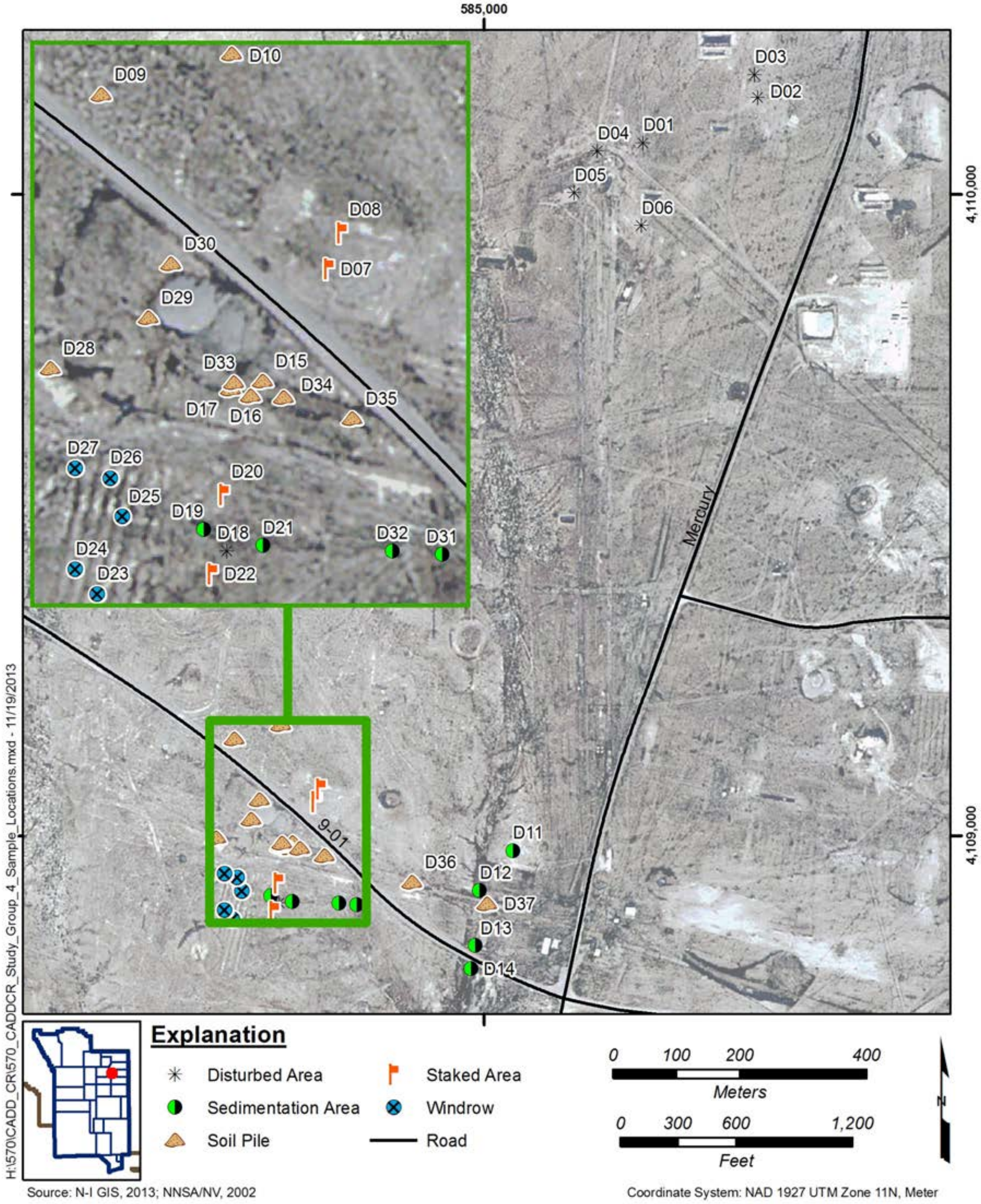
In the case of some of the soil piles where it could not be confirmed whether contamination was present below a depth of 30 cm, further sampling was conducted by obtaining a utility survey for the area in question and then collecting samples from the sample location from depths of 0 to 10 cm bgs,

Table A.6-4
Samples Collected at Study Group 4
(Page 1 of 2)

Release	Location	Sample Number	Depth (cm bgs)	Matrix	Purpose
Sedimentation Area	D11	D010	0.0 - 10.0	Soil	Environmental
	D12	D009	0.0 - 10.0	Soil	Environmental
	D13	D008	0.0 - 10.0	Soil	Environmental
	D14	D007	0.0 - 10.0	Soil	Environmental
	D19	D011	0.0 - 10.0	Soil	Environmental
	D21	D012	0.0 - 10.0	Soil	Environmental
	D31	D014	0.0 - 10.0	Soil	Environmental
	D32	D013	0.0 - 10.0	Soil	Environmental
Windrow	D23	D006	0.0 - 15.0	Soil	Environmental
	D24	D004	0.0 - 15.0	Soil	Environmental
		D005		Soil	FD of D004
	D25	D003	0.0 - 15.0	Soil	Environmental
	D26	D001	0.0 - 15.0	Soil	Environmental
	D27	D002	0.0 - 15.0	Soil	Environmental
Soil Pile	D09	D017	0.0 - 10.0	Soil	Environmental
	D10	D018	0.0 - 10.0	Soil	Environmental
	D15	D037	0.0 - 10.0	Soil	Environmental
	D16	D038	0.0 - 10.0	Soil	Environmental
		D039	10.0 - 20.0	Soil	Environmental
	D17	D040	0.0 - 10.0	Soil	Environmental
	D28	D032	0.0 - 10.0	Soil	Environmental
		D033	10.0 - 20.0	Soil	Environmental
		D034	20.0 - 30.0	Soil	Environmental
	D29	D035	0.0 - 10.0	Soil	Environmental
	D30	D036	0.0 - 10.0	Soil	Environmental
	D33	D054	0.0 - 5.0	Soil	Environmental
		D055	60.0 - 70.0	Soil	Environmental
		D056	120.0 - 130.0	Soil	Environmental

Table A.6-4
Samples Collected at Study Group 4
(Page 2 of 2)

Release	Location	Sample Number	Depth (cm bgs)	Matrix	Purpose
Soil Pile (continued)	D34	D051	0.0 - 5.0	Soil	Environmental
		D052	60.0 - 70.0	Soil	Environmental
		D053	120.0 - 130.0	Soil	Environmental
	D35	D048	0.0 - 5.0	Soil	Environmental
		D049	60.0 - 70.0	Soil	Environmental
		D050	120.0 - 130.0	Soil	Environmental
	D36	D044	0.0 - 5.0	Soil	Environmental
		D045		Soil	FD of D044
		D046	60.0 - 70.0	Soil	Environmental
		D047	120.0 - 130.0	Soil	Environmental
	D37	D041	0.0 - 5.0	Soil	Environmental
		D042	60.0 - 70.0	Soil	Environmental
		D043	120.0 - 130.0	Soil	Environmental
Staked Area	D07	D015	0.0 - 10.0	Soil	Environmental
	D08	D016	0.0 - 10.0	Soil	Environmental
	D20	D020	0.0 - 10.0	Soil	Environmental
	D22	D021	0.0 - 10.0	Soil	Environmental
Disturbed Area	D01	D022	0.0 - 10.0	Soil	Environmental
		D023		Soil	FD of D022
	D02	D024	0.0 - 10.0	Soil	Environmental
	D03	D025	0.0 - 10.0	Soil	Environmental
	D04	D026	0.0 - 10.0	Soil	Environmental
		D029	20.0 - 30.0	Soil	Environmental
	D05	D027	0.0 - 10.0	Soil	Environmental
		D030	20.0 - 30.0	Soil	Environmental
	D06	D028	0.0 - 10.0	Soil	Environmental
		D031	20.0 - 30.0	Soil	Environmental
	D18	D019	0.0 - 10.0	Soil	Environmental



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure A.6-1
Study Group 4 Sample Locations

60 to 70 cm bgs, and 120 to 130 cm bgs. After collection, samples were sent to an offsite laboratory for analysis.

Samples collected at sample locations D15, D16, D17, D29, and D30 were collected 30 cm horizontally from the side of soil piles. Soil samples from locations D33 through D37 were collected from depths up to 120 cm. All other samples were collected from depths less than 30 cm below the soil surface. All grab samples were radiologically field screened, and the surface sample and any interval samples whose field-screening values exceeded the FSLs as described in Section A.2.2.2 were sent to the offsite laboratory identified in the CAIP for analysis (with the exception of sample locations D33 through D37, in which all soil samples from all depths were sent to the offsite laboratory for the analyses listed in Table A.6-3).

A.6.2 Deviations/Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2012a) were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP, except for the assumption of surface contamination for the soil piles.

Based on the initial soil samples collected from the soil pile that extended from the gravel gertie eastward to the 9-300 bunker, it could not be definitively determined that contamination was not present at depths greater than 30 cm as originally identified in the CSM. To further characterize the soil pile, samples were collected from 0 to 10 cm, 60 to 70 cm, and 120 to 130 cm. Soil samples collected from these locations were not chosen or eliminated based on field screening, but all samples from all depths from sample locations D33 through D37 were sent for analysis to an offsite laboratory. This change did not impact any DQO decisions. A revision to the CSM was necessary to include subsurface soil.

A.6.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sample analyses were conducted as specified in the CAIP (NNSA/NSO, 2012a). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr.
For chemical contaminants, the results are reported as individual concentrations that are comparable

to their corresponding FALs. Results that are equal to or greater than FALs are identified by bold text in the results tables. The analytical parameters and laboratory methods used during this investigation are discussed in the CAIP.

Judgmental sampling was planned and implemented for Study Group 4 by selecting locations of maximum-expected radioactivity and are not intended to be representative of the area. However, TLDs collect three independent measurements of external dose that can be used to calculate a 95 percent UCL of the external dose measurement. This adds an additional level of conservatism to the judgmental external dose estimate. Therefore, 95 percent UCL of the TED estimates will be reported for Study Group 4 sample locations as the total of the internal dose estimate and the 95 percent UCL of the external dose estimate.

External doses for TLD locations are summarized in Section A.6.3.1. Internal doses for each sample plot are summarized in Section A.6.3.2. At sample locations where surface and subsurface samples were collected and submitted for analysis based on field screening, only the sample providing the greatest dose is reported for the sample location. The TEDs for each sampled location are summarized in Section A.6.3.3.

A.6.3.1 External Radiological Dose Measurements

Estimates for the external dose that a receptor would receive at each Study Group 4 TLD sample location were determined as described in Section A.2.2.5. Measurements for the external dose were calculated for the Industrial Area exposure scenario. Dose values for the Remote Work Area and Occasional Use Area scenarios were calculated by dividing the dose value of the Industrial Area scenario by the 2,000 hours of exposure to get an hourly dose rate and then multiplying by the 336 and 80 hours of annual exposure assumed by the two scenarios. Because the resolution of Decision I requires a 95 percent UCL, the standard deviation, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.6-5.

Table A.6-5
Study Group 4, 95% UCL External Dose for Each Exposure Scenario
(Page 1 of 2)

Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Sediment Area	D11	0.1	3	1.4	8.4	1.4	0.4
	D12	0.0	3	1.4	9.4	1.6	0.5
	D13	0.0	3	1.4	6.4	1.1	0.3
	D14	0.1	3	1.4	9.7	1.6	0.5
	D19	0.8	3	1.4	**431.9**	**72.6**	21.6
	D21	0.3	3	1.4	**147.7**	24.8	7.4
	D31	0.0	3	1.4	15.7	2.6	0.8
	D32	0.1	3	1.4	**27.3**	4.6	1.4
Windrows	D23	0.1	3	1.4	**47.1**	7.9	2.4
	D24	0.1	3	1.4	**47.3**	7.9	2.4
	D25	0.1	3	1.4	**68.0**	11.4	3.4
	D26	0.3	3	1.4	**77.5**	13.0	3.9
	D27	0.3	3	1.4	**86.0**	14.5	4.3
Soil Piles	D09	0.1	3	1.4	**47.9**	8.1	2.4
	D10	0.1	3	1.4	**33.9**	5.7	1.7
	D15	0.3	3	1.4	**167.0**	**28.1**	8.3
	D16	0.6	3	1.4	**164.2**	**27.6**	8.2
	D17	0.4	3	1.4	**174.1**	**29.3**	8.7
	D28	0.0	3	1.4	**39.3**	6.6	2.0
	D29	0.1	3	1.4	**41.8**	7.0	2.1
	D30	0.1	3	1.4	**58.4**	9.8	2.9
	D33	0.2	3	1.4	**69.8**	11.7	3.5
	D34	0.1	3	1.4	**56.5**	9.5	2.8
	D35	0.0	3	1.4	24.5	4.1	1.2
	D36	0.1	3	1.4	10.8	1.8	0.5
	D37	0.1	3	1.4	6.5	1.1	0.3
Staked Area	D07	0.2	3	1.4	**55.7**	9.4	2.8
	D08	0.1	3	1.4	**53.8**	9.0	2.7
	D20	0.3	3	1.4	**94.8**	15.9	4.7
	D22	0.5	3	1.4	**162.7**	**27.3**	8.1

Table A.6-5
Study Group 4, 95% UCL External Dose for Each Exposure Scenario
(Page 2 of 2)

Release	Location	Standard Deviation (OU Scenario)	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Disturbed Area	D01	0.3	3	1.4	**137.7**	23.1	6.9
	D02	0.2	3	1.4	**47.7**	8.0	2.4
	D03	0.1	3	1.4	**30.8**	5.2	1.5
	D04	0.3	3	1.4	**55.8**	9.4	2.8
	D05	0.0	3	1.4	**33.2**	5.6	1.7
	D06	0.1	3	1.4	**53.2**	8.9	2.7
	D18	0.4	3	1.4	**159.0**	**26.7**	7.9

Bold indicates the values equal to or greater than 25 mrem/yr.

A.6.3.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each sample location were determined as described in Section A.2.2.4. The internal dose at each sample location for each exposure scenario is presented in Table A.6-6.

Table A.6-6
Study Group 4 Internal Dose for Each Exposure Scenario
Calculated Values for Study Group 4 Locations
(Page 1 of 2)

Release	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Sediment Area	D11	2.7	0.4	0.2
	D12	6.7	1.1	0.4
	D13	1.6	0.3	0.1
	D14	0.4	0.1	0.0
	D19	22.8	3.8	1.4
	D21	11.0	1.9	0.7
	D31	0.4	0.1	0.0
	D32	1.0	0.2	0.1

Table A.6-6
Study Group 4 Internal Dose for Each Exposure Scenario
Calculated Values for Study Group 4 Locations
(Page 2 of 2)

Release	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Windrows	D23	3.1	0.5	0.2
	D24	6.0	1.0	0.4
	D25	0.5	0.1	0.0
	D26	12.5	2.1	0.8
	D27	**46.5**	7.8	2.8
Soil Piles	D09	1.9	0.3	0.1
	D10	0.6	0.1	0.0
	D15	8.6	1.4	0.5
	D16	9.6	1.6	0.6
	D17	14.5	2.4	0.9
	D28	0.9	0.1	0.1
	D29	2.0	0.3	0.1
	D30	5.3	0.9	0.3
	D33	4.2	0.7	0.3
	D34	2.7	0.4	0.2
	D35	0.0	0.0	0.0
	D36	0.4	0.1	0.0
	D37	0.1	0.0	0.0
Staked Area	D07	3.0	0.5	0.2
	D08	6.6	1.1	0.4
	D20	9.5	1.6	0.6
	D22	**32.8**	5.5	2.0
Disturbed Area	D01	0.3	0.0	0.0
	D02	0.4	0.1	0.0
	D03	0.0	0.0	0.0
	D04	0.0	0.0	0.0
	D05	0.0	0.0	0.0
	D06	0.0	0.0	0.0
	D18	2.4	0.4	0.1

Bold indicates the values equal to or greater than 25 mrem/yr.

A.6.3.3 Total Effective Dose

The TED for each sample plot or TLD 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 Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.6-7.

Table A.6-7
Study Group 4, TED at Sample Locations (mrem/yr)
(Page 1 of 2)

Release	**Location**	**Industrial Area**		**Remote Work Area**		**Occasional Use Area**	
		Average TED	**95% UCL of TED**	**Average TED**	**95% UCL of TED**	**Average TED**	**95% UCL of TED**
Sediment Area	D11	9.2	11.1	1.6	1.9	0.5	0.6
	D12	14.9	16.2	2.5	2.7	0.8	0.9
	D13	7.3	8.0	1.2	1.4	0.4	0.4
	D14	7.1	10.1	1.2	1.7	0.4	0.5
	D19	**427.7**	**454.6**	**71.9**	**76.4**	21.6	23.0
	D21	**147.5**	**158.7**	24.8	**26.7**	7.5	8.0
	D31	15.2	16.1	2.6	2.7	0.8	0.8
	D32	24.1	**28.3**	4.1	4.8	1.2	1.4
Windrows	D23	**47.2**	**50.1**	7.9	8.4	2.4	2.5
	D24	**49.5**	**53.3**	8.3	9.0	2.5	2.7
	D25	**63.9**	**68.5**	10.7	11.5	3.2	3.4
	D26	**81.4**	**90.0**	13.7	15.1	4.2	4.6
	D27	**121.4**	**132.5**	20.4	22.3	6.5	7.1

Table A.6-7
Study Group 4, TED at Sample Locations (mrem/yr)
(Page 2 of 2)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Soil Piles	D09	**46.8**	**49.9**	7.9	8.4	2.4	2.5
	D10	**32.6**	**34.5**	5.5	5.8	1.6	1.7
	D15	**164.5**	**175.5**	**27.6**	**29.5**	8.3	8.9
	D16	**153.7**	**173.8**	**25.9**	**29.2**	7.8	8.8
	D17	**174.3**	**188.6**	**29.3**	**31.7**	8.9	9.6
	D28	**39.3**	**40.2**	6.6	6.8	2.0	2.0
	D29	**41.0**	**43.7**	6.9	7.3	2.1	2.2
	D30	**59.0**	**63.8**	9.9	10.7	3.0	3.2
	D33	**67.3**	**74.0**	11.3	12.4	3.4	3.7
	D34	**55.0**	**59.2**	9.2	9.9	2.8	3.0
	D35	22.9	24.5	3.9	4.1	1.1	1.2
	D36	8.4	11.2	1.4	1.9	0.4	0.6
	D37	4.4	6.6	0.7	1.1	0.2	0.3
Staked Area	D07	**50.4**	**58.7**	8.5	9.9	2.5	3.0
	D08	**55.7**	**60.4**	9.4	10.2	2.9	3.1
	D20	**95.4**	**104.4**	16.0	17.5	4.9	5.3
	D22	**178.3**	**195.5**	**30.0**	**32.9**	9.2	10.1
Disturbed Area	D01	**128.6**	**138.0**	21.6	23.2	6.4	6.9
	D02	**41.4**	**48.0**	6.9	8.1	2.1	2.4
	D03	**28.1**	**30.8**	4.7	5.2	1.4	1.5
	D04	**47.1**	**55.9**	7.9	9.4	2.4	2.8
	D05	**32.4**	**33.2**	5.4	5.6	1.6	1.7
	D06	**49.7**	**53.2**	8.4	8.9	2.5	2.7
	D18	**148.1**	**161.4**	24.9	**27.1**	7.4	8.1

Bold indicates the values equal to or greater than 25 mrem/yr.

A.6.3.4 Chemical Contaminants

Thirteen soil samples and one FD (sample numbers D001 through D014) were collected from windrow and sediment locations and analyzed for PCBs. The five samples and one FD collected from the windrow locations (sample numbers D001 through D006) were also analyzed for VOCs and SVOCs. Analytical results exceeding MDCs from the Study Group 4 samples are presented in the following subsections.

A.6.3.4.1 VOCs

The analytical results for VOCs in samples that exceeded the MDCs are displayed in Table A.6-8. No results exceeded the FALs.

Table A.6-8
Study Group 4 Sample Results for VOCs

Release	Location	Sample Number	COPCs (mg/kg)			
			1,2,4-Trimethylbenzene	Chloroform	Toluene	Total Xylenes
FALs			**260**	**1.5**	**45,000**	**2,700**
Windrow	D26	D001	0.000718 (J)	0.000634 (J)	0.00173 (J)	0.000354 (J)
	D27	D002	0.000324 (J)	0.000846 (J)	0.00114 (J)	--
	D25	D003	0.000819 (J)	0.000482 (J)	0.000650 (J)	--
	D24	D004	0.000887 (J)	0.00196 (J)	0.00314 (J)	0.00047 (J)
		D005	0.001390 (J)	0.00212 (J)	0.00476 (J)	0.000743 (J)
	D23	D006	0.000870 (J)	0.000681 (J)	0.00211 (J)	0.000461 (J)

J = Estimated value.
-- = Not detected.

A.6.3.4.2 SVOCs

The analytical results for SVOCs in samples that exceeded the MDCs are displayed in Table A.6-9. No results exceeded the FALs.

A.6.3.4.3 PCBs

The analytical results for PCBs in samples that exceeded the MDCs are displayed in Table A.6-10. No results exceeded the FALs.

Table A.6-9
Study Group 4 Sample Results for SVOCs

Release	Location	Sample Number	COPCs (mg/kg)				
			Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
FALs			**2.1**	**0.21**	**2.1**	**17,000**	**21**
Windrow	D27	D002	0.0142 (J)	0.0111 (J)	0.0142 (J)	--	--
	D24	D004	--	--	0.0118 (J)	--	--
		D005	--	--	0.0146 (J)	0.0104 (J)	0.0104 (J)

J = Estimated value.
-- = Not detected.

Table A.6-10
Study Group 4 Sample Results for PCBs

Release	Location	Sample Number	COPCs (mg/kg)		
			Aroclor 1254	Aroclor 1260	Aroclor 1268
FALs			**0.740**	**0.740**	**0.740**
Windrow	D26	D001	--	0.0425	--
	D27	D002	--	0.0241	--
	D25	D003	--	0.00286 (J)	--
	D24	D005	--	0.00333 (J)	--
	D23	D006	--	0.00338 (J)	--
Sedimentation Area	D14	D007	0.00676 (J)	0.0076 (J)	0.00325 (J)
	D13	D008	0.0144 (J)	0.0139 (J)	--
	D12	D009	0.0525 (J)	0.0294 (J)	--
	D11	D010	0.0125 (J)	0.0125 (J)	0.00378 (J)
	D19	D011	--	0.149 (J)	--
	D21	D012	--	0.0261 (J)	--
	D32	D013	0.00141 (J)	0.00365 (J)	0.00268 (J)
	D31	D014	0.00298 (J)	0.00575 (J)	0.00271 (J)

J = Estimated value.
-- = Not detected.

A.6.4 Corrective Actions

No COCs or PSM were identified during the Study Group 4 investigation. Therefore, no corrective action is required in Study Group 4.

A.6.5 BMPs

As a BMP, an administrative UR was established to include any area where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr. The area identified was included in the administrative UR established for Study Group 1, so no boundary will be identified specifically addressing Study Group 4 exceedances.

A.7.0 Waste Management

This section addresses the characterization and management of investigation and remediation wastes.

Waste management activities were conducted as specified in the CAIP (NNSA/NSO, 2012a). Wastes generated during the CAI were characterized based on analytical data, process knowledge, and FSRs.

A.7.1 Generated Wastes

The wastes listed in Table A.7-1 were generated during the field investigation activities of CAU 570. The amount, type, and source of waste placed into each container were recorded in waste management logbooks that are maintained in the CAU 570 file.

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. Decontamination activities were planned and executed to minimize the volume of rinsate generated.

Wastes generated during the CAI were segregated into the following waste streams:

- Soil
- Disposable personal protective equipment (PPE) and sampling equipment
- Debris (e.g., dry-cell batteries, metal, wood, manufactured items)
- Recyclable materials (e.g., lead bricks, plates)

A.7.2 Waste Characterization and Disposal

The waste streams generated at CAU 570 were characterized using analytical results, radiological survey results, and process knowledge. The characterization of the waste and recommended disposition were determined based on a review of the analytical results and compared to federal and state regulations, permit requirements, and disposal or recycle facility waste acceptance criteria. Waste characterization documentation is maintained in the CAU 570 project file. Analytical results and comparison to regulatory criteria are presented in Table A.7-2. No analytical results exceeded regulatory criteria. The waste shipping and/or disposal documentation for CAU 570 is provided in Attachment D-2.

Table A.7-1
Waste Summary Table
(Page 1 of 2)

Container Number	Waste Description	Waste Characterization	Waste Disposition			
			Disposal Facility	Waste Volume	Disposal Date	Disposal Doc
Solid Industrial Waste						
570C01	Soil	Solid Industrial Waste	Area 9, U10c Industrial Landfill	55-gal drum	09/24/2013	LVF
570DC01	Dry-Cell Batteries	Solid Industrial Waste	Area 9, U10c Industrial Landfill	10-gal bag	07/10/2013	LVF
570C08	Debris	Solid Industrial Waste	Contents transferred to container 310R13	1 gal	08/22/2013	LVF
570C10	Soil	Solid Industrial Waste (hydrocarbon impacted)	Area 9, U10c Industrial Landfill	55-gal drum	TBD	LVF
Low-Level Radioactive Waste						
570A01	Debris - PPE	Low-Level Radioactive Waste	Area 5 - RWMC transferred to 570C09	55-gal drum	07/18/2013	CD
570C02	Soil	Low-Level Radioactive Waste	Area 5 - RWMC	15 yd^3	TBD	CD
570C03	Soil	Low-Level Radioactive Waste	Area 5 - RWMC	15 yd^3	TBD	CD
570C04	Soil	Low-Level Radioactive Waste	Area 5 - RWMC	15 yd^3	TBD	CD
570C05	Soil	Low-Level Radioactive Waste	Area 5 - RWMC	15 yd^3	TBD	CD
570C06	Asbestos Debris	Regulated Asbestos Low-Level Radioactive Waste	Area 5 - RWMC	55-gal drum	11/14/2013	CD
570C09	Soil and Debris	Low-Level Radioactive Waste	Area 5 - RWMC	18 yd^3	TBD	CD

Table A.7-1
Waste Summary Table
(Page 2 of 2)

Container Number	**Waste Description**	**Waste Characterization**	**Waste Disposition**			
			Disposal Facility	**Waste Volume**	**Disposal Date**	**Disposal Doc**
Recycled Materials						
570Bat1	Spent Lead-Acid Battery	Recycle Material	NSTec Fleet Services	1 battery	12/11/2012	WCL
570C07	Elemental Lead	Recycle Material	TMMC	10-gal drum	09/17/2013	Certificate of Recycle
570P01	Elemental Lead (bricks, rods, ingots)	Recycle Material	TMMC	36 pieces	09/17/2013	Certificate of Recycle

LVF = Load Verification Form
CD = Certificate of Disposal
NSTec = National Security Technologies, LLC
RWMC = Radioactive Waste Management Complex

TBD = To be determined
TMMC = Toxco Materials Management Center
WCL = Waste Container Log

Table A.7-2
Waste Management Results Detected above MDCs at CAU 570

Sample			Parameter	Result	Criteria	Units
Location	Number	Matrix				
A501	A501	Soil	Barium	0.402	100[a]	mg/L
Drum Number C01	C501, C503	Soil	Barium	0.429	100[a]	mg/L
			Lead	0.228	5[a]	mg/L
			Cs-137	0.396	100[b]	pCi/g
			Eu-152	0.728	100[b]	pCi/g
			Pu-238	0.0667	10[b]	pCi/g
			Pu-239/240	2.72	10[b]	pCi/g
			U-234	0.837	100[b]	pCi/g
			U-238	0.88	100[b]	pCi/g
C11	C502	Soil	2-Butanone	0.0222	200[a]	mg/L
			Barium	0.0163	100[a]	mg/L
			Lead	0.107	5[a]	mg/L
Drum Number C10	C504	Soil	Arsenic	0.0587	5[a]	mg/L
			Barium	0.363	100[a]	mg/L
			Am-241	2.53	10[b]	pCi/g
			Cs-137	6.64	100[b]	pCi/g
			Eu-152	4.08	100[b]	pCi/g

[a] TCLP limit (CFR, 2013)
[b] Radionuclide limits in NNSS U10c landfill permit (NNSA/NSO, 2010)

Cs = Cesium
Eu = Europium
mg/L = Milligrams per liter
pCi/g = Picocuries per gram

The generated waste streams were characterized as Industrial Solid Waste, Low-Level Radioactive Waste (LLW), Mixed Low-Level Radioactive Waste (MLLW), and Recyclable Materials.

A.7.2.1 Industrial Solid Waste

Industrial solid waste generated during the CAU 570 CAI was segregated into the following waste streams:

- PPE and disposable sampling equipment
- Soil removed from beneath lead bricks/plates
- Dry-cell batteries

Approximately 1 yd^3 of PPE and disposable sampling equipment was generated during CAI activities. The PPE and disposable sampling equipment generated are field screened, as generated, to meet the unrestricted release of materials screening limits of Table 4.2 of the *Nevada National Security Site Radiological Control* (RadCon) *Manual* (NNSA/NSO, 2012b). The waste was characterized as industrial solid waste that meets the chemical and radiological waste acceptance criteria of the Area 9, U10c solid waste landfill. The solid waste was bagged, marked, and placed in a roll-off container located at Building 23-153 for final disposal at the Area 9, U10c landfill.

One 55-gal drum of soil was remediated from locations directly below lead bricks and plates and placed into container 570C01. A review of the analytical results for samples collected from the drum (C501 and C503) indicated that the waste was nonregulated for disposal. The waste was characterized as industrial solid waste that meets the chemical and radiological waste acceptance criteria of the Area 9, U10c solid waste landfill.

Eleven dry-cell electric batteries were collected during the CAU 570 CAI. The batteries were issued a unique container identification number (570DC01) for tracking purposes. The batteries are described as dry-cell alkaline and were characterized as non-regulated for disposal. The solid waste was bagged, marked, and placed in a roll-off container located at Building 23-153 for final disposal at the Area 9, U10c landfill.

One 55-gal drum (570C10) of soil was generated as a result of remediation of a stained area identified at CAS 02-23-07. A review of the analytical results for samples collected at this location (sample number C504) indicated that the waste was nonregulated for disposal but contaminated with hydrocarbons. The waste was characterized as industrial solid waste that meets the chemical and radiological waste acceptance criteria of the Area 9, U10c solid waste landfill.

One 10-gal drum containing suspected cadmium-contaminated debris was generated at CAU 570 and packaged into container number 570C08. The contents were described as metallic foil remediated at CAS 02-23-07 and were assumed to be manufactured with cadmium. On August 22, 2013, the items were visually inspected and weighed by the project chemist, and were determined to be made of aluminum foil (not cadmium). The debris materials were radiologically field screened as generated, to meet the unrestricted release of materials screening limits of Table 4.2 of the NNSS RadCon Manual (NNSA/NSO, 2012b). The waste was characterized as industrial solid waste that meets the chemical and radiological waste acceptance criteria of the Area 9, U10c solid waste landfill. The solid waste was bagged, marked, and placed in a roll-off container located at Building 23-153 for final disposal at the Area 9, U10c landfill.

A.7.2.2 LLW

Approximately 79 yd^3 of LLW was generated during the CAU 570 CAI. The LLW generated was segregated into the following waste streams:

- Debris
- Soil
- Regulated asbestos low-level waste (RALLW) Debris

The LLW debris was generated at two discrete locations at CAU 570. One 55-gal drum (570A01) contained PPE and disposable sampling equipment that was generated during sampling activities within a posted radiological CA and was characterized as LLW. The waste in container 570A01 meets the waste acceptance criteria for disposal at the Area 5 RWMC. The contents of waste container 570A01 were removed on July 18, 2013, and consolidated into container 570C09.

Approximately 7 yd^3 of debris was collected in container 570C09 and managed as LLW. The debris collected at CAS 02-23-07 (i.e., the debris field) is described as miscellaneous debris typically found at a fabrication shop used to support field activities at historical testing locations. The debris consists of metal, wood, plastic, concrete, rubber, porcelain, and manufactured items that remained on site after completion of the experiments. The wastes were visually inspected as packaged to identify any nonconforming items that were segregated and managed separately from this waste stream. The debris waste was characterized as LLW and meets the waste acceptance criteria for disposal at the Area 5 RWMC.

Approximately 70 yd^3 of remediated soil were removed from CAS 02-23-07 and packaged into container numbers 570C02, 570C03, 570C04, 570C05, and 570C09. The waste was characterized as LLW and meets the waste acceptance criteria for disposal at the Area 5 RWMC.

One 55-gal drum of RALLW was generated during the CAI and packaged into container number 570C06. The contents consist of debris items segregated at the debris field area of CAS 02-23-07 that were constructed with asbestos-containing material. The debris included manufactured items such as grinding wheels, brake pads, roofing shingles, and insulation material. The waste was characterized as LLW that contains regulated asbestos and meets the waste acceptance criteria for disposal at the Area 5 RWMC.

A.7.2.3 Recycled Materials

Recycled materials generated during the CAI at CAU 570 included 36 pieces of lead shielding. The elemental lead included lead bricks, lead plates, and lead pieces that were packaged in container 570P01. The lead materials were radiologically field screened as generated, to meet the unrestricted release of materials screening limits of Table 4.2 of the RadCon Manual (NNSA/NSO, 2012b). The recycled lead materials were shipped to TMMC (see Attachment D-2).

One lead-acid battery was identified during the CAI. The battery was radiologically field screened and met the unrestricted release limits of Table 4.2 of the RadCon Manual. The battery was transferred to NSTec Fleet Services for offsite recycling.

One 10-gal drum containing elemental lead was generated at CAU 570 and packaged into container number 570C07. The contents consist of elemental lead debris items including lead tape, lead ingots, and lead pieces that were segregated at the debris field area of CAS 02-23-07. The lead debris items were determined to have radiological contamination, but met the recycle criteria of TMMC. The waste has been transferred off site to TMMC for recycling.

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 570 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 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 QAP (NNSA/NSO, 2012c).

A.8.1 Data Validation

Data validation was performed in accordance with the Soils QAP (NNSA/NSO, 2012c) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 570 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 570 files as a hard copy and electronic media.

All laboratory data were subjected to a Tier I evaluation while a Tier II evaluation was performed on a subset of reported data for all samples. A Tier III evaluation was performed on the analytical results for samples that represent 5 percent of the samples collected for site characterization.

A.8.1.1 Tier I Evaluation

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

- Sample count/type consistent with chain of custody
- Analysis count/type consistent with chain of custody
- Correct sample matrix

- Significant problems and/or nonconformances stated in a cover letter or case narrative
- Completeness of certificates of analysis
- Completeness of Contract Laboratory Program (CLP) or CLP-like packages
- Completeness of signatures, dates, and times on chain-of-custody forms
- Condition-upon-receipt variance form included
- Requested analyses performed on all samples
- Date received/analyzed given for each sample
- Correct concentration units indicated
- Electronic data transfer supplied
- Results reported for field and laboratory QC samples
- Whether or not the deliverable met the overall objectives

A.8.1.2 Tier II Evaluation

Tier II evaluation for chemical and radiochemical analysis examines, but is not limited to, the following items:

- Correct detection limits achieved

- Blank contamination evaluated and, if significant, qualifiers applied to sample results

- Certificate of Analysis consistent with data package documentation

- QC sample results (duplicates, laboratory control samples [LCSs], laboratory blanks) evaluated and used to determine laboratory result qualifiers

- Sample results, uncertainty, and MDC evaluated

- Detector system calibrated with National Institute of Standards and Technology (NIST)-traceable sources

- Calibration source preparation was documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations

- Detector system response to daily or weekly background and calibration checks for peak energy, peak centroid, peak full-width half-maximum, and peak efficiency, depending on the detection system

- Tracers NIST-traceable, appropriate for the analysis performed, and recoveries that met QC requirements

- Documentation of all QC sample preparation completely and properly performed

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

A.8.1.3 Tier III Evaluation

The Tier III review is an independent examination of the Tier II evaluation and the laboratory-reported data. A Tier III review of 5 percent of the samples collected had Tier III validation performed by TLI Solutions, Inc. in Golden, Colorado. The Tier II and Tier III evaluations were in agreement, and evaluated data were used. This review included the following additional evaluations:

- Review:
  - case narrative, chain of custody, and sample receipt forms
  - lab qualifiers (applied appropriately)
  - methods of analyses performed as dictated by the chain of custody
  - raw data, including chromatograms, instrument printouts, preparation logs, and analytical logs
  - manual integrations to determine whether the response is appropriate
  - data package for completeness
- Determine sample result qualifiers through the evaluation of (but not limited to):
  - tracers and QC sample results (e.g., duplicates, LCSs, blanks, matrix spikes) evaluated and used to determine sample results qualifiers
  - sample preservation, sample preparation/extraction and run logs, sample storage, and holding time
  - instrument and detector tuning
  - initial and continuing calibrations
  - calibration verification (initial, continuing, second source)
  - retention times
  - second column and/or second detector confirmation
  - mass spectra interpretation

  - interference check samples and serial dilutions
  - post-digestion spikes and methods of standard additions
  - breakdown evaluations
- Perform calculation checks of:
  - at least one analyte per QC sample and its recovery
  - at least one analyte per initial calibration curve, continuing calibration verification, and second-source recovery
  - at least one analyte per sample that contains positive results (hits). Radiochemical results only require calculation checks on activity concentrations (not error).
- Verify that target compound detects that are identified in the raw data are reported on the results form.
- Document any anomalies for the laboratory to clarify or rectify. The contractor should be notified of any anomalies.

A.8.2 Field QC Samples

Laboratory QC samples used to measure accuracy and precision were analyzed by the laboratory with each batch of samples submitted for analysis (see Appendix B for further discussion). Initial and continuing calibrations were also performed for each sample delivery group (SDG) When QC criteria were exceeded, qualifying flags were added to sample results. Documentation of data qualifications resulting from the application of these guidelines is retained in CAU 570 files as both hard copy and electronic media.

During the CAI, four FDs were also sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in the CAIP (NNSA/NSO, 2012a). For these samples, the duplicate results precision (i.e., relative percent differences [RPDs] between the environmental sample results and their corresponding FD sample results) were evaluated.

A.8.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

A.8.4 Laboratory Nonconformances

No laboratory nonconformance reports were issued by Navarro-Intera, LLC, during the course of the CAI.

A.8.5 TLD Data Validation

The data from the TLD measurements met rigorous data quality requirements. TLDs were obtained from, and measured by, the Environmental Technical Services group at the NNSS. This group is responsible for a routine environmental monitoring program at the NNSS. TLDs were submitted to the Environmental Technical Services group for analysis using automated TLD readers that are calibrated and maintained by the NSTec Radiological Control Department in accordance with existing QC procedures for TLD processing. A summary of the routine environmental monitoring TLD QC program can be found in the *Nevada Test Site Routine Radiological Environmental Monitoring Plan* (BN, 2003). Certification is maintained through the DOE Laboratory Accreditation Program for dosimetry.

The determination of the external dose component of the TED by TLDs was determined to be the most accurate method because of the following factors:

1. TLDs are exposed at the sample plots for an extended time period that approximates the 2,000 hours of exposure time used for the Industrial Area exposure scenario. This eliminates errors in reading dose-rate meter scale graduations and needle fluctuations that would be magnified when as-read meter values are multiplied from units of “per-hour” to 2,000 hours.

2. The use of a TLD to determine an individual’s external dose is the standard in radiation safety and serves as the “legal dose of record” when other measurements are available. Specifically, 10 CFR Part 835.402 (CFR, 2013) indicates that personal dosimeters must be provided to monitor individual exposures. The monitoring program that uses the dosimeters must be accredited in accordance with a DOE Laboratory Accreditation Program.

A.9.0 Summary

Radionuclide and chemical contaminants detected in environmental samples during the CAI were evaluated against FALs to determine the presence and extent of COCs for CAU 570. The COCs were also assumed to be present where PSM was identified within the DCBs. Based on the detected or presumed presence of COCs, the following releases require corrective actions:

- The atmospheric release from Tesla tower test (CAS 02-23-07) where CAI sample results demonstrated soil contamination levels, resulting in a dose exceeding the radiological FAL. A corrective action of clean closure was implemented, consisting of the removal of soil containing COCs. Verification sample results demonstrated that no COCs remain at this site, and no further corrective action is necessary.

- The Sugar test (CAS 09-23-10) DCB where subsurface soil contamination is assumed to exceed the radiological FAL. A corrective action of closure in place was implemented, consisting of an FFACO UR for the subsurface contamination.

- The PSM consisting of lead bricks/plates and lead-acid battery associated with activities at the Balloon Pad area (CASs 09-23-14 and 09-99-01). A corrective action of clean closure was implemented, consisting of the removal of all PSM. Verification sample results demonstrated that no COCs remain at this site, and no further corrective action is necessary.

- The PSM consisting of lead pads and the fenced CA DCB near the Eagle underground test (CAS 09-23-15). A corrective action of closure in place was implemented, consisting of an FFACO UR for the lead pads and the fenced CA.

Based on the results of the TRSs, there was no indication of the potential for COCs originating from the UGTA Releases. Therefore, no further action is needed for these potential releases.

BMPs were implemented at locations where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr and where nonhazardous debris was removed.

A summary of CAI results and the actions implemented is presented in Table A.9-1 for each CAU 570 release.

Table A.9-1
Summary of Investigation Results at CAU 570

CAS Number	Name	Study Group	Release	COC	Corrective Action	BMP
02-23-07	Tesla	1	Atmospheric Test	TED	Clean closure removal of 20 yd^3 of contaminated soil	Administrative UR at 25-mrem/IA-yr isopleth
		3	Debris	None		Removal of debris
		4	Windrows, Staked Areas, Soil Piles, Disturbed Areas	None		None
09-23-10	Sugar	2	Low-Yield Test	Assumed subsurface COCs in crater	Closure in place with FFACO UR	None
09-23-11	Ganymede	2	Safety Test	None	No further action	None
09-23-14 09-99-01	Balloon Pad	1	Atmospheric Test	None	Clean closure removal of lead bricks/plates and lead-acid battery	Administrative UR at 25-mrem/IA-yr isopleth
		3	Lead Bricks/Plates, Battery	Lead		None
			Wax Pile	None		None
09-23-15	Eagle	1	Atmospheric Release	None	Closure in place of lead pads and disposal pile with FFACO UR	None
		3	Lead Pads, Disposal Pile, Dry-Cell Batteries	Lead, assumed TED and chemical contaminants in disposal pile		Removal of dry-cell batteries
None	UGTA Releases	1	Atmospheric Release	None	No further action	None

A.10.0 References

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Appendix B

Data Assessment

B.1.0 Data Assessment

The DQA process is the scientific evaluation of the actual investigation results to determine whether the DQO criteria established in the CAU 570 CAIP (NNSA/NSO, 2012a) were met and whether DQO decisions can be resolved at the desired level of confidence. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA involves five steps that begin with a review of the DQOs and end with an answer to the DQO decisions. 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.* Perform a preliminary data review by reviewing QA reports and inspecting the data both numerically and graphically, validating and verifying the data to ensure that the measurement systems performed in accordance with the criteria specified, and using the validated dataset to determine whether the quality of the data is satisfactory.

3. *Select the Test.* Select the test based on the population of interest, population parameters, 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 and Sampling Design

This section contains a review of the DQO process presented in Appendix A of the CAIP (NNSA/NSO, 2012a). 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/NSO, 2012a) is as follows: “Is any COC present in environmental media?” 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 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/NSO, 2012c). If a COC is detected, then Decision II must be resolved.

B.1.1.1.1 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.

Criterion 1a (Confidence Judgmental Sample Locations Identify COCs)

Decision I for Study Groups 1 and 2 (as stipulated in the DQOs) was already resolved for the areas within the DCBs because those areas were already identified as requiring corrective action. Therefore, Decision I sampling only applied to those areas outside the DCBs. To resolve Decision I (determine whether a COC is present at a study group), samples were collected and analyzed following these two criteria:

- Samples must be collected in areas most likely to contain a COC.
- The analytical suite selected must be sufficient to identify any COCs present in the samples.

To resolve Decision I for the study groups outside the DCBs (as stipulated in the DQOs), the following activities were conducted:

Study Group 1

Sample plot locations were selected judgmentally outside the DCB at the highest radiological readings as detected during the PRM-470 and NaI detector TRSs. TLDs were also placed at the center of the sample plots.

Study Group 2

Sample plot locations were selected judgmentally outside the DCB at the highest radiological readings as detected during the PRM-470 and FIDLER detector TRSs. TLDs were also placed at the center of the sample plots.

Study Group 3

Judgmental and probabilistic sample locations were selected where debris or evidence of spills was present as determined during a visual survey of the area of CAU 570.

Study Group 4

Sampling locations were selected based on the presence of sedimentation areas, windrows, staked areas, soil piles, and areas of mechanical disturbance. The exact sampling location was then determined based on the location of highest readings in the previously identified areas as detected during PRM-470 TRSs.

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

Control of the false-negative decision error for the probabilistic samples was accomplished by ensuring the following:

- The samples were collected from unbiased locations.
- A sufficient sample size was collected (see Section B.1.1.1.1).
- A false-rejection rate of 0.05 was used in calculating the 95 percent UCLs and minimum sample size.

Selection of the sample aliquot locations within a sample plot (inclusive of Study Groups 1 and 2) was accomplished using a random start, systematic triangular grid pattern for sample placement. This permitted an unbiased, equally weighted chance that any given location within the boundaries of the sample plot would be chosen. Although the TLD locations were not established at random locations (i.e., they were placed at the center of the sample plot), they provided an integrated, unbiased measurement of dose from the plot area.

The minimum number of samples required for each sample plot was calculated for both the internal (soil samples) and external (TLD elements) dose samples. 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 less than three, three was adopted as the minimum number of samples required. The results of the minimum sample size calculations and the number of samples collected are presented in Table B.1-1. As shown in these tables, the minimum number of sample plot and TLD samples was met or exceeded. The minimum sample size calculations were conducted as stipulated in the CAIP (NNSA/NSO, 2012a) 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

Soil Samples				
Source	**Plot**	**Standard Deviation**	**Minimum Sample Size**	**Samples Collected**
Study Group 1	A136	0.26	3	4
	A137	1.69	3	4
Study Group 2	B01	0.36	3	4
	B02	1.29	3	4

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

Criterion 2 (Confidence in Detecting COCs Present in Samples)

The analytical methods were chosen during the DQO process as the analyses required to detect any of the COPCs listed in the CAIP that were defined as the contaminants that could reasonably be expected at the site and 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 have the capability of identifying any COPC present in the sample.

All samples were analyzed using the analytical methods listed in Section 3.2 of the CAIP (NNSA/NSO, 2012a) with the following exceptions:

- In addition to the radiological analyses, windrow and sediment area samples were also analyzed for VOCs and SVOCs (sample numbers D001 through D014).
- Due to the remote possibility of Tc-99, Pu-241, and Sr-90 being used as tracers in nuclear tests on the NNSS, Tc-99 and Sr-90 were included in the analysis request for the sample(s) at each study group with the highest FSRs (sample numbers A607, B604, and B605).

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Soils QAP (NNSA/NSO, 2012b). The sensitivity acceptance criterion defined in the CAIP is that analytical detection limits will be less than the corresponding FAL (NNSA/NSO, 2012a).
The criterion is that all detection limits are less than their corresponding Occasional Use Area internal dose RRMGs for radionuclides. All of the analytical result detection limits for all contaminants were less than their corresponding FALs or RRMGs. Therefore, the DQI for sensitivity has been met and no data were rejected due to sensitivity.

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

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

Precision

Precision was evaluated as described in Section 6.2.4 of the CAIP (NNSA/NSO, 2012a) and Section 4.2 of the Soils QAP (NNSA/NSO, 2012b). As stipulated in Section 4.3 of the Soils QAP, when the analysis of a particular contaminant does not meet the DQI criteria and the highest reported activity for that contaminant exceeds one-half of its corresponding FAL, the data assessment must include explanations or justifications for its use or rejection. The sample results that were qualified for precision are presented in Table B.1-2.

Table B.1-2
Precision Measurements

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Pu-238	Plutonium	1	93	98.9
Pu-239/240		1	93	98.9
Am-241	Americium	16	93	82.8
Lead	Metal	16	27	40.7
CrVI		13	13	0.0
Sr-90	Strontium	4	4	0.0

There were no analytical data qualified for precision that exceeded one-half the FAL based on the following evaluation.

Of the 16 lead results that were qualified for precision, 3 were judgmental samples where individual results were compared to the FAL. All of these results were less than 1/20 of the Tier 1-based FAL. The remaining 13 lead results were probabilistic samples where the combined effects of all 13 samples were used to characterize the lead contamination for the area, which was then compared to the FAL. This value was less than 1/6 of the Tier 1-based FAL.

The 13 CrVI results were probabilistic samples where the combined effect of all 13 samples were used to characterize the CrVI contamination for the area, which was then compared to the FAL. This value was less than 1/8 of the Tier 1-based FAL.

Of the four Sr-90 results that were qualified for precision, the maximum detected concentration was less than 1/600 of the corresponding RRMG for the Occasional Use Area TED.

Therefore, the potential for a false-negative DQO decision error is negligible and all results that were qualified for precision can be confidently used. As the precision rates for all other constituents meet the acceptance criteria for precision, the dataset is determined to be acceptable for the DQI of precision.

Accuracy

Accuracy was evaluated as described in Section 6.2.4 of the CAIP (NNSA/NSO, 2012a) and Section 4.2 of the Soils QAP (NNSA/NSO, 2012b). As stipulated in Section 4.3 of the Soils QAP, when analysis of a particular contaminant does not meet the DQI criteria and the highest reported activity for that contaminant exceeds one-half of its corresponding FAL, the data assessment must include explanations or justifications for its use or rejection. The sample results that were qualified for accuracy are presented in Table B.1-3.

Table B.1-3
Accuracy Measurements

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Barium	Metals	9	27	66.7
Selenium		9	27	66.7
CrVI		13	13	0

There were no analytical data qualified for accuracy that exceeded one-half the FAL based on the following evaluation.

The 13 CrVI results that were qualified for accuracy were probabilistic samples where the combined effects of all 13 samples were used to characterize the CrVI contamination for the area, which was then compared to the FAL. This value was less than 1/8 of the Tier 1-based FAL.

Of the nine sample results for barium and selenium that were qualified for accuracy, the maximum detected concentration of barium was less than 1/1,000 of the Tier 1-based FAL, and the maximum detected concentration of selenium was approximately 1/5,000 of the Tier 1-based FAL.

Therefore, the potential for a false-negative DQO decision error is negligible, and the results that were qualified for accuracy can be confidently used. As the accuracy rates for all other constituents meet the acceptance criteria for accuracy, the dataset is determined to be acceptable for the DQI of accuracy.

Representativeness

The DQO process as identified in Appendix A of the CAIP (NNSA/NSO, 2012a) was used to address sampling and analytical requirements for CAU 570. During this process, appropriate locations were selected that enabled the collected samples 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. 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 ratio 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.

Based on the methodical selection of sample locations and the use of Am and Pu concentrations that are more representative of the sampled area, the analytical data acquired during the CAU 570 CAI are considered to adequately represent contaminant concentrations of the sampled population.

Comparability

Field sampling, as described in the CAIP (NNSA/NSO, 2012a), was performed and documented in accordance with approved procedures that are comparable to standard industry practices. Approved analytical methods and procedures per DOE were used to analyze, report, and validate the data. These are comparable to other methods used not only in industry and government practices, but (most importantly) are comparable to other investigations conducted for the NNSS. Therefore, CAU 570 datasets are considered comparable to other datasets generated using these same, standardized DOE procedures, thereby meeting DQO requirements.

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

Completeness

The CAIP (NNSA/NSO, 2012a) 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 the CAS-specific analytes identified in the CAIP having valid results. Rejected data (either qualified as rejected or data that failed the criterion of sensitivity) were not used in the resolution of DQO decisions and are not counted toward meeting the completeness acceptance criterion.

As no data were qualified as rejected, the dataset for CAU 570 has met the general completeness criteria. Sufficient information is available to make the DQO decisions.

B.1.1.1.2 DQO Provisions To Limit False-Positive Decision Error

The false-positive decision error was controlled by assessing the potential for false-positive analytical results. 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 qualifications are applied to the data when applicable. There were no data qualifications that would indicate a potential false-positive analytical result.

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

B.1.1.2 Decision II

Decision II as presented in the CAIP (NNSA/NSO, 2012a) is as follows: “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
- Any other information needed to evaluate the feasibility of remediation alternatives

A corrective action will be determined for any site containing a COC. The evaluation of the need for corrective action will include the potential for wastes that are present at the site to cause the future contamination of site environmental media if the wastes were to be released.

For Study Groups 2 and 4, there were no COCs detected outside the DCBs (as defined in the CAIP). Therefore, Decision II was resolved. The following describes the Decision II sampling that was conducted for other study groups:

Study Group 1

Based on the data evaluation and the proposed scenario, COCs were identified in Study Group 1 at sample locations A007 and A137 because the 95 percent UCL of TED at these locations was greater than the FAL of 25 mrem/OU-yr. To determine the extent of the area where the Occasional Use Area TED exceeded the FAL, a TRS was conducted in a dense circular pattern around A137 to a radius of about 30 m (Figure A.3-3). A correlation of radiation survey values to TED values as described in Section A.2.6 was conducted. The radiation survey and TED values exhibited a correlation of 0.97. This correlation exceeds the minimum criteria of 0.8 as set in the Soils RBCA document (NNSA/NSO, 2012c). The corrective action boundary was established to encompass the TRS isopleth of 44.2 multiples of background. The soil within this boundary was excavated, and verification samples demonstrated that no further corrective action was required.

Study Group 3

The extent of the PSM was defined by the physical dimensions of each item. This was verified by the absence of COCs in samples C01 through C09, collected around the lead pads; and in verification samples C010 through C014, collected from soils beneath lead bricks/plates (Section A.5.5).

For the stained soil area, the extent of contamination was determined by the presence of discolored soil. This was verified by the absence of COCs in sample C015, collected from the soil at the bottom of the excavation after the corrective action (Section A.5.5).

B.1.1.3 Sampling Design

The CAIP (NNSA/NSO, 2012a) stipulated that the following sampling processes would be implemented:

- Sampling of sample plots will be conducted by a combination of judgmental and probabilistic sampling approaches.

  Result. The locations of the plots were selected judgmentally, and samples were collected within each plot probabilistically as described in Section A.2.0.

- Judgmental sampling will be conducted at other releases and at locations of potential contamination identified during the CAI.

  Result. All judgmental sampling was conducted as prescribed in the CAIP. However, additional sampling was conducted at the debris field. This area was defined by the visual survey based on the presence of debris. This defined area was characterized using probabilistic soil sampling by collecting 12 samples from unbiased locations.

B.1.2 Conduct a Preliminary Data Review

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

B.1.3 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. For other types of contamination, the test for making DQO decisions was the comparison of the maximum analyte result from each release to the corresponding FAL. All radiological FALs were based on an exposure duration to a site worker using the Occasional Use Area exposure scenario. All chemical FALs were based on an exposure duration to a site worker using the Industrial Area scenario.

The key assumptions that could impact a DQO decision are listed in Table B.1-4.

Table B.1-4
Key Assumptions

Exposure Scenario	Occasional Use Area
Affected Media	Surface, shallow, and subsurface soil
Location of Contamination/Release Points	Contamination investigated in Study Groups 1 and 2 is assumed to be present in surface soils that have been deposited in an annular pattern surrounding GZs. Contamination investigated in Study Group 3 is assumed to be located in surface soil directly below or adjacent to contaminated debris or spills. Contamination investigated in Study Group 4 is assumed to be present in varying configurations depending on the different scenarios identified for Study Group 4. In the case of windrows, contamination is assumed to be present uniformly throughout the entire windrow. In the case of soil piles, staked areas, and sedimentation areas, contamination is assumed to be present in surface and shallow subsurface soils. For mechanically disturbed areas, contamination is assumed to be present uniformly from the surface to the native soil interface.
Transport Mechanisms	Surface water runoff serves as the major driving force for lateral migration of contaminants while percolation of precipitation or runoff through subsurface media provides a driver for vertical transport of contaminants. Wind may cause limited resuspension and transport of windborne contaminants; however, this transport mechanism is less likely to cause migration of contamination at levels exceeding FALs.
Preferential Pathways	Vertical transport is expected to dominate over lateral transport due to small surface gradients. However, the CAU is located on an alluvial fan that drains to Yucca Flat, so there is some potential for lateral transport.
Lateral and Vertical Extent of Contamination	Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Groundwater contamination is not expected. Lateral and vertical extent of COC contamination is assumed to be within the spatial boundaries.
Groundwater Impacts	None
Future Land Use	Nuclear Test Zone
Other DQO Assumptions	Not Applicable

B.1.4 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 570 DQOs and Table B.1-4. All data collected during the CAI supported the CSM, and a revision to the CSM as described in Section A.6.2 was necessary.

B.1.4.1 Other DQO Commitments

The CAIP (NNSA/NSO, 2012a) made the following commitments:

1. Sample plots for the release scenarios of Study Groups 1 and 2 will be determined judgmentally based on the highest result of the aerial and ground-based radiological surveys. This will be done in an effort to find locations where the internal dose contributes the greatest amount to TED.

   Result: Decision I was resolved by the collection of environmental samples in four sample plots (two per study group) as required in the CAIP.

2. External dose (penetrating radiation dose for the purposes of this document) for Study Groups 1 and 2 will be determined by collecting *in situ* measurements using TLDs. The TLD measurements will be taken at a height of approximately 1 m. For sample plots, the TLDs will be located in the approximate center of the plot. The TLDs to determine Study Group 1 extent will be located radially emanating from the sample plots.

   Result: One TLD each was placed at the center of the sample plots. The 95 percent UCL of the average TED exceeded the Occasional Use Area FAL at two locations. The other TLDs were placed in a radial pattern emanating from the highest radiological readings.

3. For the Study Group 3 investigation, a judgmental sampling approach will be used to investigate the likelihood of the soil containing a COC. Biasing factors such as stains, presence of lead bricks, broken lead-acid batteries, and wastes suspected of containing hazardous or radiological components will be used to select the most appropriate Decision I samples.

   Result: Lead bricks and plates were removed from locations throughout the CAU. Confirmation samples were then collected from soil beneath where lead had been located. Eight soil samples were collected to demonstrate that lead pads had not contaminated the surrounding soil. During the visual survey, a debris field was identified, and a probabilistic sample plan for the area was generated. Twelve soil samples were collected and analyzed to characterize the nature of the potential contaminants. A sample from the pile of wax and a soil sample from beneath the wax pile were also collected. No contaminants were present in concentrations that exceeded the associated FAL.

4. For the Study Group 4 investigation, the selection of sample locations to determine the presence of contamination will be based on the likelihood of a contaminant release. That likelihood will be established based on process knowledge, radiological surveys, geophysical anomalies, lithology, site knowledge, previous sample results, professional experience, visual indicators, potential contaminant characteristics, and any other biasing factor. Individual sample results rather than average concentrations will be used to compare to FALs.

   Result: Samples were collected from windrows areas, soil piles, sedimentation areas, staked areas, and disturbed areas based on the presence of biasing factors such as visual indicators and the highest radiological readings from each type of area. Individual sample results were used to compare to FALs

B.1.5 Draw Conclusions from the Data

This section resolves the DQO decisions for CAU 570.

B.1.5.1 Decision Rules for Both Decision I and II

Decision rule: If COC contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in Section A.5.2 of the CAIP, then work will be suspended, and the investigation strategy will be reconsidered, else the decision will be to continue sampling.

- **Result:** The COC contamination was found to be consistent with the CSM and did not extend beyond the spatial boundaries.

B.1.5.2 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 that contaminant is identified as a COC, and Decision II samples will be collected, else no further investigation is needed for that release in that population.

- **Result:** PSM was present and COCs were assumed to be present within the established DCBs in Study Groups 2 and 3. Radiological contamination exceeding the FAL was also found at Study Group 1. Therefore, Decision II needed to be resolved. No COCs were identified at Study Group 4; therefore, Decision II was not required.

Decision rule: If a COC exists at any CAS or study group, then a corrective action will be determined, else no further action is required.

- **Result:** Because COCs were identified at Study Groups 1, 2, and 3, corrective actions are required.

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

- **Result:** PSM was present at Study Group 3. Therefore, a corrective action is required for each item of PSM.

B.1.5.3 Decision Rules for Decision II

Decision rule: If the population parameter (the observed concentration of any COC) in the Decision II population of interest exceeds the corresponding FAL or potential remediation waste types have not been adequately defined, then additional samples will be collected to complete the Decision II evaluation, else the extent of the COC contamination has been defined.

- **Result:** Decision II was resolved for the items of PSM and the radiological COCs at Study Group 1 as described in Sections A.3.3 and A.5.3. Wastes were characterized as described in Section A.7.2. Therefore, no additional information is needed to complete the Decision II evaluation.

B.2.0 References

EPA, see U.S. Environmental Protection Agency.

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

PNNL, see Pacific Northwest National Laboratory.

Pacific Northwest National Laboratory. 2007. *Visual Sample Plan, Version 5.0 User's Guide*, PNNL-16939. Richland, WA.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012a. *Corrective Action Investigation Plan for Corrective Action Unit* 570*:* Area 9 Yucca Flat Atmospheric Test Sites*, Nevada National Security Site, Nevada*, Rev. 0, DOE/NV--1483. Las Vegas, NV.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012c. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 0, DOE/NV--1475. Las Vegas, NV.

U.S. Environmental Protection Agency. 2006. *Data Quality Assessment: Statistical Methods for Practitioners*, EPA QA/G-9S, EPA/240/B-06/003. Washington, DC: Office of Environmental Information.

Appendix C

Risk Assessment

C.1.0 Risk Assessment

The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NSO, 2012b). This process conforms with NAC Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2012a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2012b) 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.

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 570 CAIP [NNSA/NSO, 2012a]). 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/NSO, 2012b) is summarized in Figure C.1-1.

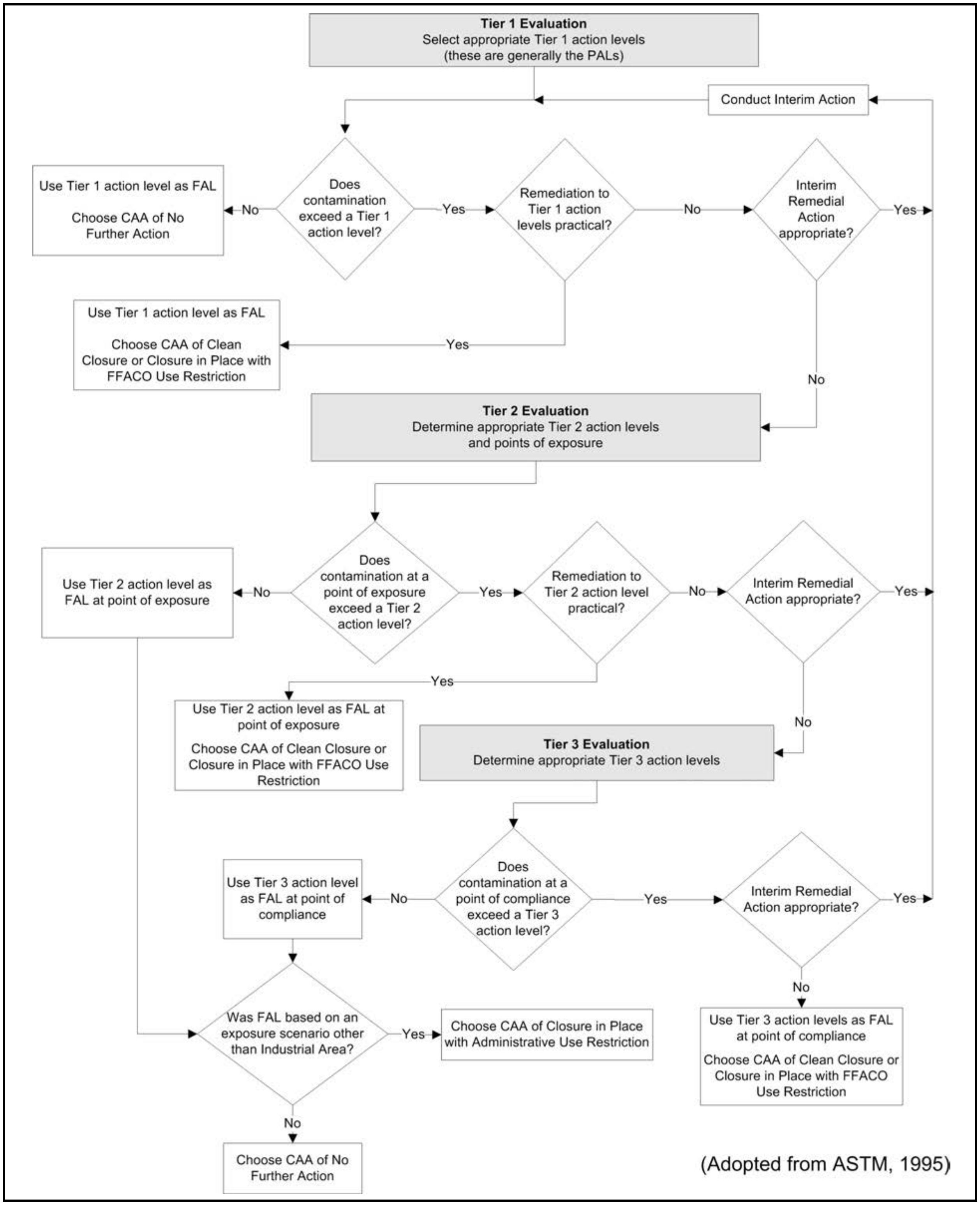

Figure C.1-1
RBCA Decision Process

It is assumed that contamination exceeding the FAL is present and requires corrective action within the following DCBs:

- The crater area at the Sugar GZ
- The Eagle CA

The following PSM is assumed to contain sufficient quantities of hazardous chemicals to cause the underlying soil to exceed a FAL when the PSM is eventually released to the soil:

- Lead pads at Study Group 3

The contamination associated with these releases is assumed to exceed FALs and require corrective action. Therefore, the need for corrective action will not be included in this risk evaluation. However, it will be included in the evaluation of corrective actions.

There were no elevated TRS values detected around the UGTA Releases that would indicate the potential presence of COCs originating from any of these release sites.

In addition, soil exceeding the radionuclide FAL at Study Group 1 was removed under an interim corrective action during the CAI. However, this risk evaluation is intended for use in making corrective action decisions for CAU 570 conditions at the conclusion of the CAI (after any interim corrective actions are completed).

C.1.1 Scenario

CAU 570, Area 9 Yucca Flat Atmospheric Test Sites, comprises the following six CASs within Area 9 of the NNSS:

- 02-23-07, Atmospheric Test Site - Tesla
- 09-23-01, Atmospheric Test Site T-9
- 09-23-11, Atmospheric Test Site S-9G
- 09-23-14, Atmospheric Test Site - Rushmore
- 09-23-15, Eagle Contamination Area
- 09-99-01, Atmospheric Test Site B-9A

CAS 02-23-07 (referred to as Tesla in this document), the third of the Teapot series, was a weapons-related test detonated at the T-9b tower site atop a 300-ft tower. The test was detonated on March 1, 1955, and had a yield of 7 kt (Maag et al., 1981).

CAS 09-23-10 (referred to as Sugar in this document), the sixth nuclear test of Operation Buster-Jangle, the first of the Jangle phase, was a weapons-effects test detonated from a 1-m platform. The detonation created a crater 28 m in diameter by 6.4 m deep. Test objectives included evaluating civil or military effects of a nuclear detonation on various targets such as military hardware. The test was detonated on November 19, 1951, and had a yield of 1.2 kt (GE, 1979).

CAS 09-23-11 (referred to as Ganymede in this document), the 36th test of Operation Hardtack II, was a safety experiment detonated at ground level inside a gravel containment that consisted of a wooden structure covered with 20 ft of gravel. The test took place on October 30, 1958, and had zero yield (H&N, 1959). The gravel gertie structure at Ganymede was previously investigated under the Industrial Sites CAU 139 and was identified as CAS 09-23-01. As a result of CAU 139 investigation (NNSA/NSO, 2007), an FFACO UR was established for the assumed presence of COCs within the structure.

CAS 09-23-14 (referred to as Rushmore or Balloon Pad in this document), the 23rd test of Operation Hardtack II, was detonated at the B-9A balloon pad after rehabilitation of the pad. The device was suspended 500 ft in the air by a 67-ft-diameter balloon tethered to the B-9A pad. The weapons-related test took place on October 22, 1958, and had a yield of 188 tons (H&N, 1959).

CAS 09-23-15 (referred to as Eagle in this document), is a fenced mound of soil and debris located east of the U9av crater. The fenced area is less than 0.5 acres and is posted as an HCA. Eagle, the 17th test of Operation Niblick, was a weapons-related test that took place on December 12, 1963, and had a yield of 5.3 kt (DOE/NV, 2000). During the Eagle test, the line-of-sight pipe ruptured, venting nuclear material to the atmosphere while damaging and scattering the pipe cap as well as associated structures and experiments (Olsen, 1964). The contaminated debris and soil from the Eagle test were collected in a mound and later fenced and identified as an HCA.

CAS 09-99-01 (referred to as Balloon Pad in this document) was the site of seven weapons-related balloon tests in 1957 as part of Operation Plumbbob. The contamination from the tests was due primarily to induced activity in the soil (GE, 1979).

Tests that are also included and evaluated in the closure of CAU 570 are underground tests throughout the area with a documented release to surface soils (referred to as UGTA Releases in this document). These include Ajax, Eagle, Pleasant, Brazos, Eel, and Hod-B (Red). The releases from these tests occurred from 1962 to 1970 and consisted of atmospheric deposition of radionuclides.

C.1.2 Site Assessment

The CAU 570 study groups were investigated to identify the sources of release, both chemical and radiological. During the investigation, historical records and photographs were reviewed to determine the potential significant transport and exposure pathways, the regional hydrogeologic and geologic characteristics for the CAU, and the current or potential future use of the site. Visual surveys and TRSs were conducted to determine the appropriate locations for the collection of soil samples. Samples were collected, and the results were reviewed to determine whether COCs were present. Major contaminants at CAU 570 consist of radioisotopes from nuclear testing at levels less than FALs in the area outside the DCBs with the exception of one soil plot (A137) and one TLD only location (A007). Contaminant concentration levels in excess of FALs are assumed to exist inside the DCBs.

Migration pathways for contamination include windborne material and materials displaced from excavation activities. The area of CAU 570 is flat, dotted with craters from various underground detonations, and gently slopes to the southeast. No significant drainages were identified in the area, so sediment samples were collected from areas where water from the area appears to pool. It is also apparent that water from the area runs into the craters in the area, but no soil samples were collected from craters because the craters were not determined to be stable and therefore were unsafe to enter. Subsurface migration pathways at CAU 570 are expected to be predominately vertical. The average annual precipitation at the nearest rain gauge station to CAU 570 is 16.80 cm, and the depth to groundwater in this area is approximately 525 m (NNSA/NSO, 2012a).

During the historical records review, it was revealed that there have been releases from other tests throughout the area, although TRSs revealed no significant impact to the area.

C.1.3 Site Classification and Initial Response Action

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

Based on the CAI and the completion of interim corrective actions, the area no longer contains contaminants that present an immediate threat to human health, safety, and the environment; therefore, no additional interim response actions are necessary at these sites. However, contamination is present within the craters, a soil pile, and a gravel gertie that, if excavated, could pose a threat to human health, safety, and/or the environment. PSM is also present in the form of lead pads. Therefore, CAU 570 has been determined to be a Classification 2 site as defined by ASTM Method E1739.

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/NSO, 2012a) 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 are based on the Industrial Area exposure scenario, which assumes that a full-time industrial worker is present at a particular location for his or her entire career (8 hr/day, 250 day/yr for a duration of 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.

The Tier 1 action levels for chemical contaminants are the following PALs as defined in the CAIP:

- EPA Region 9 RSLs (EPA, 2013).
- Background concentrations for RCRA metals are evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered the mean plus two times

the standard deviation of the mean based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).

- For COPCs without established RSLs, a protocol similar to EPA Region 9 is used to establish an action level; otherwise, an established value from another source may be chosen.

Although the PALs are based on an Industrial Area 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 CASs, the DQOs stated that site workers could be exposed to COCs through oral ingestion, inhalation, or dermal contact (absorption) of soil or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials at the CASs. The potential exposure pathways would be through worker contact with the contaminated soil or various 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 Industrial Area scenario (2,000 hr/yr) was used to calculate the Tier 1 action levels (i.e., PALs). For radiological contaminants, the 95 percent UCL of 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.

All sampled locations at each CAU 570 study group that exceed a Tier 1 action level (i.e., PAL) are 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 outside any DCB, this site worker would receive a 25-mrem dose at each of these study group locations in the exposure times listed in Table C.1-2.

Table C.1-1
Locations Where TED Exceeds the Tier 1 Action Level at CAU 570 (mrem/IA-yr)
(Page 1 of 2)

Study Group	Location	Average TED	95% UCL TED
Study Group 1 (Balloon Pad)	A136	**138.4**	**155.2**
Study Group 1 (Tesla)	A139	**53.8**	**63.3**
Study Group 2 (Sugar)	B01	**66.8**	**70.3**
Study Group 2 (Ganymede)	B02	**78.7**	**88.3**
Study Group 4	D01	**128.6**	**138.0**
	D02	**41.4**	**48.0**
	D03	**28.1**	**30.8**
	D04	**47.1**	**55.9**
	D05	**32.4**	**33.2**
	D06	**49.7**	**53.2**
	D07	**50.4**	**58.7**
	D08	**55.7**	**60.4**
	D09	**46.8**	**49.9**
	D10	**32.6**	**34.5**
	D15	**164.5**	**175.5**
	D16	**153.7**	**173.8**
	D17	**174.3**	**188.6**
	D18	**148.1**	**161.4**
	D20	**95.4**	**104.4**
	D21	**147.5**	**158.7**
	D22	**178.3**	**195.5**
	D23	**47.2**	**50.1**
	D24	**49.5**	**53.3**
	D25	**63.9**	**68.5**
	D26	**81.4**	**90.0**
	D27	**121.4**	**132.5**
	D28	**39.3**	**40.2**

Table C.1-1
Locations Where TED Exceeds the Tier 1 Action Level at CAU 570 (mrem/IA-yr)
(Page 2 of 2)

Study Group	Location	Average TED	95% UCL TED
Study Group 4 (continued)	D29	**41.0**	**43.7**
	D30	**59.0**	**63.8**
	D32	24.1	**28.3**
	D33	**67.3**	**74.0**
	D34	**55.0**	**59.2**

Bold indicates the values exceeding 25 mrem/yr.

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

Study Group	Location of Maximum Dose for Each Study Group	Average TED (mrem/IA-yr)	Minimum Exposure Time (hours)
Study Group 1 (Tesla)	A051	151.9	329
Study Group 1 (Balloon Pad)	A136	138.4	361
Study Group 2 (Sugar)	B01	66.8	749
Study Group 2 (Ganymede)	B02	78.7	635
Study Group 4	D22	178.3	280

C.1.7 Evaluation of Tier 1 Results

For the locations exceeding Tier 1 action levels for radionuclide contamination listed in Table C.1-1, NNSA/NFO determined that remediation to the Tier 1 action level is not appropriate. The risk to receptors from contaminants at CAU 570 is due to chronic exposure to radionuclides (i.e., receiving a dose over time). Therefore, the risk to a receptor 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 570 determined that workers may be present at these sites for only a few hours per year (see Section C.1.10), and it is not reasonable to assume that any worker would be present at this site for 2,000 hr/yr (DOE/NV, 1996). Therefore, it was determined to conduct a Tier 2 evaluation.

For the chemical contamination assumed to require corrective action (i.e., the PSM), it was determined that remediation to the Tier 1 action levels was feasible and appropriate. Therefore, the FALs for chemical contaminants at CAU 570 were established at the Tier 1 action levels.

C.1.8 Tier 1 Remedial Action Evaluation

No remedial actions of radiological contaminants 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 radioactivity—and, therefore, able to receive a dose.

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 570 CAS 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 570 identified the general types of work activities that are currently conducted at the site, to include fencing/posting inspection, maintenance workers, and military trainees. 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 or trespassers). In order to estimate the amount of time a site worker might spend conducting current or future activities, the NNSA/NFO and/or M&O contractor departments responsible for these activities were consulted. Under the current and projected future land use at each of the CAU 570 CASs, 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 URs. The URs require a periodic inspection to ensure that any required controls are intact and legible. This may require two people to spend up to 10 hr/yr at CAU 570.

- **Trespasser.** This would include workers or individuals who do not have a specific work assignment at one of the CASs. Although the sites will be posted with warning signs, 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 570 study groups, the most exposed worker would be the inspection and maintenance worker who would not be exposed to site contamination for more than 10 hr/yr. Based on the conservative assumption that the most exposed worker would be exposed to the maximum dose measured at any sampled location outside any DCB for the entire 10 hours, this worker would receive a maximum potential dose at each study group as listed in Table C.1-3.

In the CAU 570 DQOs, it was conservatively determined that the Occasional Use Area exposure scenario (as listed in Section 3.1.1 of the CAIP [NNSA/NSO, 2012a]) would be appropriate in calculating receptor exposure time based on current land use at all CAU 570 CASs. 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

Table C.1-3
Maximum Potential Dose to Most Exposed Worker at CAU 570 Study Groups

Study Group	Most Exposed Worker	Exposure Time	Maximum Potential Dose
Study Group 1	Inspection and Maintenance Worker	10 hr/yr	2.7 mrem/yr
Study Group 2	Inspection and Maintenance Worker	10 hr/yr	0.4 mrem/yr
Study Group 4	Inspection and Maintenance Worker	10 hr/yr	2.1 mrem/yr

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 Occasional Use Area exposure scenario.

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

The average and 95 percent UCL TEDs calculated using the Occasional Use Area exposure scenario were compared to the 25-mrem/OU-yr Tier 2 action level. As shown in Table C.1-4, none of the 95 percent UCL TED values exceeded the 25-mrem/OU-yr Tier 2 action level.

Table C.1-4
Occasional Use Area Scenario TED (mrem/OU-yr)
(Page 1 of 2)

Study Group	Plot/Location	Average TED	95% UCL TED
Study Group 1	A051	7.6	8.0
	A136	6.9	7.8
Study Group 2	B01	3.4	3.5
	B02	4.0	4.5
Study Group 4	D01	6.4	6.9
	D02	2.1	2.4
	D03	1.4	1.5
	D04	2.4	2.8
	D05	1.6	1.7

Table C.1-4
Occasional Use Area Scenario TED (mrem/OU-yr)
(Page 2 of 2)

Study Group	Plot/Location	Average TED	95% UCL TED
Study Group 4 (continued)	D06	2.5	2.7
	D07	2.5	3.0
	D08	2.9	3.1
	D09	2.4	2.5
	D10	1.6	1.7
	D15	8.3	8.9
	D16	7.8	8.8
	D17	8.9	9.6
	D18	7.4	8.1
	D20	4.9	5.3
	D21	7.5	8.0
	D22	9.2	10.1
	D23	2.4	2.5
	D24	2.5	2.7
	D25	3.2	3.4
	D26	4.2	4.6
	D27	6.5	7.1
	D28	2.0	2.0
	D29	2.1	2.2
	D30	3.0	3.2
	D31	0.8	0.8
	D32	1.2	1.4
	D33	3.4	3.7
	D34	2.8	3.0
	D35	1.1	1.2
	D36	0.4	0.6
	D37	0.2	0.3

Bold indicates the value is equal to or greater than 25 mrem/yr.

The Tier 2 action levels are typically compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Points of exposure are defined as those locations or areas at which an individual or population may come in contact with a COC originating from a CAS. However, for CAU 570, the Tier 2 action levels were conservatively compared to the maximum contaminant concentration from a single point location.

C.1.12 Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation, soil contamination at CAU 570 beyond that assumed to be present within DCBs, and in the form of PSM, is not present at levels that exceed Tier 2 action levels. The subsurface contamination at Sugar, the waste pile at Eagle, and the lead pads at Eagle are assumed to exceed the Tier 2 action levels. As corrective actions are practical for these releases, the Tier 2 action level is established as the FAL, and corrective actions are proposed.

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 Recommendations

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 study group. However, for CAU 570, the Tier 2 action levels were conservatively compared to the maximum contaminant concentration from single point locations.

Soil contamination at CAU 570, beyond that assumed to be present within DCBs and in the form of PSM, is not present at levels exceeding FALs. The subsurface contamination at Sugar, the waste pile at Eagle, and the lead pads at Eagle are assumed to exceed FALs and require corrective action.

The corrective actions for CAU 570 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 may be necessary.

The FAL was based on an exposure time of 80 hr/yr of site worker exposure to CAS surface soils. If the land use at Tesla or the Balloon Pad changed to a more intensive use of the site, a site worker could be potentially exposed to site contamination for longer exposure times and be exposed to an unacceptable level of risk. Therefore, an administrative boundary was established at Tesla and the Balloon Pad as a BMP that would restrict a more intensive use of this site without NDEP notification. The area at Tesla and the Balloon Pad that could potentially provide sufficient dose to cause a full-time industrial worker to receive an annual dose exceeding 25 mrem was conservatively bounded in Section A.3.7. Therefore, an administrative boundary was identified for Tesla and the Balloon Pad.

C.3.0 References

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Appendix D

Closure Activity Summary

D.1.0 Closure Activity Summary

The following subsections document the closure activities that were completed for CAU 570.

D.1.1 CAS 02-23-07 (Tesla) Closure Activities

Based on the results of this investigation, a corrective action of clean closure was implemented at CAS 02-23-07. Soil containing the COCs was excavated and placed in lined intermodal containers for disposal at the NNSS Area 5 RWMC. Also, PSM in the form of a lead brick was identified that required corrective action. All PSM and soil containing COCs were removed during the CAI. Waste management, characterization, and disposal information is presented in Section A.7.0. A BMP of an administrative UR (as presented in Attachment D-1) was implemented to prevent a future site worker from inadvertently receiving a dose exceeding 25 mrem/IA-yr if a more intensive use of the site were to occur in the future.

D.1.2 CAS 09-23-10 (Sugar) Closure Activities

No COCs were identified within the sampled location at Sugar. However, it is assumed that subsurface contamination present in the Sugar crater (due to direct injection of radionuclides into the subsurface soil from the nuclear test) exceeds the radiological FAL of 25 mrem/OU-yr. Therefore, a corrective action of closure in place with a UR was implemented for the subsurface contamination.

The established FFACO UR for Sugar is defined by the coordinates listed in the FFACO UR form and as illustrated in Attachment D-1. Any use of the area within the FFACO UR for activities that are restricted by the URs will require NDEP notification. The FFACO UR signs posted at this site reads as follows:

WARNING

SUBSURFACE RADIOLOGICAL CONTAMINATION
FFACO Site CAU 570 / CAS 09-23-10
Sugar Contamination Area
No activities that may alter or modify the containment control are
permitted in this area without U.S. Government permission.
Before working in this area,
Contact Real Estate Services at 702-295-2528

D.1.3 CAS 09-23-11 (Ganymede) Closure Activities

No COCs were identified within sampled locations at Ganymede. However, it is assumed that subsurface contamination present in the Ganymede gravel gertie (due to direct injection of radionuclides into the gravel mound and soil from the nuclear test) exceeds the radiological FAL of 25 mrem/OU-yr. An FFACO UR was previously implemented for this release during the investigation of CAS 09-23-01 as part of the Industrial Sites Project. Therefore, no further corrective action is warranted.

D.1.4 CAS 09-23-15 (Eagle) Closure Activities

No COCs were detected within the sampled area at CAS 09-23-15. However, PSM in the form of lead pads and a contaminated waste pile was identified that requires corrective action. The lead pads and contaminated waste pile were left in place, and an FFACO UR was implemented as illustrated in Attachment D-1. The FFACO UR signs for the lead pads and contaminated waste pile read as follows:

WARNING

RADIOLOGICAL CONTAMINATION
METALLIC LEAD
FFACO Site CAU 570 / CAS 09-23-15
Eagle Contamination Area
No activities that may alter or modify the containment control are
permitted in this area without U.S. Government permission.
Before working in this area,
Contact Real Estate Services at 702-295-2528

D.1.5 CAS 09-99-01 (Balloon Pad) and CAS 09-23-14 (Rushmore) Closure Activities

No COCs were detected within the sampled area at CASs 09-99-01 and 09-23-14. However, PSM in the form of a lead-acid battery and lead bricks/plates was identified that requires corrective action. All PSM and contaminated soil were removed during the CAI as described in Appendix A. Waste management, characterization and disposal information is presented in Section A.7.0. A BMP of an administrative UR (as presented in Attachment D-1) was implemented to prevent a future site worker from inadvertently receiving a dose exceeding 25 mrem/IA-yr if a more intensive use of the site were to occur in the future.

Attachment D-1

Use Restrictions

(12 Pages)

Use Restriction Information

CAU Number/Description: 570/Area 9 Yucca Flat Atmospheric Test Sites
Applicable CAS Number/Description: 02-23-07 Atmospheric Test Site Tesla

Contact (DOE AL/Activity): NNSA/NFO Soils Federal Activity Lead

FFACO Use Restriction Physical Description:

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

UR Points	Northing	Easting

Depth: N/A

Survey Source (GPS, GIS, etc): N/A

Basis for FFACO UR(s):

Summary Statement: N/A

Contaminants Table:

Maximum Concentration of Contaminants			
Constituent	**Maximum Concentration**	**Action Level**	**Units**

Site Controls: N/A

Description: N/A

Inspection/Maintenance Frequency: N/A

Administrative Use Restriction Physical Description*:

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

UR Points	Northing	Easting
Southeast	4,108,998	584,682
South	4,108,910	584,560
West	4,109,112	584,332
Northwest	4,109,311	584,363
North Northwest	4,109,481	584,512
Northeast	4,109,493	584,724
East	4,109,228	584,741

Depth: 5 cm bgs

Survey Source (GPS, GIS, etc): GIS

*Coordinates for the Administrative Use Restriction exclude the area defined by the FFACO Use Restriction coordinates.

Note: Effective upon acceptance of closure documents by NDEP

Use Restriction Information

Basis for Administrative Use Restriction(s):

Summary Statement: This administrative use restriction is to protect site workers from inadvertent exposure. Data from surface sampling indicate that a worker could potentially receive a 25 mrem dose in approximately 329 hours of exposure to the surface location with the maximum detected radioactivity. Current land use at this site does not require site workers to be present for this amount of exposure time. However, as a best management practice, this administrative use restriction will prevent a future (more intensive) use of the area. The analytical results and locations of all samples collected are presented in the CADD/CR for CAU 570.

Contaminants Table:

Maximum Concentration of Contaminants for CAU 570 **CAS 02-23-07, Atmospheric Test Site Tesla**			
Constituent	**Combined Dose**	**Action Level**	**Units**
Cesium-137	151.8	25	mrem/IA-yr (2000 hours of exposure)
Europium-152			
Plutonium-239/240			
Silver-108M			

Site Controls: This administrative use restriction is established at the coordinates listed above and depicted in the attached figure. No physical site controls are required for this administrative use restriction.

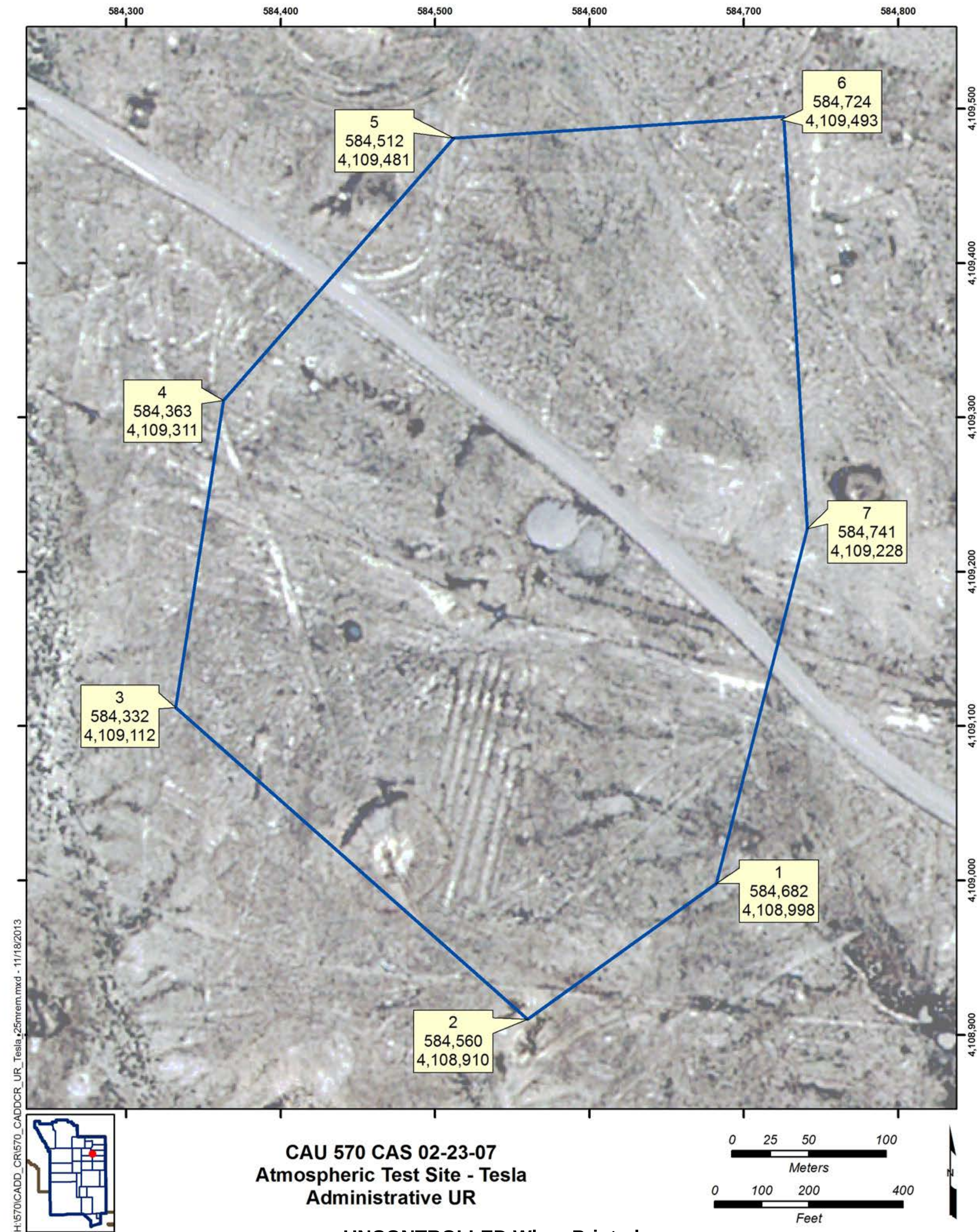
Description: This administrative UR is recorded in the FFACO database, NNSA Nevada Field Office M&O GIS, and the NNSA Nevada Field Office CAU/CAS files. No site controls are required for this administrative use restriction other than the administrative controls for land use at the NNSS.

Inspection/Maintenance Frequency: N/A

The future use of any land related to this Corrective Action Unit (CAU), as described by the above surveyed location, is restricted from any DOE or Air Force activity that may alter or modify the containment control as approved by the state and identified in the CAU CR or other CAU documentation unless appropriate concurrence is obtained in advance.

Comments: Personnel are restricted from performing any work in this restricted area that would result in a more intensive use of the site than the current land use (i.e., activities consistent with the Occasional Use Area exposure scenario). Activities included in the current land use include short duration activities such as site visits, maintenance of demarcation areas, and work on utilities. Permission to conduct any restricted activities within this area requires prior notification to NDEP.

Submitted By: /s/ Tiffany A. Lantow **Date:** 11/21/2013



CAU 570 CAS 02-23-07
Atmospheric Test Site - Tesla
Administrative UR

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Source: N-I GIS, 2013; NNSA/NV, 2002

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Coordinate System: NAD 1983 UTM Zone 11N, Meter

Use Restriction Information

CAU Number/Description: 570/Area 9 Yucca Flat Atmospheric Test Sites
Applicable CAS Number/Description: 09-23-10 Atmospheric Test Site T-9

Contact (DOE AL/Activity): NNSA/NFO Soils Federal Activity Lead

FFACO Use Restriction Physical Description:

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

UR Points	Northing	Easting
Southeast	4,109,867	585,333
Southwest	4,109,880	585,299
Northwest	4,109,913	585,315
Northeast	4,109,903	585,347

Depth: Subsurface to 25 ft bgs

Survey Source (GPS, GIS, etc): GPS

Basis for FFACO UR(s):

Summary Statement: This FFACO use restriction is to protect site workers from inadvertent exposure. Based on investigation results, there are no surface contaminants present in concentrations that exceed action levels. Subsurface contamination is assumed to be present within the crater formed as a result of atmospheric testing. The contamination, if exposed through excavation, could cause a site worker to receive a dose exceeding 25 mrem/yr.

Contaminants Table:

Maximum Concentration of Contaminants for CAU 570 CAS 09-23-10, Atmospheric Test Site T-9			
Constituent	**Maximum Concentration**	**Action Level**	**Units**
Assumed presence of chemical & radiological contaminants		N/A	N/A

Site Controls: The use restricted area encompasses the area where subsurface soil contamination is present that, if excavated, is assumed to exceed the FAL of 25 mrem in 80 hours (the Occasional Use Area annual exposure scenario). It is established at the boundary identified by the coordinates listed above and depicted in the attached figure. Site controls include warning signs placed on the use restriction boundary.

Description: The FFACO UR is recorded in the FFACO database, NNSA Nevada Field Office M&O GIS, and the NNSA Nevada Field Office CAU/CAS files. FFACO UR signs are posted at the site.

Inspection/Maintenance Frequency: Annual post-closure inspections will be conducted to ensure postings are in place, intact, and legible.

Use Restriction Information

Administrative Use Restriction Physical Description*:

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

UR Points	Northing	Easting

Depth: N/A

Survey Source (GPS, GIS, etc): GIS

*Coordinates for the Administrative Use Restriction exclude the area defined by the FFACO Use Restriction coordinates.

Basis for Administrative Use Restriction(s):

Summary Statement: N/A

Contaminants Table:

Maximum Concentration of Contaminants			
Constituent	**Maximum Concentration**	**Action Level**	**Units**

Site Controls: N/A

Description: N/A

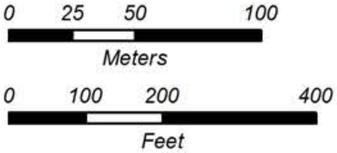
Inspection/Maintenance Frequency: N/A

The future use of any land related to this Corrective Action Unit (CAU), as described by the above surveyed location, is restricted from any DOE or Air Force activity that may alter or modify the containment control as approved by the state and identified in the CAU CR or other CAU documentation unless appropriate concurrence is obtained in advance.

Comments: Personnel are restricted from performing any work in this restricted area that would result in a more intensive use of the site than the current land use (i.e., activities consistent with the Occasional Use Area exposure scenario). Activities included in the current land use include short duration activities such as site visits, maintenance of the use restriction postings, maintenance of demarcation areas, and work on utilities. Permission to conduct any restricted activities within the area requires prior notification to NDEP.

Submitted By: /s/ Tiffany A. Lantow **Date:** 11/21/2013

CAU 570 CAS 09-23-10
Atmospheric Test Site T-9
FFACO UR



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Source: N-I GIS, 2013; NNSA/NV, 2002

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Coordinate System: NAD 1983 UTM Zone 11N, Meter

Use Restriction Information

CAU Number/Description: 570/Area 9 Yucca Flat Atmospheric Test Sites
Applicable CAS Number/Description: 09-23-15 Eagle Contamination Area

Contact (DOE AL/Activity): NNSA/NFO Soils Federal Activity Lead

FFACO Use Restriction Physical Description:

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

UR Points	Northing	Easting
Southeast	4,109,770	584,930
Southwest	4,109,770	584,917
West	4,109,810	584,917
Northwest	4,109,850	584,928
Northeast	4,109,839	584,954
East	4,109,819	584,961

Depth: Surface to 25 ft bgs

Survey Source (GPS, GIS, etc): GIS

Basis for FFACO UR(s):

Summary Statement: This FFACO use restriction is to protect site workers from inadvertent exposure to lead and radioactive contaminants. Metallic lead is present in the lead pads. Contamination is also assumed to be present within the soil pile formed when debris from the Eagle underground test was pushed into a pile. The contamination could cause a site worker to receive a dose exceeding 25 mrem/yr.

Contaminants Table:

Maximum Concentration of Contaminants for CAU 570 CAS 09-23-15, Eagle Contamination Area			
Constituent	**Maximum Concentration**	**Action Level**	**Units**
Lead	Metallic Lead	800	mg/kg
Assumed presence of chemical and radiological contaminants		N/A	N/A

Site Controls: The use restricted area encompasses the area where the lead pads are present and where soil contamination is assumed to exceed the FAL of 25 mrem in 80 hours (the Occasional Use Area annual exposure scenario). It is established at the boundary identified by the coordinates listed above and depicted in the attached figure. Site controls include warning signs placed on the use restriction boundary.

Description: The FFACO UR is recorded in the FFACO database, NNSA Nevada Field Office M&O GIS, and the NNSA Nevada Field Office CAU/CAS files. FFACO UR signs are posted at the site.

Inspection/Maintenance Frequency: Annual post-closure inspections will be conducted to ensure postings are in place, intact, and legible.

Administrative Use Restriction Physical Description*:

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

Use Restriction Information

UR Points	Northing	Easting

Depth: N/A

Survey Source (GPS, GIS, etc): N/A

*Coordinates for the Administrative Use Restriction exclude the area defined by the FFACO Use Restriction coordinates.

Basis for Administrative Use Restriction(s):

Summary Statement: N/A.

Contaminants Table:

Maximum Concentration of Contaminants			
Constituent	**Maximum Concentration**	**Action Level**	**Units**

Site Controls: N/A

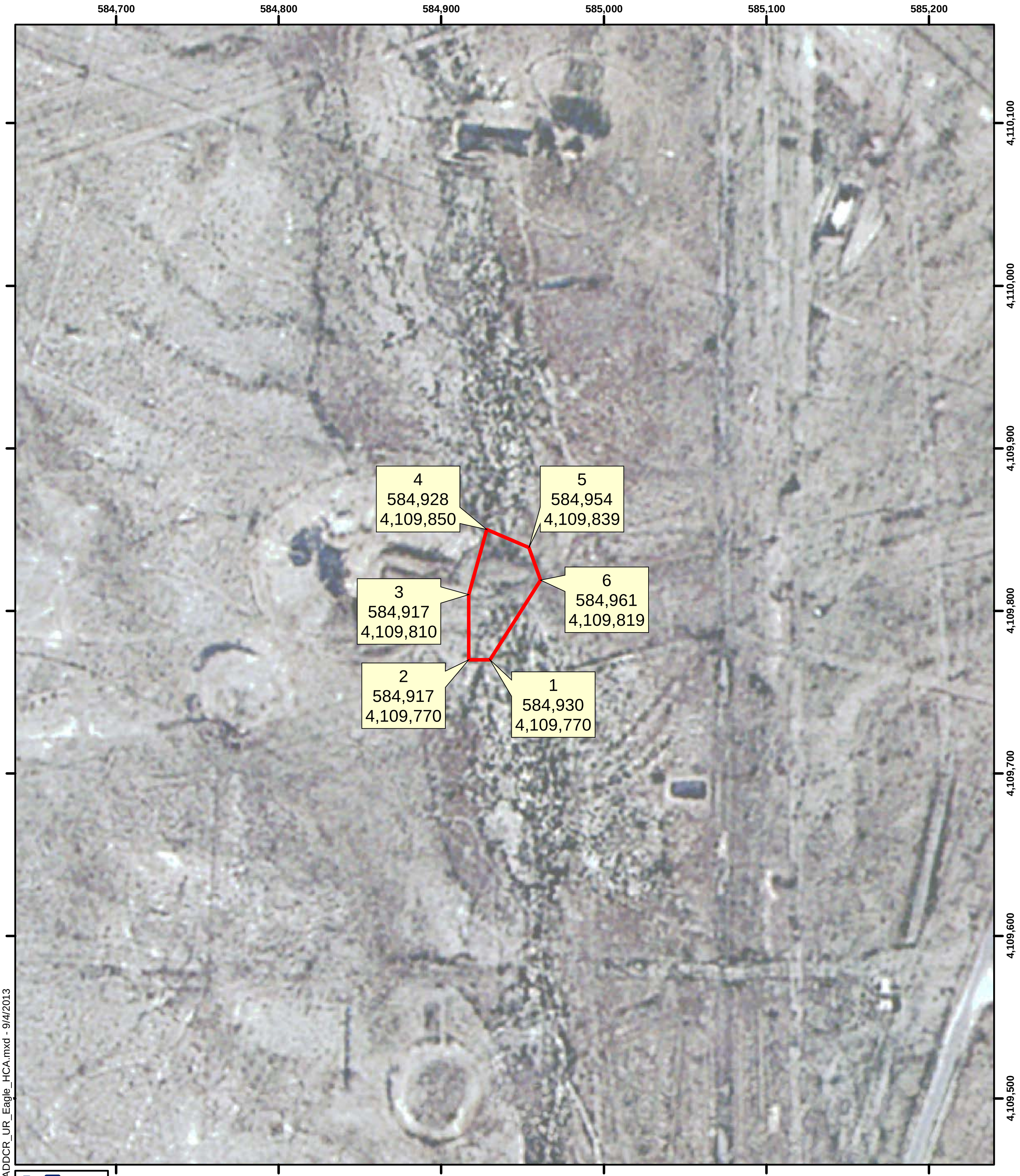
Description: N.

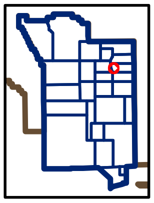
Inspection/Maintenance Frequency: N/A

The future use of any land related to this Corrective Action Unit (CAU), as described by the above surveyed location, is restricted from any DOE or Air Force activity that may alter or modify the containment control as approved by the state and identified in the CAU CR or other CAU documentation unless appropriate concurrence is obtained in advance.

Comments: Personnel are restricted from performing any work in this restricted area that would result in a more intensive use of the site than the current land use (i.e., activities consistent with the Occasional Use Area exposure scenario). Activities included in the current land use include short duration activities such as site visits, maintenance of the use restriction postings, maintenance of demarcation areas, and work on utilities. Permission to conduct any restricted activities within the area requires prior notification to NDEP.

Submitted By: /s/ Tiffany A. Lantow **Date:** 11/21/2013





CAU 570 CAS 09-23-15
Eagle Contamination Area
FFACO UR

UNCONTROLLED When Printed

Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1983 UTM Zone 11N, Meter

H:\570\CADD_CR\570_CADDCR_UR_Eagle_HCA.mxd - 9/4/2013

Use Restriction Information

CAU Number/Description: 570/Area 9 Yucca Flat Atmospheric Test Sites
Applicable CAS Number/Description: 09-99-01 Atmospheric Test Site B-9A

Contact (DOE AL/Activity): NNSA/NFO Soils Federal Activity Lead

FFACO Use Restriction Physical Description:

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

UR Points	Northing	Easting

Depth: N/A

Survey Source (GPS, GIS, etc): N/A

Basis for FFACO UR(s):

Summary Statement: N/A

Contaminants Table:

Maximum Concentration of Contaminants			
Constituent	**Maximum Concentration**	**Action Level**	**Units**

Site Controls: N/A

Description: N/A

Inspection/Maintenance Frequency: N/A

Administrative Use Restriction Physical Description*:

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

UR Points	Northing	Easting
Southeast	4,109,833	585,336
South	4,109,830	585,105
Southwest	4,109,997	584,718
Northwest	4,110,420	584,712
North-Northwest	4,110,630	584,945
North-Northeast	4,110,634	585,231
Northeast	4,110,386	585,457
East	4,110,164	585,458

Depth: Surface to 5 cm bgs

Survey Source (GPS, GIS, etc): GIS

*Coordinates for the Administrative Use Restriction exclude the area defined by the FFACO Use Restriction coordinates.

Use Restriction Information

Basis for Administrative Use Restriction(s):

Summary Statement: This administrative use restriction is to protect site workers from inadvertent exposure. Data from surface sampling indicate that a worker could potentially receive a 25 mrem dose in approximately 361 hours of exposure to the surface location with the maximum detected radioactivity. Current land use at this site does not require site workers to be present for this amount of exposure time. However, as a best management practice, this administrative use restriction will prevent a future (more intensive) use of the area. The analytical results and locations of all samples collected are presented in the CADD/CR for CAU 570.

Contaminants Table:

Maximum Concentration of Contaminants for CAU 570 CAS 09-99-01, Atmospheric Test Site B-9A			
Constituent	**Combined Dose**	**Action Level**	**Units**
Europium-152	138.4	25	mrem/IA-yr (2000 hours of exposure)

Site Controls: This administrative use restriction is established at the coordinates listed above and depicted in the attached figure. No physical site controls are required for this administrative use restriction.

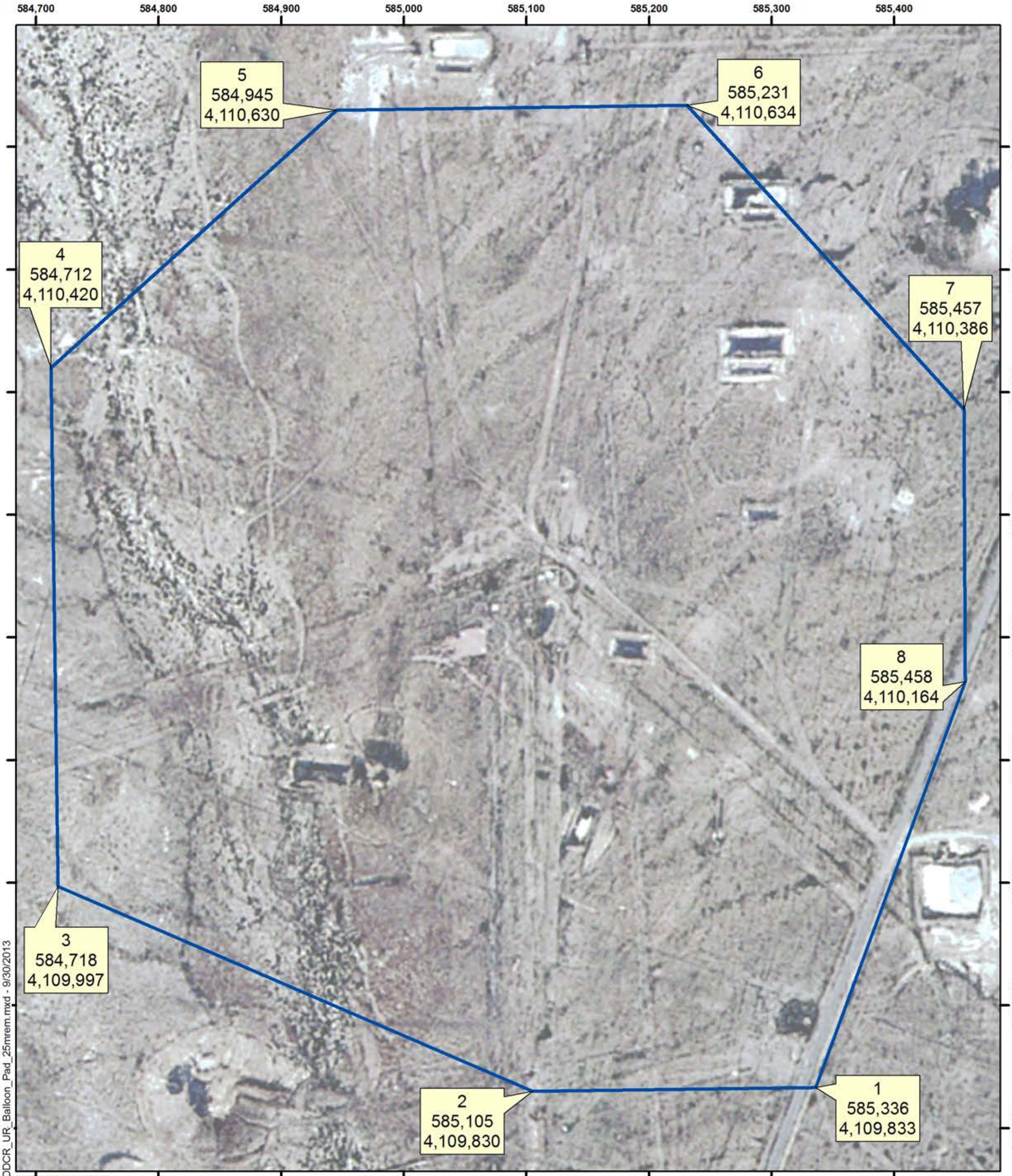
Description: This administrative UR is recorded in the FFACO database, NNSA Nevada Field Office M&O GIS, and the NNSA Nevada Field Office CAU/CAS files. No site controls are required for this administrative use restriction other than the administrative controls for land use at the NNSS.

Inspection/Maintenance Frequency: N/A

The future use of any land related to this Corrective Action Unit (CAU), as described by the above surveyed location, is restricted from any DOE or Air Force activity that may alter or modify the containment control as approved by the state and identified in the CAU CR or other CAU documentation unless appropriate concurrence is obtained in advance.

Comments: Personnel are restricted from performing any work in this restricted area that would result in a more intensive use of the site than the current land use (i.e., activities consistent with the Occasional Use Area exposure scenario). Activities included in the current land use include short duration activities such as site visits, maintenance of the use restriction postings, maintenance of demarcation areas, and work on utilities. Permission to conduct any restricted activities within this area requires prior notification to NDEP.

Submitted By: /s/ Tiffany A. Lantow **Date:** 11/21/2013



CAU 570 CAS 09-99-01
Atmospheric Test Site B-9A
Administrative UR

0 25 50 100
Meters
0 100 200 400
Feet
N

H:\570\CADD_CR\570_CADDCR_UR_Balloon_Pad_25mrem.mxd - 9/30/2013

Source: N-I GIS, 2013; NNSA/NV, 2002

UNCONTROLLED When Printed

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Attachment D-2

Waste Disposal Documentation

(20 Pages)

CERTFICATE OF RECYCLE

ISSUED TO: Navarro-Interra, LLC
COMPANY ADDRESS: Mercury NV 89023

Toxco Inc. certifies that the lead material noted in Contract No.NI13B0001A was received at the Toxco Material Management Center (TMMC) and title was assumed and the material will be reused as lead shielding within and in support of government or commercial nuclear industrial application as required by the Department of Energy Material Suspension.

Recycle and Disposition of Contaminated Lead from Navarro-Interra, LLC (N-I) c/o U.S. DOE NNSA/NFO Received in Shipment A13611.

/s/ Rick L. Low

Rick L. Low, TOXCO Materials Management Center Vice President/RSO 9/17/13

TOXCO, INC.
109 Flint Rd.
Oak Ridge TN 37830

Included: LEAD Recycle for CAU 570
1) 570P01 – pallet w/ 36 pieces
2) 570C07 – drum of some lead pieces

9/17/13

LVF - Rolloff containing 570DC01

NSTec
Form
FRM-0918

NNSS LANDFILL LOAD VERIFICATION

09/26/12
Rev. 03
Page **1** of **2**

SWO USE (Select One) AREA ☐ 23 ☐ 6 ☒ 9/10C **LANDFILL**

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

REQUIRED: WASTE GERERATOR INFORMATION

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

Waste Generator: Mark Heser

Phone Number: 5-2124

Location / Origin: Building 23-153 - 20 yd3 roll-off (container # 153R12) of industrial waste for disposal at Area 9, U10c

Waste Category: (check one) ☐ Commercial ☒ Industrial

Waste Type: (check one) ☐ NNSS ☐ Putrescrible ☒ FFACO-onsite ☐ WAC Exception ☐ Non-Putrescible ☐ Asbestos Containing Material ☐ FFACO-offsite ☐ Historic DOE/NV

Pollution Prevention Category: (check one) ☒ Environmental management ☐ Defense Projects ☐ YMP

Pollution Prevention Category: (check one) ☐ Clean-Up ☒ Routine

Method of Characterization: (check one) ☐ Sampling & Analysis ☒ Process Knowledge ☒ Contents

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

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

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

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

Acceptable waste at any NNSS landfill: ☒ Paper ☐ Rocks / unaltered geologic materials ☒ Empty containers

☐ Asphalt ☒ Metal ☒ Wood ☐ Soil ☐ Rubber (excluding tires) ☐ Demolition debris

☒ Plastic ☐ Wire ☐ Cable ☒ Cloth ☐ Insulation (non-Asbestosform) ☐ Cement & concrete

☒ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)

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

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

Additional waste accepted at the Area 9 U10c Landfill:

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

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

☒ Hydrocarbons (contact SWO) ☐ Other ____

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

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

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

REQUIRED: WASTE GENERATOR SIGNATURE

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

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

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

Radiological Survey Release for Waste Disposal
RCT Initials

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

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

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

SIGNATURE: /s/ Signature on File DATE: 5-13-13

BN-0646 (10/05)

Print Name: Mark Heser // /s/ Mark Heser

Signature: ____ Date: 5/13/13

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

SWO USE ONLY

Load Weight (net from scale or estimate): 4,980 ✓ Certifier: /s/ Signature on File
Printed Name & Signature

UNCONTROLLED When Printed

Waste Container Log

1. Container ID: 570DC01
2. Container Barcode: LVEC N/A

3. CAU: 570 **4. CAS/Location:** All **5. CAS Letter:** N/A

6. Container Type: 5H **7. Container Size:** 10 gallon

8. Pre-Use Inspection Checklist:	Yes	No
Is the outside of the waste container free of defects (i.e., dents, cracks, corrosion, or other defects)?	✓	
Is the container lid, door, or closure in good condition?	✓	
Is the container capable of being secured with a lock or TID?	N/A	
Are all container welds and/or seams intact and in good condition?	N/A	
Are all container gaskets in place and in good condition?	N/A	
Is the container empty?	✓	
Is the container free of liquids?	✓	
Are the interior surfaces of the container free of defects (i.e., dents, cracks, corrosion, or other defects)?	✓	

Waste Handler's Signature: /s/ Mark Heser Badge No.: IB53550 Date: 12/3/12

Note: If any item is "**No**," then the container shall be segregated and a "Hold Tag" completed and affixed. Notify the WCO, WO Manager, or designee.

9. Liner(s):

Is a minimum 6-mil total liner(s) in place for solid wastes in drums? (Circle: yes / [✓ no])
OR: Are appropriate liners in place for other types of containers? (Circle: yes / [✓ no])
and describe Dry Cell batteries packaged into 6 mil plastic Bag.
OR: If no liner(s) required, circle [✓ N/A].

10. Container Markings and Labels (applied at the time of packaging):

Container ID: 570DC01 Accumulation Start Date*: N/A

(* Not applicable to satellite accumulation areas)

Contents: 11 EACH - Energizer (Model #520) dry cell Alkaline batteries.

Circle all Labels applied to container at time of packaging:

Haz. Waste Pend. Analysis	[✓ Non-Hazardous]	PCB	Hazardous
Rad. Mat. Pend. Analysis	Hydrocarbon	Asbestos	Radioactive

Other (Describe):

Comments: Label on exterior of batteries indicates these batteries are "Energizer Model #520".

Waste Container Log

Container ID: 570DC01

11. Contents Log

A. Item Number B. Date	C. % Contam. D. Estimated Volume (gallons)	E. Waste Type (Circle and Describe)	F. Absorbent Type (w/Amt. and Units) G. TID Number (Old and New)	H. Prohibited and/or NNSS Restricted Waste Forms Present or Pending Analysis	I. Characterization Information	J. Waste Handler (WH) Signature K. Verifier (WH Qualified) Signature	J. Badge Number K. Badge Number
A. 1	C. <1%	E. PPE, Sampling Equip, Oil, Rinsate, Soil, [✓ Other] Describe Dry Cell / Alkaline Batteries	F. N/A	H. NONE	I. PK-Model-520 Manf. = Energizer	J. /s/ Mark Heser	IB53550
B. 12/3/12	D. 11 each		G. New: N/A		Visual Inspection - No staining observed RSR-121203-SL-03	K. /s/ Signature on File	IB37867
A.	C.	E. PPE, Sampling Equip, Oil, Rinsate, Soil, Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE, Sampling Equip, Oil, Rinsate, Soil, Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE, Sampling Equip, Oil, Rinsate, Soil, Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE, Sampling Equip, Oil, Rinsate, Soil, Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	Last Entry. MH

Waste Container Log

Container ID: 570DC01

To be filled out by Waste Operations Staff or designee

Post Closure	Contaminant Density: N/A (units)	
Package Gross Weight: N/A (kg/lb)	Package Tare Weight: N/A (kg/lb)	
Scale ID No.: N/A	Scale Calibration Expiration Date: N/A	
Signature: /s/ Mark Heser	Badge No.: IB53550	Date: 12/3/12
Torque: N/A (ft-lb)		
Torque Wrench ID#: N/A	Torque Wrench Calibration Expiration Date: N/A	
Signature: /s/ Mark Heser	Badge No.: IB 53550	Date: 12/3/12

NNSSWAC WASTE FORM CRITERIA REVIEW: List NNSSWAC Prohibited or Restricted Waste Forms:

N/A

Description and concurrence with actions taken to render NNSSWAC restricted waste forms NNSSWAC compliant:

N/A

Signature: /s/ Mark Heser	Badge No.: IB53550	Date: 12/3/12

Final Waste Characterization (Circle all that apply):

Hazardous LLW MLLW PCB Asbestos Beryllium

Hydrocarbon Other: None

Recommended Disposition/Disposal Pathway: Transfer to Roll-off @ B153 - final disposal at Area 9, U10C

Signature: /s/ Mark Heser	Badge No.: IB53550	Date: 12/3/12

Waste Disposed or Shipped for Treatment/Disposal, Date: Transferred to roll off - 12/3/12
Roll-off to U10C - 7-10-13

Signature: /s/ Mark Heser	Badge No.: IB 53550	Date: 12/3/12

Executed Disposal Pathway/Facility: Area 9, U10C landfill

Certificate of Treatment/Disposal Received, Date: Completed LVF

Recommended/Compliant Treatment/Disposal Confirmed, Date: 7-15-13

WO Mgr Signature: /s/ John M. Fowler	Badge No.: IB31107	Date: 09/06/2013

Waste Container Log

1. Container ID: 570Bat1

2. Container Barcode: LVEC N/A

3. CAU: 570 **4. CAS/Location:** N/A **5. CAS Letter:** N/A

12 volt -

6. Container Type: N/A - Battery Casing **7. Container Size:** N/A - Battery

8. Pre-Use Inspection Checklist:	Yes	No
Is the outside of the waste container free of defects (i.e., dents, cracks, corrosion, or other defects)?	✓	
Is the container lid, door, or closure in good condition?		N/A
Is the container capable of being secured with a lock or TID?		N/A
Are all container welds and/or seams intact and in good condition?		N/A
Are all container gaskets in place and in good condition?		N/A
Is the container empty?		N/A ①
Is the container free of liquids?	✓ ①	
Are the interior surfaces of the container free of defects (i.e., dents, cracks, corrosion, or other defects)?		N/A

Waste Handler's Signature: /s/ Mark Heser Badge No.: IB 53550 Date: 12/3/12

Note: If any item is "**No**," then the container shall be segregated and a "Hold Tag" completed and affixed. Notify the WCO, WO Manager, or designee.

9. Liner(s):

Is a minimum 6-mil total liner(s) in place for solid wastes in drums? (Circle: yes [✓ no])

OR: Are appropriate liners in place for other types of containers? (Circle: yes [✓ no])

and describe Intact Battery Casing - No container or Liner Required

OR: If no liner(s) required, circle: [✓ N/A.]

10. Container Markings and Labels (applied at the time of packaging):

Container ID: 570Bat1 Accumulation Start Date*: N/A - universal waste

(* Not applicable to satellite accumulation areas)

Contents: 1 EAch - Spent, Dry 12 volt Battery Casing

Circle all Labels applied to container at time of packaging:

Haz. Waste Pend. Analysis
Rad. Mat. Pend. Analysis
Non-Hazardous
Hydrocarbon
PCB
Asbestos
Hazardous
Radioactive

Other (Describe): None

Comments: ① Spent 12 volt Lead Acid battery Casing.
Battery is dry - No electrolyte
Battery Casing is intact.

Waste Container Log

Directions for Waste Container Log – Waste Hander Section

A Qualified Waste Handler must complete Pages 1 through 4 of the Waste Container Log for each waste container generated. A different Qualified Waste Handler must verify each entry recorded in Section 11, Contents Log.

1. **Container ID** – Enter the CAU number, CAS letter, sequential number (i.e., ###A##).
2. **Container Barcode** – Enter the barcode number that was placed on the container when it was receipt inspected.
3. **CAU** – Enter the CAU number or project designation where the waste was generated (i.e., CAU ###).
4. **CAS/Location** – Enter the CAS number or site location identifier where the waste was generated.
5. **CAS Letter** – Enter the CAS letter associated with the CAS via the Project Field Instruction.
6. **Container Type** – Enter the container type (e.g., Steel Drum, B-25 Box, Plastic Bucket).
7. **Container Size** – Enter the container's maximum capacity (e.g., 55 gal, 5 gal, 3.5 cubic yards).
8. **Pre-Use Inspection Checklist** – Conduct an initial pre-use inspection before placing waste in the container. If the container condition changes after waste are placed in the container, then correct the Pre-Use Inspection section and notify the WCO and Environmental Compliance Manager, or designee.
9. **Liners** – Circle or Describe the type(s) of liners used for the container being filled.
10. **Container Labels/Markings (at the time of packaging)** – Circle all the appropriate boxes for labels that are placed on the container and list/describe any others applied (e.g., Container ID: ###A##; Contents: Rinsate; Accumulation Start Date: 01/01/05).
11. **Contents Log:**
    - A. **Item number** – A unique number designating each package, item, or increment of waste placed in the container (e.g., 1, 2, 3). The number should match the number on the item or package physically placed in the container.
    - B. **Date** – Date that the package is placed in the container.
    - C. **% Contam.** – Enter the percent contaminant on the waste media (example – minimum soil contamination on PPE = 1%; saturated oil absorbent pads = 100%) .
    - D. **Estimated Volume (gallons)** – Estimate volume in gallons of package placed in the container. Use minus sign (-) for volume in gallons removed from the container (e.g. removed 2 gallons for waste management sample analysis).
    - E. **Waste Type (Circle and Describe)** – Circle and describe in the space provided the source of the waste (e.g., PPE – Tyvek, nitrile gloves, boots; Rinsate – Decon of backhoe bucket).
    - F. **Absorbent Type (w/Amt. and Units)** – Absorbent Type (e.g., Waste Lock, Petroset II-G, Aquaset, None) and amount with units.
    - G. **TID Number** – If waste is being added to a container for the first time (i.e., the first Contents Log item entry), document the Tamper Indicating Device (TID) number applied as the "New" TID. When accessing a container that is already TID'd (i.e., one or more entries already listed on the Contents Log), ensure that the TID found applied to the container matches the last "New" TID number listed on the Contents Log, and record this number as the "Old" TID number on the current entry line of the Contents Log. If the found TID does not match the previous entry on the Contents Log, contact the project's Waste Operations Coordinator for resolution. Once access to the container has been completed and a new TID applied, record the number of the "New" TID.
    - H. **NNSSWAC Prohibited Waste Forms** – If the waste is known or suspected to contain, or is being analyzed for NNSSWAC LLW prohibited waste forms, then write "Known," "Suspected," or "Pending" as applicable, and the prohibited item(s); otherwise, write "None." ***NNSSWAC prohibited waste forms: Free Liquids, Hazardous Waste (untreated), Chelating Agents, Compressed Gas, Transuranic Waste, Etiological Agents, Explosives/Pyrophorics, Reactive Chemicals.***

      NNSSWAC Restricted Waste Forms – If the waste is known, suspected, or is being analyzed for NNSSWAC LLW restricted waste forms, then write "Known," "Suspected," or "Pending" as applicable, and the restricted waste form(s); otherwise, write "None." ***NNSSWAC restricted waste forms: PCBs (Solids < 500ppm), Friable Asbestos, Animal Carcasses, LDR-treated MLLW, Particulates, Beryllium (>0.1 percent); see Comments below.***
    - I. **Characterization Information** – Sample information (i.e., sample numbers, direct waste sample numbers), sample matrix (i.e., soil, oil, rinsate), radiological swipe survey, and additional information concerning the waste.
    - J. **Waste Handler (WH) Signature and Badge Number** – The WH shall sign and enter his or her badge number.
    - K. **Verifier (WH Qualified) Signature and Badge Number** – The Verifier shall sign and enter his or her badge number.

Comments: Document actions performed to meet NNSSWAC for restricted waste forms, (e.g., particulates: immobilized or secured; sealed sources: list mass, component(s), radioisotopes, and activity; asbestos and/or beryllium: how packaged, marked/labeled; animal carcasses: layered in lime) as applicable.

Note: N/A all empty fields.

Waste Container Log

Container ID: 570 Bal 1

11. Contents Log

A. Item Number	C. % Contam.	E. Waste Type (Circle and Describe)	F. Absorbent Type (w/Amt. and Units)	H. Prohibited and/or NNSS Restricted Waste Forms Present or Pending Analysis	I. Characterization Information	J. Waste Handler (WH) Signature	Badge Number
B. Date	D. Estimated Volume (gallons)		G. TID Number (Old and New)			K. Verifier (WH Qualified) Signature	Badge Number
A. 1	C. <1%	E. PPE Sampling Equip Oil Rinsate Soil [✓ Other] Describe 12 volt - lead Acid battery Intact	F. N/A	H. Hazardous Waste	I. P.K - Lead Acid Battery - Dry - no electrolyte - Intact battery casing	J. /s/ Mark Heser	IB53550
B. 12/3/12	D. 1 EAch		G. New: N/A		RSR* 121203-SL-03	K. /s/ Signature on File	IB37867
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	Last Entry M Heser

Waste Container Log

Container ID: 570 Bal 1

11. Contents Log

A. Item Number B. Date	C. % Contam. D. Estimated Volume (gallons)	E. Waste Type (Circle and Describe)	F. Absorbent Type (w/Amt. and Units) G. TID Number (Old and New)	H. Prohibited and/or NNSS Restricted Waste Forms Present or Pending Analysis	I. Characterization Information	J. Waste Handler (WH) Signature K. Verifier (WH Qualified) Signature	Badge Number Badge Number
A.	C.	E. PPE Rinsate Sampling Equip Soil Oil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Rinsate Sampling Equip Soil Oil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Rinsate Sampling Equip Soil Oil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Rinsate Sampling Equip Soil Oil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Rinsate Sampling Equip Soil Oil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	No entries MHeser

Waste Container Log

Container ID: 570 Bal 1

To be filled out by Waste Operations Staff or designee

Post Closure

Contaminant Density: varies (units)

Package Gross Weight: N/A (kg/lb)

Package Tare Weight: N/A (kg/lb)

Scale ID No.: N/A

Scale Calibration Expiration Date: N/A

Signature /s/ Mark Heser | Badge No.: IB 53550 | Date: 12/3/12

Torque: N/A (ft-lb)

Torque Wrench ID#: N/A

Torque Wrench Calibration Expiration Date: N/A

Signature: /s/ Mark Heser | Badge No.: IB53550 | Date: 12/3/12

NNSSWAC WASTE FORM CRITERIA REVIEW: List NNSSWAC Prohibited or Restricted Waste Forms:

LEAD Acid Battery – Hazardous Waste
Not going to Area 5 RWMS

Description and concurrence with actions taken to render NNSSWAC restricted waste forms NNSSWAC compliant:

Hazardous Waste

Signature: /s/ Mark Heser | Badge No.: IB 53550 | Date: 12/3/12

Final Waste Characterization (Circle all that apply):

Hazardous LLW MLLW PCB Asbestos Beryllium

Hydrocarbon Other: None

Recommended Disposition/Disposal Pathway: Transfer to NSTec Fleet Services for off-site recycle

Signature: /s/ Mark Heser | Badge No.: IB 53550 | Date: 12/3/12

Waste Disposed or Shipped for Treatment/Disposal, Date: 12/11/12

Signature: /s/ Mark Heser | Badge No.: IB53550 | Date: 12/11/12

Executed Disposal Pathway/Facility: Transfered to NSTec Fleet Services for off-site recycle

Certificate of Treatment/Disposal Received, Date: Completed WCL – 12-11-12

Recommended/Compliant Treatment/Disposal Confirmed, Date: 12-11-12

WO Mgr Signature: /s/ Mark Heser for JMF | Badge No.: IB 53550 | Date: 12-11-12

[redacted]

Waste Container Log

Container ID: 570 Bot 1

Comments:

Waste Container Log

1. Container ID: 570C08

2. Container Barcode: LVEC 120102

3. CAU: 570 **4. CAS/Location:** 02-23-07 **5. CAS Letter:** C

6. Container Type: Metal Drum **7. Container Size:** 10 gal

8. Pre-Use Inspection Checklist:	Yes	No
Is the outside of the waste container free of defects (i.e., dents, cracks, corrosion, or other defects)?	✓	
Is the container lid, door, or closure in good condition?	✓	
Is the container capable of being secured with a lock or TID?	✓	
Are all container welds and/or seams intact and in good condition?	✓	
Are all container gaskets in place and in good condition?	✓	
Is the container empty?	✓	
Is the container free of liquids?	✓	
Are the interior surfaces of the container free of defects (i.e., dents, cracks, corrosion, or other defects)?	✓	

Waste Handler's Signature: /s/ Signature on File Badge No.: IB37867 Date: 6/18/2013

Note: If any item is "**No**," then the container shall be segregated and a "Hold Tag" completed and affixed. Notify the WCO, WO Manager, or designee.

9. Liner(s):

Is a minimum 6-mil total liner(s) in place for solid wastes in drums? (Circle: [✓ yes] / no)

OR: Are appropriate liners in place for other types of containers? (Circle: yes / no) and describe

OR: If no liner(s) required, circle: N/A.

10. Container Markings and Labels (applied at the time of packaging):

Container ID: 570C08 Accumulation Start Date*: N/A

(* Not applicable to satellite accumulation areas)

Contents: Potentially Cadmium / Aluminum Debris

Circle all Labels applied to container at time of packaging:

[✓ Haz. Waste Pend. Analysis] Non-Hazardous PCB Hazardous

[✓ Rad. Mat. Pend. Analysis] Hydrocarbon Asbestos Radioactive

Other (Describe):

Comments:

Waste Container Log

Directions for Waste Container Log – Waste Hander Section

A Qualified Waste Handler must complete Pages 1 through 4 of the Waste Container Log for each waste container generated. A different Qualified Waste Handler must verify each entry recorded in Section 11, Contents Log.

1. **Container ID** – Enter the CAU number, CAS letter, sequential number (i.e., ###A##).
2. **Container Barcode** – Enter the barcode number that was placed on the container when it was receipt inspected.
3. **CAU** – Enter the CAU number or project designation where the waste was generated (i.e., CAU ###).
4. **CAS/Location** – Enter the CAS number or site location identifier where the waste was generated.
5. **CAS Letter** – Enter the CAS letter associated with the CAS via the Project Field Instruction.
6. **Container Type** – Enter the container type (e.g., Steel Drum, B-25 Box, Plastic Bucket).
7. **Container Size** – Enter the container's maximum capacity (e.g., 55 gal, 5 gal, 3.5 cubic yards).
8. **Pre-Use Inspection Checklist** – Conduct an initial pre-use inspection before placing waste in the container. If the container condition changes after waste are placed in the container, then correct the Pre-Use Inspection section and notify the WCO and Environmental Compliance Manager, or designee.
9. **Liners** – Circle or Describe the type(s) of liners used for the container being filled.
10. **Container Labels/Markings (at the time of packaging)** – Circle all the appropriate boxes for labels that are placed on the container and list/describe any others applied (e.g., Container ID: ###A##; Contents: Rinsate; Accumulation Start Date: 01/01/05).
11. **Contents Log**:
    - A. **Item number** – A unique number designating each package, item, or increment of waste placed in the container (e.g., 1, 2, 3). The number should match the number on the item or package physically placed in the container.
    - B. **Date** – Date that the package is placed in the container.
    - C. **% Contam.** – Enter the percent contaminant on the waste media (example – minimum soil contamination on PPE = 1%; saturated oil absorbent pads = 100%).
    - D. **Estimated Volume (gallons)** – Estimate volume in gallons of package placed in the container. Use minus sign (-) for volume in gallons removed from the container (e.g. removed 2 gallons for waste management sample analysis).
    - E. **Waste Type (Circle and Describe)** – Circle and describe in the space provided the source of the waste (e.g., PPE – Tyvek, nitrile gloves, boots; Rinsate – Decon of backhoe bucket).
    - F. **Absorbent Type (w/Amt. and Units)** – Absorbent Type (e.g., Waste Lock, Petroset II-G, Aquaset, None) and amount with units.
    - G. **TID Number** – If waste is being added to a container for the first time (i.e., the first Contents Log item entry), document the Tamper Indicating Device (TID) number applied as the "New" TID. When accessing a container that is already TID'd (i.e., one or more entries already listed on the Contents Log), ensure that the TID found applied to the container matches the last "New" TID number listed on the Contents Log, and record this number as the "Old" TID number on the current entry line of the Contents Log. If the found TID does not match the previous entry on the Contents Log, contact the project's Waste Operations Coordinator for resolution. Once access to the container has been completed and a new TID applied, record the number of the "New" TID.
    - H. **NNSSWAC Prohibited Waste Forms** – If the waste is known or suspected to contain, or is being analyzed for NNSSWAC LLW prohibited waste forms, then write "Known," "Suspected," or "Pending" as applicable, and the prohibited item(s); otherwise, write "None." ***NNSSWAC prohibited waste forms: Free Liquids, Hazardous Waste (untreated), Chelating Agents, Compressed Gas, Transuranic Waste, Etiological Agents, Explosives/Pyrophorics, Reactive Chemicals.***

      NNSSWAC Restricted Waste Forms – If the waste is known, suspected, or is being analyzed for NNSSWAC LLW restricted waste forms, then write "Known," "Suspected," or "Pending" as applicable, and the restricted waste form(s); otherwise, write "None." ***NNSSWAC restricted waste forms: PCBs (Solids < 500ppm), Friable Asbestos, Animal Carcasses, LDR-treated MLLW, Particulates, Beryllium (>0.1 percent); see Comments below.***
    - I. **Characterization Information** – Sample information (i.e., sample numbers, direct waste sample numbers), sample matrix (i.e., soil, oil, rinsate), radiological swipe survey, and additional information concerning the waste.
    - J. **Waste Handler (WH) Signature and Badge Number** – The WH shall sign and enter his or her badge number.
    - K. **Verifier (WH Qualified) Signature and Badge Number** – The Verifier shall sign and enter his or her badge number.

Comments: Document actions performed to meet NNSSWAC for restricted waste forms, (e.g., particulates: immobilized or secured; sealed sources: list mass, component(s), radioisotopes, and activity; asbestos and/or beryllium: how packaged, marked/labeled; animal carcasses: layered in lime) as applicable.

Note: N/A all empty fields.

Waste Container Log

Container ID: 570C08

11. Contents Log

A. Item Number B. Date	C. % Contam. D. Estimated Volume (gallons)	E. Waste Type (Circle and Describe)	F. Absorbent Type (w/Amt. and Units) G. TID Number (Old and New)	H. Prohibited and/or NNSS Restricted Waste Forms Present or Pending Analysis	I. Characterization Information	J. Waste Handler (WH) Signature / Badge Number K. Verifier (WH Qualified) Signature / Badge Number
A. 1 B. 6/18/2013	C. 100 D. 1	E. PPE Sampling Equip Oil Rinsate Soil [✓ Other] Describe Metallic Foil	F. Wistolock 770 G. New: 021715	H. HAZARDOUS WASTE RADIOACTIVE WASTE	I. 130618-SL-33	J. /s/ Mark Heser IB32867 K. /s/ Signature on File IB52007
A. 2 B. 6/9/13	C. N/A D. ~1 gal	E. PPE Sampling Equip Oil Rinsate Soil Other Describe Removed waste	F. N/A G. Old: 021715 New: N/A	H. Empty	I. Removed contents & Repackaged into drum 570C07. Drum Empty & Red tagged	J. /s/ Mark Heser IB 53550 K. /s/ Signature on File IB37867
A. 3 B. 8/22/13	C. N/A D. N/A	E. PPE Sampling Equip Oil Rinsate Soil Other Describe Debris is Aluminum Foil & Aluminum Backed paper.	F. N/A G. Old: N/A New: N/A	H. None	I. These Items were visually inspected & weighed and determined to be Aluminum Foil - Not cadmium. Removed - to Rolloff 310R13	J. /s/ Mark Heser IB53550 K. /s/ Signature on File IB56693
A. B.	C. D.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F. G. Old: New:	H.	I.	J. K.
A. B.	C. D.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F. G. Old: New:	H.	I.	J. K. Last entry M Heser

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Waste Container Log

Container ID: 570C08

11. Contents Log

A. Item Number B. Date	C. % Contam. D. Estimated Volume (gallons)	E. Waste Type (Circle and Describe)	F. Absorbent Type (w/Amt. and Units) G. TID Number (Old and New)	H. Prohibited and/or NNSS Restricted Waste Forms Present or Pending Analysis	I. Characterization Information	J. Waste Handler (WH) Signature K. Verifier (WH Qualified) Signature	Badge Number
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	
A.	C.	E. PPE Sampling Equip Oil Rinsate Soil Other Describe	F.	H.	I.	J.	
B.	D.		G. Old: New:			K.	No entries M. Heser

Waste Container Log

Container ID: 570C08

To be filled out by Waste Operations Staff or designee

Post Closure	Contaminant Density:________(units)	
Package Gross Weight:______(kg/lb)	Package Tare Weight:________(kg/lb)	
Scale ID No.:	Scale Calibration Expiration Date:	
Signature:	Badge No.:	Date:
Torque:__________(ft-lb)		
Torque Wrench ID#:	Torque Wrench Calibration Expiration Date:	
Signature:	Badge No.:	Date:

NNSSWAC WASTE FORM CRITERIA REVIEW: List NNSSWAC Prohibited or Restricted Waste Forms:

Description and concurrence with actions taken to render NNSSWAC restricted waste forms NNSSWAC compliant:

N/A

Signature:	Badge No.:	Date:

Final Waste Characterization (Circle all that apply):

Hazardous	LLW	MLLW	PCB	Asbestos	Beryllium
Hydrocarbon	Other: __________				

Recommended Disposition/Disposal Pathway:

Signature:	Badge No.:	Date:

Waste Disposed or Shipped for Treatment/Disposal, Date:

Signature:	Badge No.:	Date:

Executed Disposal Pathway/Facility:

Certificate of Treatment/Disposal Received, Date:

Recommended/Compliant Treatment/Disposal Confirmed, Date:________

WO Mgr Signature:	Badge No.:	Date:

Waste Container Log

Container ID: 570C08

Comments:

6/18/13

Originally packaged as potentially hazardous for cadmium.

6/19/13 - contents removed and packaged into container 570C07 - both "potentially hazardous" for heavy metals. MHeser

8/22/13 - contents removed from container 570C07 - inspected in detail & samples weighed. Items determined to be aluminum foil pieces & Aluminum backed paper. Very light weight (e.g. piece $(100\,cm^2)$ are 11.3 grams - too light for S.G. of cadmium).
This material was removed from container, received rad release, and packaged into roll-off 310R13. MHeser.

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FRM-0918

NNSS LANDFILL LOAD VERIFICATION

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SWO USE (Select One) AREA ☐ 23 ☐ 6 ☒ 9/10C **LANDFILL**

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

REQUIRED: WASTE GERERATOR INFORMATION

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

Waste Generator: Mark Heser

Phone Number: 5-2124

Location / Origin: NNSS - Area 9; CAU 570 - 1 each, 55 gallon steel drum (container # 570C01 for disposal

Waste Category: (check one) ☐ Commercial ☒ Industrial

Waste Type: (check one) ☐ NNSS ☐ Non-Putrescible ☐ Putrescible ☐ Asbestos Containing Material ☒ FFACO-onsite ☐ FFACO-offsite ☐ WAC Exception ☐ Historic DOE/NV

Pollution Prevention Category: (check one) ☒ Environmental management ☐ Defense Projects ☐ YMP

Pollution Prevention Category: (check one) ☒ Clean-Up ☐ Routine

Method of Characterization: (check one) ☒ Sampling & Analysis ☒ Process Knowledge ☐ Contents

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

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

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

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

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

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses
☐ Asbestos ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: ____

Additional waste accepted at the Area 9 U10c Landfill:
☐ Non-friable asbestos ☐ Drained automobiles and military vehicles ☐ Solid fractions from sand/oil/water separators
☐ Light ballasts (contact SWO) ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground Tanks
☐ Hydrocarbons (contact SWO) ☐ Other ____

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ ____
☐ Septic sludge ☐ Rags ☐ Drained fuel filters (gas & diesel) ☐ Crushed non-teme plated oil filters
☐ Plants ☐ Soil ☐ Sludge from sand/oil/water separators ☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

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

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

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

Print Name: Mark Heser

Signature: /s/ Mark Heser

Date: ~~5/30/2013~~ RE 9/24/13

Radiological Survey Release for Waste Disposal
RCT Initials
JH This container/load meets the criteria for no added man-made radioactive material
____ This container/load meets the criteria for Radcon Manual Table 4.2 release limits.
____ This container/load is exempt from survey due to process knowledge and origin.
SIGNATURE: /s/ Signature on File DATE: 4/22/13
BN-0646 (10/05)

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

SWO USE ONLY

Load Weight (net from scale or estimate): 500

Certifier: /s/ Signature on File
Printed Name & Signature

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Form
FRM-0918

NNSS LANDFILL LOAD VERIFICATION

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SWO USE (Select One) AREA ☐ 23 ☐ 6 ☒ 9/10C **LANDFILL**

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

REQUIRED: WASTE GERERATOR INFORMATION
(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: Mark Heser Phone Number: 5-2124

Location / Origin: Building 23-153 - 20 yd3 roll-off (container # ~~153R12~~ 310R13 MH) of industrial waste for disposal at Area 9, U10c

Waste Category: (check one) ☐ Commercial ☒ Industrial

Waste Type: (check one) ☐ NNSS ☐ Putrescible ☒ FFACO-onsite ☐ WAC Exception
☐ Non-Putrescible ☐ Asbestos Containing Material ☐ FFACO-offsite ☐ Historic DOE/NV

Pollution Prevention Category: (check one) ☒ Environmental management ☐ Defense Projects ☐ YMP

Pollution Prevention Category: (check one) ☐ Clean-Up ☒ Routine

Method of Characterization: (check one) ☐ Sampling & Analysis ☒ Process Knowledge ☒ Contents

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

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

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES
Check all allowable wastes that are contained within this load:

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

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

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses
☐ Asbestos ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: ____

Additional waste accepted at the Area 9 U10c Landfill:
☐ Non-friable asbestos ☐ Drained automobiles and military vehicles ☐ Solid fractions from sand/oil/water separators
☐ Light ballasts (contact SWO) ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground Tanks
☒ Hydrocarbons (contact SWO) ☐ Other ____

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ ____
☐ Septic sludge ☐ Rags ☐ Drained fuel filters (gas & diesel) ☐ Crushed non-teme plated oil filters
☐ Plants ☐ Soil ☐ Sludge from sand/oil/water separators ☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

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

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

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

Radiological Survey Release for Waste Disposal
RCT Initials
____ **This container/load meets the criteria for no added man-made radioactive material**
____ **This container/load meets the criteria for Radcon Manual Table 4.2 release limits.**
____ **This container/load is exempt from survey due to process knowledge and origin.**
SIGNATURE: /s/ Signature on File **DATE:** 5-13-13
BN-0646 (10/05)

Print Name: Mark Heser // /s/ Mark Heser

Signature: ____ Date: ~~5/13/13~~ RE 9/25/13

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

SWO USE ONLY

Load Weight (net from scale or estimate): 2,500 Certifier: /s/ Signature on File
Printed Name & Signature

Certificate of Disposal

This is to certify that the Waste Stream No. LITN000000011, Revision 2, shipment number ITL14002, with container number 570C06 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Mark Heser	N-I	Waste Coordinator
Shipped by	Organization	Title
/s/ Mark Heser		11-14-13
Signature		Date
ED TAKAHASHI	NSTec	Sr Scientist.
Received by	Organization	Title
/s/ Ed Takahashi		14-NOV-2013
Signature		Date

Appendix E

Evaluation of Corrective Action Alternatives

E.1.0 Introduction

This appendix presents the corrective action objectives for CAU 570, 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 570 conditions at the conclusion of the CAI (after any interim corrective actions are completed).

On May 1, 1996, the 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 stated that the ANPR should be considered the primary corrective action implementation guidance (Laws and Herman, 1997). The ANPR indicates 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/NSO, 2012b). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2012b). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2012c) 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).

The 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 text describes 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 Section 2.3.1.

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 CFR 260 to 282, “Hazardous Waste Management” [CFR, 2013a]; 40 CFR 761 “Polychlorinated Biphenyls,” [CFR, 2013b]; and NAC 444.842 to 444.980, “Facilities for Management of Hazardous Waste” [NAC, 2012a]).

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 are 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 Corrective Action Alternatives

This section identifies and briefly describes the viable corrective action technologies and the CAAs considered for each CAU 570 CAS. The CAAs are based on the current nature of contamination at CAU 570, which does not include contamination removed as part of the corrective actions completed during the CAI (Section 2.2.1). Based on the review of existing data, future use, and current operations at the NNSS, the following alternatives have been developed for consideration at CAU 570:

- **Alternative 1.** No Further Action
- **Alternative 2.** Clean Closure
- **Alternative 3.** Closure in Place

E.1.3.1 Alternative 1 – No Further Action

Under Alternative 1, no corrective action activities are implemented. This alternative is a baseline case against which to compare and assess the other CAAs and their ability to meet the corrective action standards.

E.1.3.2 Alternative 2 – Clean Closure

Alternative 2 includes excavating and disposing of PSM and impacted soil presenting a dose exceeding the 25-mrem/OU-yr FAL to a depth of 25 ft bgs (the maximum depth to which a construction activity might excavate for a building foundation or basement). A visual inspection will be conducted to ensure that the PSM has been removed before the corrective action is completed. Verification samples will be collected and analyzed for the presence of a COC after contaminated soil is removed.

Contaminated materials that are removed 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.

E.1.3.3 Alternative 3 – Closure in Place

Alternative 3 includes the implementation of a UR where contamination is present at levels that exceed a FAL. 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.1.4 Evaluation and Comparison of Alternatives

Each CAA presented in Section E.1.3 will be evaluated for the CASs that contain a COC based on the general corrective action standards listed in Section E.1.2. This evaluation is presented in Table E.1-1. Any CAA that does not meet the general corrective action standards will be removed from consideration.

The remaining CAAs will be further evaluated based on the remedy selection decision factors described in Section E.1.2. This evaluation is presented in Table E.1-2. For each remedy selection decision factor, the CAAs are ranked relative to one another. The CAA with the least desirable impact on the remedy selection decision factor will be given a ranking of 1. The CAAs with increasingly desirable impacts on the remedy selection decision factor will receive increasing rank numbers. The CAAs that will have an equal impact on the remedy selection decision factor will receive an

Table E.1-1
Evaluation of General Corrective Action Standards

CASs 09-23-10, 09-23-15		
CAA 1, No Further Action		
Standard	**Comply?**	**Explanation**
Protection of Human Health and the Environment	No	COCs are present at concentrations that exceed the additivity factor (AF) of 1.
Compliance with Media Cleanup Standards	No	COCs are present at concentrations that exceed the additivity factor (AF) of 1.
Control the Source(s) of the Release	Yes	All testing and construction activities in the area have been discontinued.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	This alternative will not generate waste.
CAA 2, Clean Closure		
Standard	**Comply?**	**Explanation**
Protection of Human Health and the Environment	Yes	Contamination exceeding the risk-based action levels will be removed.
Compliance with Media Cleanup Standards	Yes	Contamination exceeding the risk-based action levels will be removed.
Control the Source(s) of the Release	Yes	All testing and construction activities in the area have been discontinued,
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	Excavated waste can be managed in compliance with all standards.
CAA 3, Closure in Place		
Standard	**Comply?**	**Explanation**
Protection of Human Health and the Environment	Yes	URs will be implemented to protect site workers from contamination exceeding the risk-based action levels.
Compliance with Media Cleanup Standards	Yes	Although COCs will not be removed, site workers will not be exposed to COCs.
Control the Source(s) of the Release	Yes	All testing and construction activities in the area have been discontinued
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	This alternative will not generate waste.

Table E.1-2
Evaluation of Remedy Selection Decision Factors

CASs 09-23-10, 09-23-15		
CAA 1, No Further Action		
Factor	**Rank**	**Explanation**
Not evaluated, as this CAA did not meet the General Corrective Action Standards		
CAA 2, Clean Closure		
Factor	**Rank**	**Explanation**
Short-Term Reliability and Effectiveness	1	This alternative is reliable and effective, but involves increased short-term exposure of site workers to COCs during soil removal operations.
Reduction of Toxicity, Mobility, and/or Volume	2	This alternative will result in a decrease of toxicity and mobility, but will generate significant waste volumes.
Long-Term Reliability and Effectiveness	2	This alternative is reliable and effective at protecting human health and the environment because removal of the contaminated media will eliminate future exposure of site workers to COCs.
Feasibility	1	This option would involve the excavation, disposal, and backfill of approximately 16,400 m^3 of soil.
Cost	1	Cost is estimated to be approximately $5,200,000.
Score	7	
CAA 3, Closure in Place		
Factor	**Rank**	**Explanation**
Short-Term Reliability and Effectiveness	2	This alternative is reliable and effective in providing increased protection of human health by preventing contact with COCs.
Reduction of Toxicity, Mobility, and/or Volume	1	This alternative will not reduce toxicity or mobility of the COCs that are present, but will not generate excavation waste volumes.
Long-Term Reliability and Effectiveness	1	This alternative is reliable but requires ongoing maintenance. It is effective in providing protection of human health by preventing inadvertent contact with COCs.
Feasibility	2	This alternative can be readily implemented.
Cost	2	The installation costs are estimated at $25,000. Ongoing maintenance costs for this alternative are estimated at $1,000 annually for each CAS.
Score	8	

equal ranking number. The scoring listed in this table represents the sum of the remedy selection decision factor rankings for each CAA.

The evaluation of CAAs does not include corrective actions that have been completed during the CAI. The excavation of contaminated soil in Study Group 1 and the removal of lead and batteries in Study Group 3 are considered to be complete and do not require any further corrective action.

The five EPA remedy selection decision factors are (1) short-term reliability and effectiveness; (2) reduction of toxicity, mobility, and/or volume; (3) long-term reliability and effectiveness; (4) feasibility; and (5) cost. These factors are evaluated in Table E.1-2.

The first remedy selection decision factor—short-term reliability and effectiveness—is a qualitative measure of the impacts on human health and the environment during implementation of the CAA. While clean closure is both reliable and effective in the long term, this alternative involves increased, short-term exposure of site workers to radiological contamination during soil and debris removal. In contrast, closure in place does not require removal of soil, and there is no short-term exposure of site workers. Signs are posted, and disturbance of contaminated soil and debris is not necessary.

The second remedy selection decision factor—reduction of toxicity, mobility, and/or volume—is a qualitative measure of changes in characteristics of contaminated media that result from implementation of the CAA. Under clean closure, contaminated media that exceed FALs (to a depth of 25 ft bgs) would be removed from the area, thereby eliminating both mobility and the onsite volume of contaminated media. In contrast, closure in place does not reduce toxicity, mobility, or volume.

The third remedy selection decision factor—long-term reliability and effectiveness—is a qualitative evaluation of performance after site closure and into the future. Removal of contaminated media for clean closure provides long-term reliability and effectiveness, whereas closure in place does not.

The fourth remedy selection decision factor—feasibility—includes an evaluation of the requirements for construction and operation as well as administrative constraints. For the closure in place alternative, no construction is required other than the installation of postings. Some maintenance and administrative requirements would be ongoing. For the clean closure alternative, substantial construction, operation, and administrative actions consistent with soil removal and management of generated wastes are needed.

The fifth remedy selection decision factor—cost—includes assessment of both capital (direct) costs of implementation and costs for operation and maintenance of the corrective action. As shown in Table E.1-2, the estimated cost for clean closure is $5.2 million; while the costs for closure in place are limited to those derived from acquiring, hanging, inspecting, and occasionally replacing, UR signs (estimated to be $25,000 for the first year and $1,000 for each year thereafter).

E.2.0 Recommended Alternative

The corrective actions that were completed during the CAU 570 field investigation were as follows:

- Excavation of contaminated soils at Study Group 1. This corrective action involved the removal of 77 yd^3 of radioactively contaminated soil. Confirmation soil samples and TLDs were collected and analyzed.
- Excavation of stained soil at Study Group 3. This corrective action involved the removal of approximately 25 gal of soil. A confirmation sample was collected and analyzed.
- Removal of lead at Study Group 3. This corrective action involved the removal of 36 pieces of lead from complete or partially buried locations. Approximately 30 gal of soil was also removed from the immediate area of the lead. Confirmation samples were collected and analyzed.
- Removal of a lead-acid battery at Study Group 3. This corrective action involved the removal of one lead-acid battery. Because the case was still secured, no confirmation samples were collected.

This document verifies the completion of these corrective actions. Therefore, additional corrective actions were not required nor included in the evaluation of CAAs.

Remaining surface contamination at CASs 02-23-07 (Tesla), 09-23-11 (Ganymede), 09-23-14 (Rushmore), 09-99-01 (Balloon Pad), and at the UGTA Releases did not exceed FALs and does not require corrective action. Also, no elevated TRS values were detected around the UGTA Releases that would indicate the potential presence of COCs originating from any of these release sites. Therefore, the CAA of no further action was selected for these sites.

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. The corrective action recommendations for CAU 570 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 may be necessary.

The following CAU 570 CASs require corrective action:

- CAS 09-23-10 (Sugar) contains the assumed presence of subsurface contamination exceeding the radiological FAL.
- CAS 09-23-15 (Eagle) contains the assumed presence of chemical and radiological contamination exceeding FALs. This area also includes the presence of PSM in the form of two lead pads.

The three CAAs of no further action (CAA 1), clean closure (CAA 2), and closure in place (CAA 3) were evaluated for the areas at CAS 09-23-10 (Sugar) and CAS 09-23-15 (Eagle). Only CAA 2 and CAA 3 met all requirements for general corrective action standards (Section E.1.2). Further evaluation of the two CAAs was based on the five EPA remedy-selection decision factors.

Alternative 3, closure in place, was the highest scoring CAA in Table E.1-2 and is selected as the preferred correction action for CAS 09-23-10 (Sugar) and CAS 09-23-15 (Eagle), which contain high levels of removable contamination. Working in areas with high levels of removable contamination (such as removing soil under a corrective action of clean closure) requires extensive radiological controls to protect workers from inhaling or ingesting airborne radioactive particles. A corrective action of clean closure at these CASs would require extensive excavations (the corrective action areas and volumes at each CAS are presented in Table E.1-3) of up to 25 ft in depth. Based on the extent of the corrective action boundaries and the infeasibility of removing large quantities of soils containing high levels of removable contamination, the corrective action of closure in place with URs was selected for both of these CASs.

Table E.1-3
Corrective Action Boundary Areas and Volumes at CAU 570 CASs

CAS	Area (m^2)	Volume (m^3)
09-23-10 (Sugar)	1,100	8,100
09-23-15 (Eagle)	870	1,740

In addition to the identified corrective actions, the following actions will be implemented as a BMP:

In accordance with the Soils RBCA document (NNSA/NSO, 2012b) and Section 3.3 of the CAIP (NNSA/NSO, 2012a), an administrative UR was identified as a BMP for areas where 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 (CASs 02-23-07 and 09-99-01). This conservative assumption is that a worker would be exposed to site contamination for a period of 2,000 hr/yr. This administrative UR (implemented as a BMP) is not part of any FFACO corrective action. To determine the extent of this area, a correlation of radiation survey values to the 95 percent UCL of Industrial Area TED values was conducted as discussed in Section A.2.6 for each area where dose is present at a level exceeding 25 mrem/IA-yr (as is the case at the Tesla and Balloon Pad sites). The radiation survey with the best correlation was the TRS. The administrative UR boundaries at both these sites were identified to encompass the TRS isopleth corresponding to a dose of 25 mrem/IA-yr. The administrative URs will be recorded and controlled in the same manner as the FFACO URs, but will not require posting or inspections. The administrative URs are presented in Attachment D-1.

All URs are recorded in the FFACO database, the M&O Contractor GIS, and the NNSA/NFO CAU/CAS files. The development of URs for CAU 570 are based on current land use. Any proposed activity within a use-restricted area that would result in higher risk to the most exposed site worker than that presented in the risk evaluation (Appendix C) would require NDEP approval.

E.3.0 Cost Estimates

The cost estimate for clean closure of CASs 09-23-10 (Sugar) and 09-23-15 (Eagle) is estimated to conduct the following activities:

- Preparation and procurement
- Grub surface contamination
- Excavate, load, and dispose contaminated soil (roughly 98,000 m^3)
- Backfill excavated soil
- Equipment decontamination

The estimated costs for clean closure of Sugar and Eagle were based on removing contaminated soil within the DCBs (specifically, soil within the HCA at Eagle and soil within the CA to 25 ft bgs at Sugar). The cost for clean closure of each CAS was estimated to be $4.2 million for Sugar and $1 million for Eagle.

The costs for closure in place, however, are limited to those derived from acquiring, hanging, inspecting, and occasionally replacing, UR signs, and are estimated to be approximately $25,000 for the first year and $1,000 for each year thereafter.

E.4.0 References

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Appendix F

Sample Location Coordinates

F.1.0 Sample Location Coordinates

The center of each sample plot and the locations of individual soil and TLD sample locations for the CAU 570 Study Groups were surveyed using a GPS instrument. Survey coordinates for these locations are listed in Tables F.1-1 through F.1-4.

Table F.1-1
Sample Plot/Location Coordinates for Study Group 1
(Page 1 of 5)

Sample Location	Easting[a]	Northing[a]
A001	585030.8	4108991
A002	584950.7	4108971
A003	584905.9	4108961
A004	584798.1	4108934
A005	584737.3	4108919
A006	584696.6	4108907
A007	584670.1	4108903
A008	584643.9	4108896
A009	584604.4	4108886
A010	584542.2	4108868
A011	584434.4	4108843
A012	584392	4108830
A013	584310.3	4108810
A014	584181.9	4108776
A015	584241.4	4109163
A016	584355.4	4109094
A017	584426.1	4109053
A018	584464.7	4109028
A019	584557	4108971
A020	584611.2	4108939
A021	584648.1	4108916
A022	584690.3	4108888
A023	584727.8	4108867
A024	584782.8	4108833

Table F.1-1
Sample Plot/Location Coordinates for Study Group 1
(Page 2 of 5)

Sample Location	Easting[a]	Northing[a]
A025	584878.9	4108776
A026	584916.2	4108754
A027	584987.8	4108709
A028	585096.3	4108638
A029	584655.6	4108881
A030	584640.7	4108845
A031	584612.3	4108783
A032	584565.6	4108684
A033	584546.8	4108642
A034	584511	4108565
A035	584453.3	4108443
A036	584794.5	4108413
A037	584761.6	4108543
A038	584741.5	4108624
A039	584731.6	4108666
A040	584703.9	4108774
A041	584687.8	4108837
A042	584678.8	4108876
A043	584663.8	4108929
A044	584655.6	4108970
A045	584640.3	4109033
A046	584614.2	4109138
A047	584603.6	4109183
A048	584583.1	4109262
A049	584605.9	4109386
A050	584678.7	4108928
A051	584696.2	4108966
A052	584728.2	4109031
A053	584769.4	4109125
A054	584789	4109165

Table F.1-1
Sample Plot/Location Coordinates for Study Group 1
(Page 3 of 5)

Sample Location	Easting[a]	Northing[a]
A055	584821.6	4109236
A056	584878.6	4109365
A057	584939.1	4109493
A058	584987.7	4109597
A059	585019.9	4109668
A060	585049.6	4109731
A061	585085.8	4109812
A062	585128.8	4109903
A063	585162.5	4109980
A064	585177	4110012
A065	585195.8	4110050
A066	585211.8	4110084
A067	585224.4	4110115
A068	585263.4	4110199
A069	585306.2	4110290
A070	585344.4	4110368
A071	585372.2	4110432
A072	585388.3	4110468
A073	585404.8	4110502
A074	585451.4	4110608
A075	585509.2	4110757
A076	585442.3	4109317
A077	585388.5	4109469
A078	585356.1	4109575
A079	585342.9	4109616
A080	585330.3	4109650
A081	585309.5	4109721
A082	585282.1	4109798
A083	585249.6	4109897
A084	585221.2	4109981

Table F.1-1
Sample Plot/Location Coordinates for Study Group 1
(Page 4 of 5)

Sample Location	Easting[a]	Northing[a]
A085	585212.2	4110013
A086	585184.6	4110089
A087	585174.7	4110121
A088	585144.1	4110207
A089	585113.8	4110300
A090	585086.2	4110383
A091	585064.2	4110450
A092	585052.1	4110491
A093	585039.7	4110527
A094	585000.9	4110639
A095	584952.7	4110785
A096	584488.8	4110373
A097	584653.7	4110346
A098	584755.7	4110278
A099	584775.5	4110246
A100	584809.7	4110227
A101	584873.2	4110197
A102	584952.3	4110163
A103	585046	4110122
A104	585127.9	4110085
A105	585157.4	4110071
A106	585231.8	4110039
A107	585261.3	4110024
A108	585345.2	4109984
A109	585436.2	4109944
A110	585512.8	4109909
A111	585577.3	4109879
A112	585612	4109865
A113	585650.2	4109848
A114	585754.7	4109800

Table F.1-1
Sample Plot/Location Coordinates for Study Group 1
(Page 5 of 5)

Sample Location	Easting[a]	Northing[a]
A115	585893	4109724
A116	585930.8	4110291
A117	585766.4	4110293
A118	585669.5	4110205
A119	585632.9	4110191
A120	585598.7	4110179
A121	585529	4110156
A122	585445.3	4110128
A123	585351.7	4110096
A124	585264	4110069
A125	585232.4	4110058
A126	584462.1	4109802
A127	584612.1	4109856
A128	584719.6	4109890
A129	584758	4109901
A130	584794.5	4109912
A131	584861.8	4109937
A132	584942.7	4109963
A133	585040.6	4109996
A134	585125	4110024
A135	585156.6	4110034
A136	585221.1	4110122
A137	584678.6	4108899
A138	584686.1	4108897
A139	584678.5	4108899
A140	584666.6	4108905
A141	584661	4108925

[a] UTM Zone 11, NAD 1927 (U.S. Western) in meters.

NAD = North American Datum
UTM = Universal Transverse Mercator

Table F.1-2
Sample Plot/Location Coordinates for Study Group 2

Sample Location	Easting[a]	Northing[a]
B01	585402.8	4109717
B02	584693.5	4109079

[a] UTM Zone 11, NAD 1927 (U.S. Western) in meters.

Table F.1-3
Sample Plot/Location Coordinates for Study Group 3
(Page 1 of 2)

Sample Location	Easting[a]	Northing[a]
C01	585003.0	4109583
C02	585001.8	4109585
C03	584998.8	4109584
C04	585000.2	4109581
C05	584999.7	4109577
C06	585000.1	4109573
C07	585003.3	4109574
C08	585002.7	4109578
C09	585351.4	4110913
C10	585179.7	4110048
C11	585177.4	4110051
C12	584803.6	4108856
C13	584794.0	4108872
C14	584784.9	4108888
C15	584766.8	4108888
C16	584775.9	4108871
C17	584786.0	4108856
C18	584775.6	4108840
C19	584766.5	4108856
C20	584757.7	4108872
C21	584738.2	4108872
C22	584748.5	4108856

Table F.1-3
Sample Plot/Location Coordinates for Study Group 3
(Page 2 of 2)

Sample Location	Easting[a]	Northing[a]
C23	584756.6	4108841
C24	585059.3	4108837
C25	585358.0	4110912
C26	584837.0	4108893

[a] UTM Zone 11, NAD 1927 (U.S. Western) in meters.

Table F.1-4
Sample Plot/Location Coordinates for Study Group 4
(Page 1 of 2)

Sample Location	Easting[a]	Northing[a]
D01	585250.4	4110080
D02	585431	4110151
D03	585426	4110187
D04	585178.5	4110068
D05	585142.6	4110003
D06	585247.8	4109951
D07	584735.5	4109053
D08	584743.1	4109073
D09	584606.7	4109151
D10	584680.5	4109174
D11	585045.5	4108977
D12	584992.8	4108914
D13	584986.4	4108829
D14	584979.9	4108792
D15	584698.1	4108990
D16	584691.3	4108981
D17	584680.1	4108985
D18	584677.8	4108894
D19	584664.8	4108907
D20	584676.3	4108926

Table F.1-4
Sample Plot/Location Coordinates for Study Group 4
(Page 2 of 2)

Sample Location	Easting[a]	Northing[a]
D21	584698.3	4108897
D22	584669.5	4108881
D23	584604.5	4108870
D24	584592.1	4108884
D25	584618.8	4108914
D26	584611.8	4108935
D27	584592	4108941
D28	584577.8	4108997
D29	584633.4	4109026
D30	584646.2	4109056
D31	584800.1	4108892
D32	584771.7	4108894
D33	584681.9	4108989
D34	584710	4108981
D35	584749.1	4108969
D36	584886.3	4108928
D37	585004.3	4108894

[b] UTM Zone 11, NAD 1927 (U.S. Western) in meters.

Nine aliquot sample locations were established at each plot for each composite sample (4 composite samples, 36 aloquoit sample locations). Visual Sample Plan software (PNNL, 2007) was used to derive coordinates for a systematic triangular grid pattern based on a randomly generated origin or starting point. The sample aliquot locations for each composite sample are in a tabular format in terms of east and north distances from the southwest corner stake at each plot (Tables F.1-5 and F.1-6).

In some cases, aliquot locations were moved due to surface/subsurface obstructions or conditions (e.g., rocks, vegetation, and animal burrows). These offsets (distance and direction) of each aliquot location were recorded in the project files. It is important to note that if an offset was less than the nominal 4-in. width of the core sample, the original coordinate was not modified.

Table F.1-5
Sample Plot Location Distance (Study Group 1) in Meters

Sample Plot A136		
Composite Number	Easting (Distance m)	Northing (Distance m)
601	1.0	2.4
	4.6	2.4
	8.2	2.4
	2.8	5.5
	6.4	5.5
	10.0	5.5
	1.0	8.7
	4.6	8.7
	8.2	8.7
602	2.1	0.8
	5.6	0.8
	9.2	0.8
	0.3	3.9
	3.8	3.9
	7.4	3.9
	2.1	7.0
	5.6	7.0
	9.2	7.0
603	0.9	1.8
	4.5	1.8
	8.1	1.8
	2.7	4.9
	6.3	4.9
	9.9	4.9
	0.9	8.0
	4.5	8.0
	8.1	8.0
604	2.7	2.3
	6.3	2.3
	9.8	2.3
	0.9	5.4
	4.5	5.4
	8.0	5.4
	2.7	8.5
	6.3	8.5
	9.8	8.5

Sample Plot A137		
Composite Number	Easting (Distance m)	Northing (Distance m)
605	1.0	2.4
	4.6	2.4
	8.2	2.4
	2.8	5.5
	6.4	5.5
	10.0	5.5
	1.0	8.7
	4.6	8.7
	8.2	8.7
606	2.1	0.8
	5.6	0.8
	9.2	0.8
	0.3	3.9
	3.8	3.9
	7.4	3.9
	2.1	7.0
	5.6	7.0
	9.2	7.0
607	0.9	1.8
	4.5	1.8
	8.1	1.8
	2.7	4.9
	6.3	4.9
	9.9	4.9
	0.9	8.0
	4.5	8.0
	8.1	8.0
608	2.7	2.3
	6.3	2.3
	9.8	2.3
	0.9	5.4
	4.5	5.4
	8.0	5.4
	2.7	8.5
	6.3	8.5
	9.8	8.5

Sample Plot A139		
Composite Number	Easting (Distance m)	Northing (Distance m)
011	1.0	2.4
	4.6	2.4
	8.2	2.4
	2.8	5.5
	6.4	5.5
	10.0	5.5
	1.0	8.7
	4.6	8.7
	8.2	8.7
012	2.1	0.8
	5.6	0.8
	9.2	0.8
	0.3	3.9
	3.8	3.9
	7.4	3.9
	2.1	7.0
	5.6	7.0
	9.2	7.0
013	0.9	1.8
	4.5	1.8
	8.1	1.8
	2.7	4.9
	6.3	4.9
	9.9	4.9
	0.9	8.0
	4.5	8.0
	8.1	8.0
014	2.7	2.3
	6.3	2.3
	9.8	2.3
	0.9	5.4
	4.5	5.4
	8.0	5.4
	2.7	8.5
	6.3	8.5
	9.8	8.5

Note: Coordinate distance is measured from the southwest corner of the sample plot to the east (Easting) and to the north (Northing).

Table F.1-6
Sample Plot Location Distance (Study Group 2) in Meters

Sample Plot B01		
Composite Number	**Easting (Distance m)**	**Northing (Distance m)**
B601	1.0	2.4
	4.6	2.4
	8.2	2.4
	2.8	5.5
	6.4	5.5
	10.0	5.5
	1.0	8.7
	4.6	8.7
	8.2	8.7
B602	2.1	0.8
	5.6	0.8
	9.2	0.8
	0.3	3.9
	3.8	3.9
	7.4	3.9
	2.1	7.0
	5.6	7.0
	9.2	7.0
B603	0.9	1.8
	4.5	1.8
	8.1	1.8
	2.7	4.9
	6.3	4.9
	9.9	4.9
	0.9	8.0
	4.5	8.0
	8.1	8.0
B604	2.7	2.3
	6.3	2.3
	9.8	2.3
	0.9	5.4
	4.5	5.4
	8.0	5.4
	2.7	8.5
	6.3	8.5
	9.8	8.5

Sample Plot B02		
Composite Number	**Easting (Distance m)**	**Northing (Distance m)**
B605	1.0	2.4
	4.6	2.4
	8.2	2.4
	2.8	5.5
	6.4	5.5
	10.0	5.5
	1.0	8.7
	4.6	8.7
	8.2	8.7
B606	2.1	0.8
	5.6	0.8
	9.2	0.8
	0.3	3.9
	3.8	3.9
	7.4	3.9
	2.1	7.0
	5.6	7.0
	9.2	7.0
B607	0.9	1.8
	4.5	1.8
	8.1	1.8
	2.7	4.9
	6.3	4.9
	9.9	4.9
	0.9	8.0
	4.5	8.0
	8.1	8.0
B608	2.7	2.3
	6.3	2.3
	9.8	2.3
	0.9	5.4
	4.5	5.4
	8.0	5.4
	2.7	8.5
	6.3	8.5
	9.8	8.5

Note: Coordinate distance is measured from the southwest corner of the sample plot to the east (Easting) and to the north (Northing).

F.2.0 References

PNNL, see Pacific Northwest National Laboratory.

Pacific Northwest National Laboratory. 2007. *Visual Sample Plan, Version 5.0 User's Guide*, PNNL-16939. Richland, WA.

Appendix G

CAU 570 Geophysical Survey Report

G.1.0 Technical Memorandum: Conduct of Geophysical Surveys at CAU 570

G.1.1 Introduction

Geophysical surveys were conducted at five different sites within CAU 570 between November 14, 2012, and January 24, 2013. The sites, listed generally south to north, were the Debris Field, the Gravel Gertie, the Lead Pad area, the Balloon Pad area, and the C-09 Lead Plate area. The locations of the five sites are shown on Figure G.1-1. The objective of the surveys was to detect metal debris potentially buried at the sites (e.g., landfills, bricks).

G.1.2 Equipment Used

An EM61-MK2A time domain metal detector produced by Geonics Limited of Mississauga, Ontario, Canada, was used to conduct the surveys. The surveys at all but one of the five areas were conducted with the coils mounted on wheels as shown in Figure G.1-2. The survey at the Lead Pad area was conducted with the coils suspended from a harness worn by the operator.

The EM61-MK2A detects both ferrous and non-ferrous objects with excellent spatial resolution. Each system includes a single transmitter coil and two receiver coils. The coils are 1 by 0.5 m in size.

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, allowing the detection of metal. Four time gates (channels) of data are collected. The earlier time gates (channels) improve the detection of smaller targets (Geonics, 2013). The signal received is reported in units of millivolts (mV). With the coils mounted on wheels, as shown in Figure G.1-2, the lowermost coil is approximately 40 cm ags. With the coils suspended from a harness worn by the operator, as was done at the Lead Pad area, the lowermost coil is approximately 10 cm ags. 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.

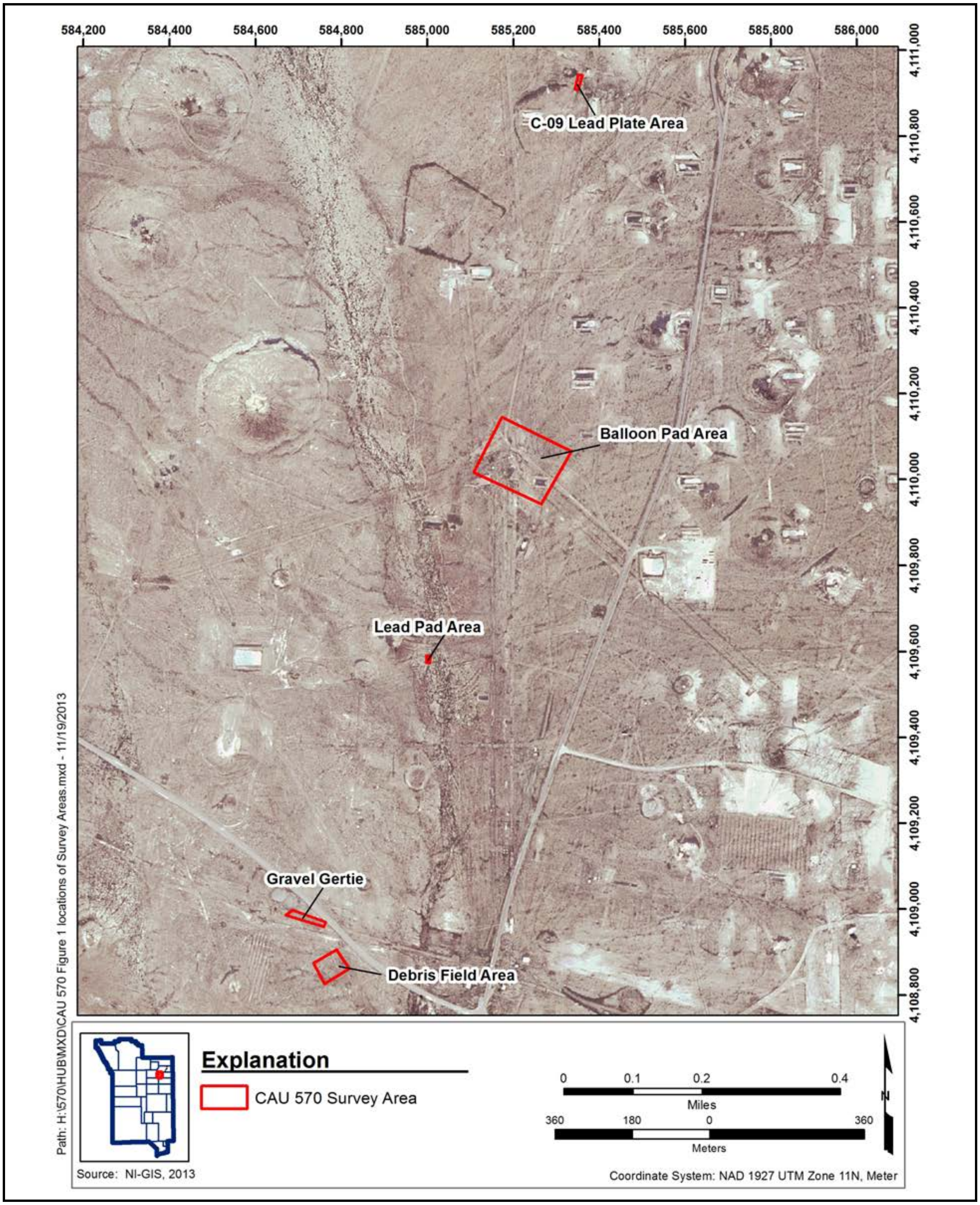


Figure G.1-1
Locations of Areas Surveyed

Figure G.1-2
Photo of the EM61-MK2A with Wheels Supporting Coils
Source: Geonics, 2013

An Archer 14802 Field personal computer (PC) with integrated Hemisphere XF101 GPS receiver from Juniper Systems, Inc. of Logan, Utah, was used to collect the data produced by the EM61-MK2A. The datalogger shown mounted on the EM61-MK2A in Figure G.1-2 is an older Allegro unit now replaced by the Archer Field PC. 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.

G.1.3 Conduct of the Geophysical Surveys

Each of the areas surveyed was somewhat different in terms of the size of the area to be surveyed and the intent of the survey. As such, there were some differences in the ways the areas were surveyed. For the Debris Field, Gravel Gertie, and C-09 Lead Plate areas, the surveys were performed such that each traverse was immediately adjacent to the last traverse, causing the coils to be passed directly over the entire area surveyed. Where the vegetation and topography required some deviation from this plan, each pass with the unit was still close enough to the last that the instrument would have detected any significant metallic debris present. The Balloon Pad area is relatively large, and the intent of the survey was general reconnaissance. With the exception of the areas of elevated instrument response identified as requiring closer inspection, the survey was walked such that the spacing between passes of the coils was 2 to 3 m. With the exception of the Lead Pad area, the surveys were done with the coils mounted on wheels as shown in Figure G.1-2. At the Lead Pad area, the coils were suspended from a harness worn by the operator.

The strength of the EM61-MK2A instrument response, in millivolts, is relative. It is a function of the ability of the magnetic field generated by the coils to excite a current in an object. The size of the object as well as its conductivity and iron content will affect the instrument response received as will the distance from the receiver coils (i.e., depth of burial). As such, a small piece of highly ferrous material at ground surface would yield a much 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 datalogger and GPS unit recorded the EM61-MK2A survey data in UTM 11 North World Geodetic System (WGS) 84 coordinates, in meters. The locations of surface debris were recorded with a Trimble GEO Explorer 2008 or 2005 series GPS unit running ArcPad held stationary at each location. The Trimble collected the data in UTM 11 NAD 27 coordinates, in meters. The location data for EM61-MK2A responses were taken while the GPS unit was moving as the unit was walked over the survey area. Although it is not generally the case, differences between the locations reported for the surface debris and EM61-MK2A response data may be different by as much as a few meters due to the difference in how the GPS data were collected (i.e., stationary versus moving).

The data were reduced using DAT61MK2 software provided by Geonics Limited (Geonics, 2005). This software allows the user to reduce the “raw” data files saved in the datalogger to files containing the UTM coordinates of the data points, in meters, and the four time gate response values (channels of data) generated by the EM61-MK2A. The location data were converted to the project standard UTM11 NAD 27 coordinate system using ArcMap Version 10 by ESRI (N-I GIS, 2013). The

EM61-MK2A response data, matched to the UTM11 NAD27 coordinates, was then imported into Version 7 of the Surfer program by Golden Software of Golden, Colorado (Golden Software, 2012) for contouring and visualization. All contouring was accomplished using the routines in Surfer.

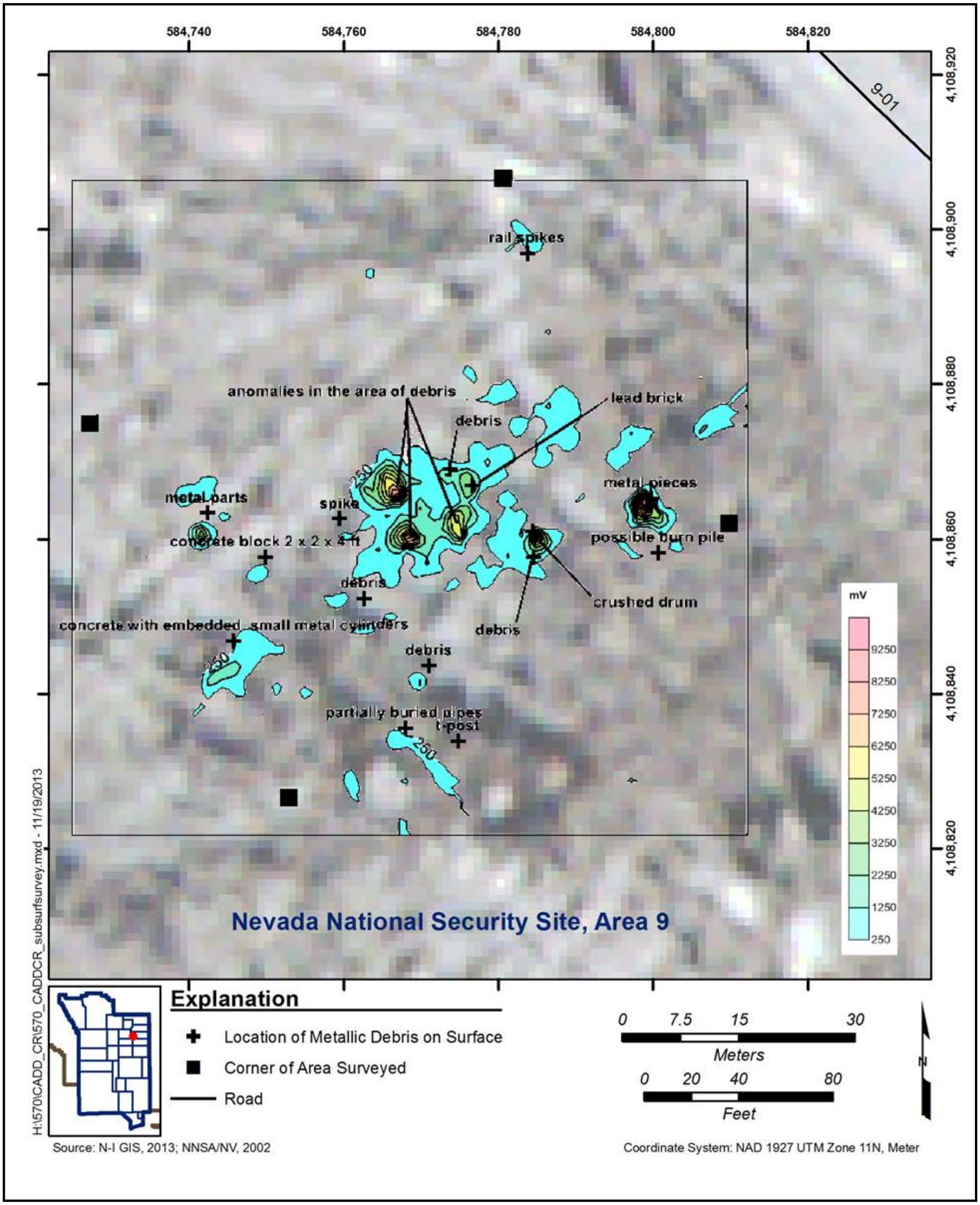
The Channel 1 data are the first data collected and represent the strongest response received for any metallic debris detected. The Channel 1 data are used in all of the figures showing response data in this appendix (see Figures G.1-3 through G.1-5, and Figures G.1-7 and G.1-8).

G.1.4 Survey Results for the Debris Field Area

The area surveyed in the Debris Field area includes an area suspected of potentially containing buried metallic debris. The area is generally flat. The survey was conducted on December 0, 2012, with the coils mounted on the wheels as shown in Figure G.1-2. Each traverse of the survey was immediately adjacent to the last, causing the coils to be passed directly over the entire area surveyed. Where the vegetation, debris, or topography required some deviation from this plan, each pass with the unit was still close enough to the last that the instrument would have detected any significant metallic debris (i.e., larger than a small wrench) present. The metallic debris present in the area induced a wide range of instrument responses, from a low of -18 mV to a high of 11,664 mV for the Channel 1 data.

Figure G.1-3 is a plot of the Channel 1 data with the corners of the area surveyed as well as the locations of metallic debris on the surface indicated. Figure G.1-3 shows that the instrument responses detected generally align with the known locations of metallic surface debris. The plot shows the locations of the three largest points of elevated instrument response that do not align with the locations of metallic debris at the surface. Subsequent shallow excavation at these points of elevated instrument response revealed the presence of metal debris buried 3 to 6 in. bgs. These points of elevated instrument response are located in an area measuring approximately 40 by 20 ft with metal debris scattered on the surface. The amount of debris gives rise to what appears to be a general area of elevated instrument response; however, the levels overall are not indicative of a significant amount of metal and therefore do not indicate a landfill.

Within the general area of elevated instrument response discussed above, a lead brick was discovered. The brick was properly removed from the site on December 3, 2012, the day of the survey. The location where the brick was found is indicated on Figure G.1-3.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure G.1-3
Debris Field Area Survey Results

Outside the general area of elevated instrument response, all of the significant responses are associated with metallic debris found at the surface (e.g., metal drum, metal debris, concrete with embedded small metal cylinders). There is no indication of a landfill containing significant metallic debris within the area surveyed.

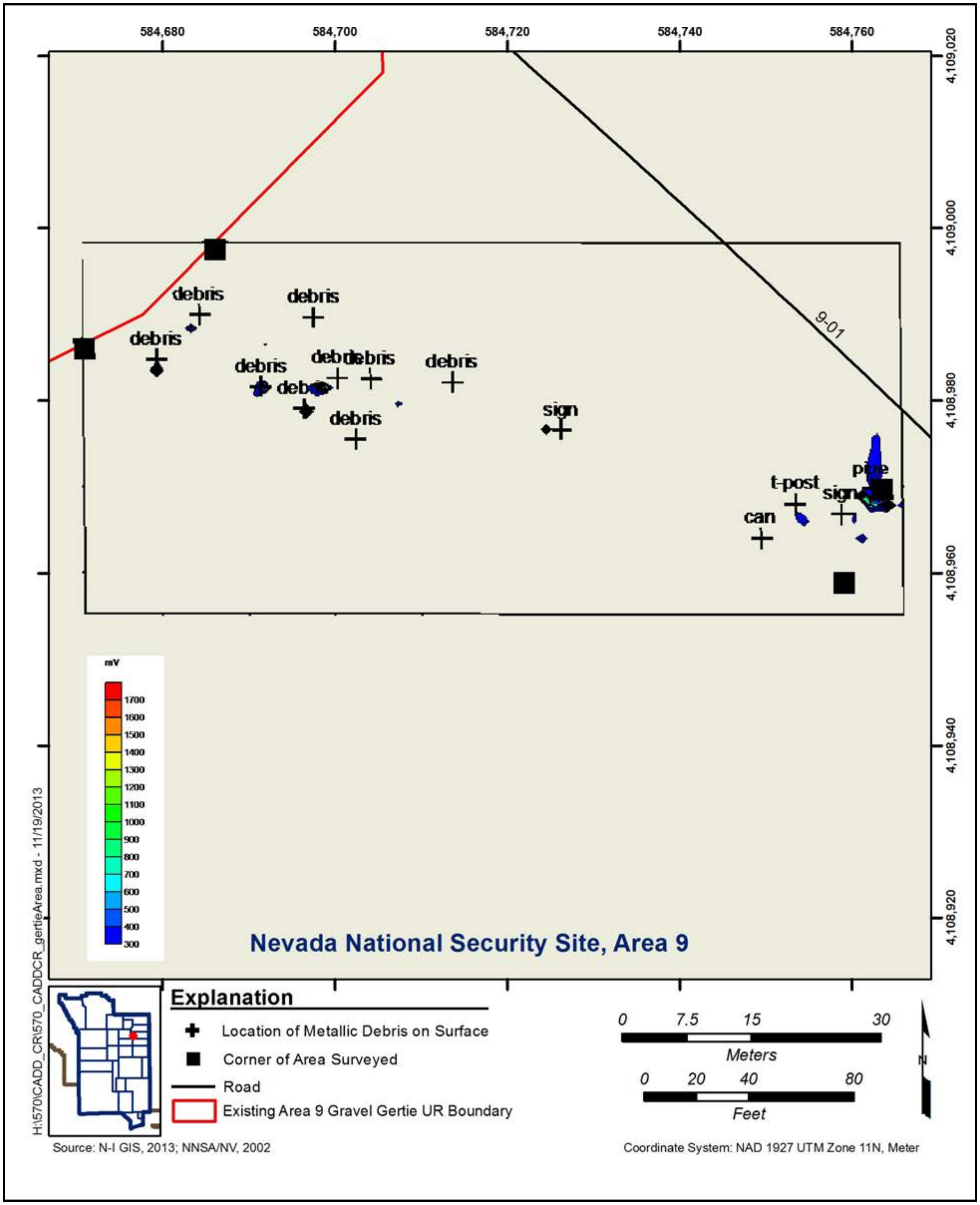
G.1.5 Survey Results for the Gravel Gertie Area

The Gravel Gertie area surveyed on December 3, 2012, includes an area suspected of potentially containing buried metallic debris, instrument cabling, and/or an underground vault. The survey covered the linear mound running from Road 9-01 west to the Gravel Gertie. The area was surveyed with the coils mounted on the wheels as shown in Figure G.1-2. Each traverse of the survey was immediately adjacent to the last, causing the coils to be passed directly over the entire area surveyed. Where the vegetation and topography required some deviation from this plan, each pass with the unit was still close enough to the last that the instrument would have detected any significant metallic debris (i.e., larger than a small wrench). The metallic debris present in the area induced a wide range of instrument responses, from a low of -11 mV to a high of 4,226 mV for the Channel 1 data.

Figure G.1-4 is a plot of the Channel 1 data with the corners of the area surveyed as well as the locations of metallic debris on the surface indicated. The point of greatest instrument response is at the northeast corner of the area surveyed and is due to the detection of a metal pipe running along the edge of Road 9-01. Given the angle of the long axis of the linear mound and Road 9-01, this is the location within the area surveyed that came closest to the pipe. The remaining points of elevated instrument response are all low in amplitude (i.e., less than 500 mV) and associated with metallic debris found at the surface. There is no indication of significant metallic debris within the area surveyed. Instrument cabling, if contained in an underground vault, may potentially be too deep for the EM61-MK2A to detect.

G.1.6 Survey Results for the Lead Pad Area

The Lead Pad area, surveyed on January 24, 2013, includes an area suspected of potentially containing buried structural features and/or additional lead pads. The area is flat with two aboveground square lead pads, each contained in a steel frame secured in a concrete base. The pads, each less than 0.5 m on a side, are located approximately 9 m from each other on a generally



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure G.1-4
Gravel Gertie Area Survey Results

north–south line. The area was surveyed with the coils suspended from a harness worn by the operator. With the coils suspended from the harness, the bottom coil was around 10 cm ags. The coils were aligned such that the long axis of the coils was parallel to the direction in which the survey was walked. The survey was walked such that there was no more than approximately 1 m between the edges of the coils from one pass to the next. Each pass with the unit was still close enough to the last that the instrument would have detected any significant metallic debris (i.e., larger than small wrench). The metallic debris present in the area induced a wide range of instrument responses, from a low of -179 mV to a high of 11,302 mV for the Channel 1 data.

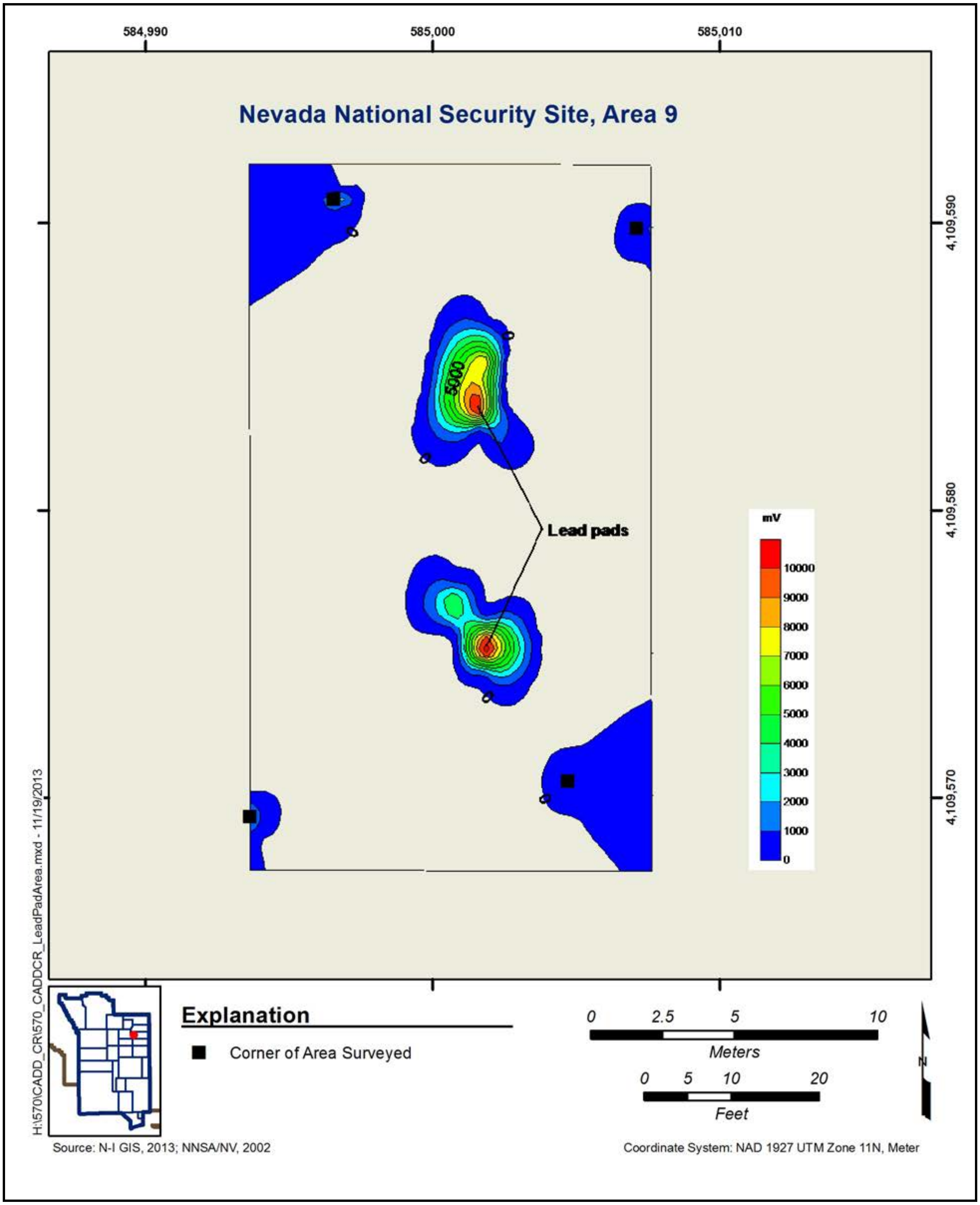
Figure G.1-5 is a plot of the Channel 1 data. The only areas of elevated instrument response detected are associated with the aboveground lead pads. The corners of the surveyed area were not independently surveyed with a Trimble unit, as brass fittings were used to mark the corners. Due to the brass fittings used to mark the corners, they appear as the four areas of elevated instrument response at the edges of the figure. There is no indication of additional buried lead pads or other structural features containing significant metal within the area surveyed.

G.1.7 Survey Results for the Balloon Pad Area

The Balloon Pad area was surveyed on November 14 and December 4, 2012, with the objective of a general reconnaissance of the area. The survey area is generally flat with the exception of a mud pit, a mound where the test infrastructure is concentrated, and a depression/trench extending south–southwest of the mound.

The area surveyed includes all of the area within the boundaries of the corner markers with three exceptions. Figure G.1-6 shows the corner markers of the survey area and areas that were excluded from the survey. The operators did not enter the mud pit or the depression/trench, and not all of the area containing the concentration of test infrastructure was surveyed, as it is mounded and contains significant metal and reinforced concrete.

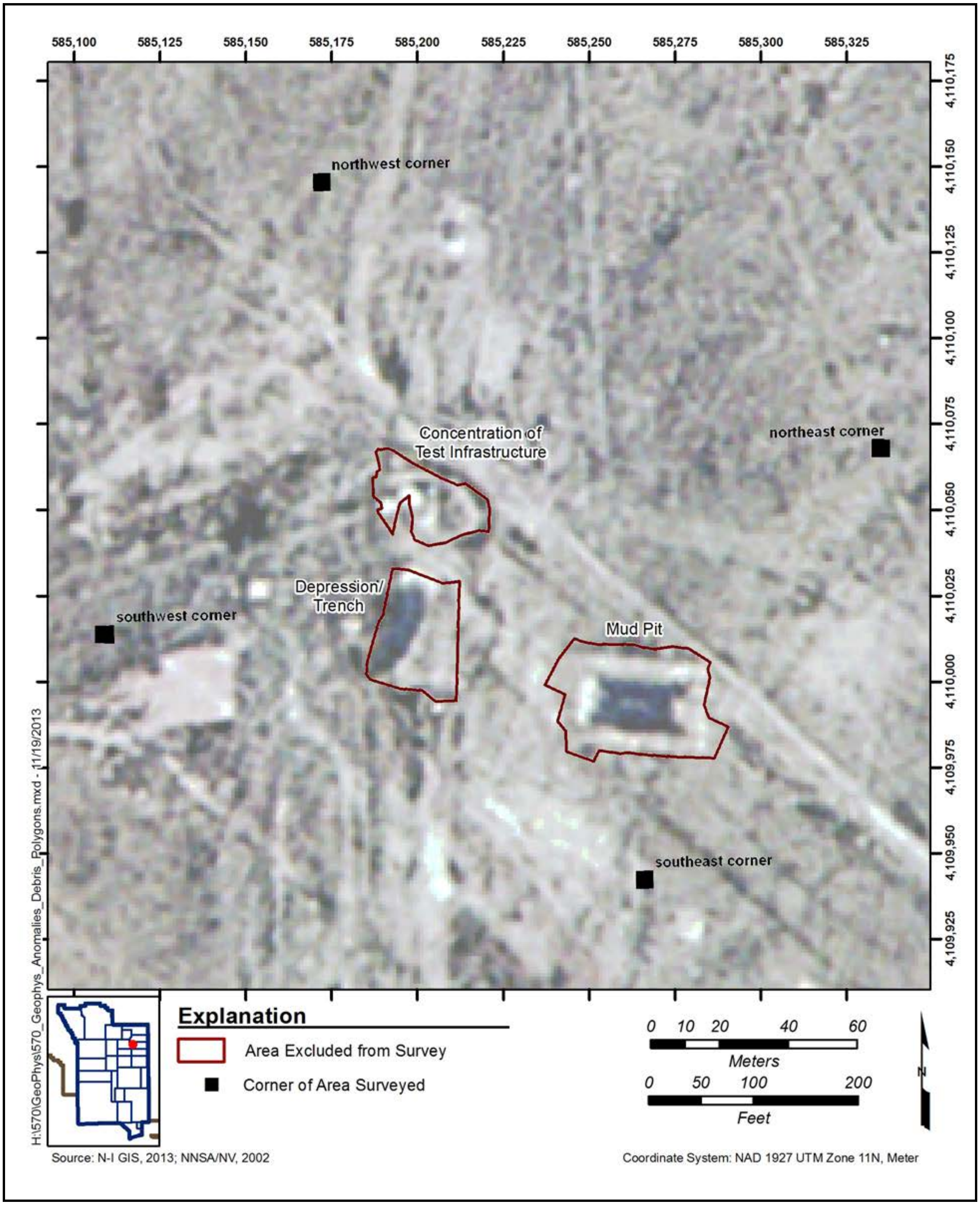
The initial survey on November 14, 2012, covered the entire area suspected of potentially containing buried metallic debris, with the exceptions noted above. However, satellite coverage for GPS positioning information was lost during part of the survey, and several areas of elevated instrument response were identified that were not clearly associated with metallic objects/debris at the surface.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure G.1-5
Lead Pad Area Survey Results



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure G.1-6
Areas Excluded from the Survey at the Balloon Pad

On December 4, 2012, the area over which satellite coverage had been lost was resurveyed. In addition, the areas of elevated instrument response not clearly associated with metallic objects/debris at the surface were resurveyed. The surveys were conducted with the coils mounted on the wheels as shown in Figure G.1-2.

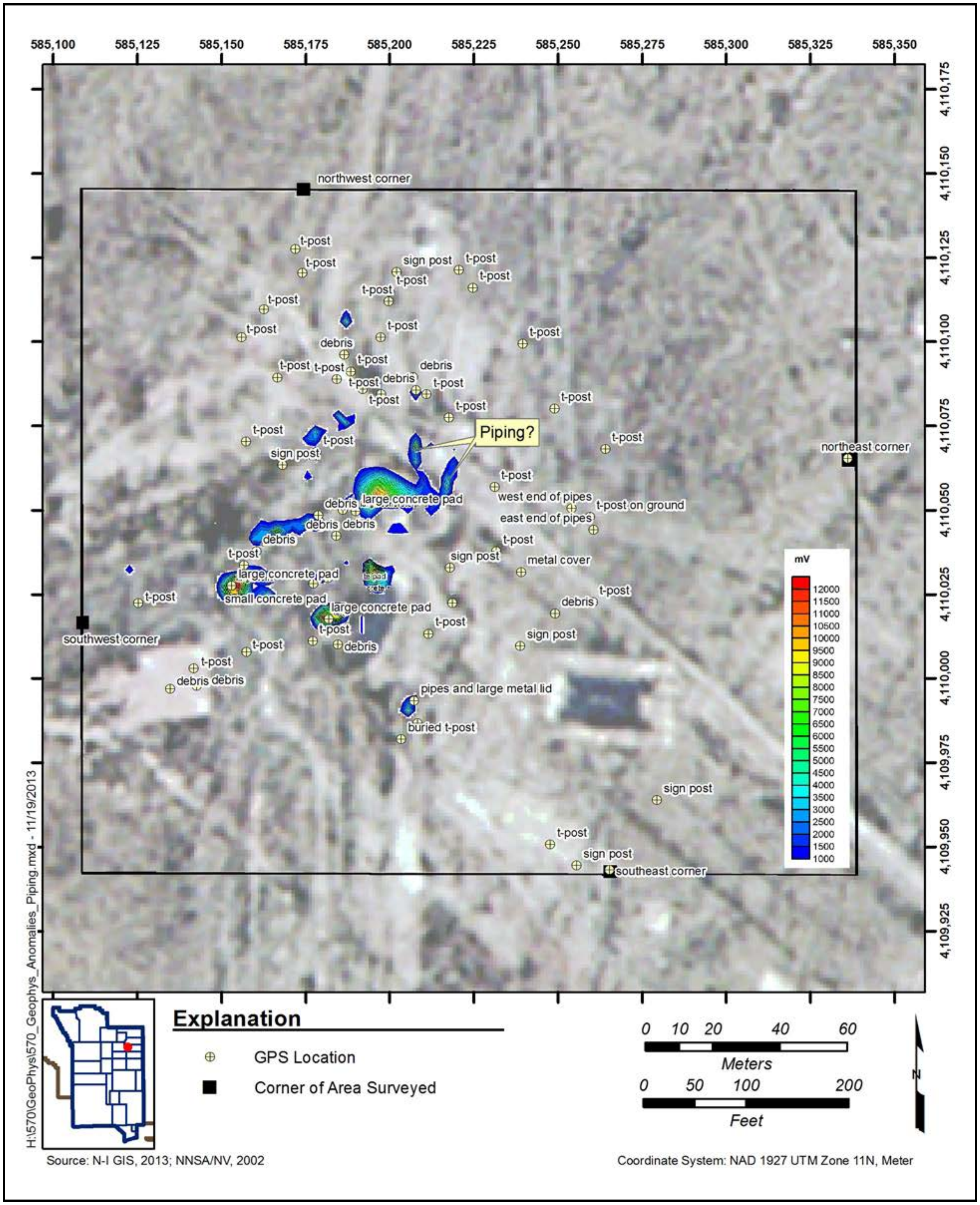
As noted earlier, the intent of the survey was general reconnaissance. With the exception of the areas of elevated instrument response identified as requiring closer inspection, the survey was walked such that the spacing between passes of the coils was 2 to 3 m. The surveys of the areas of elevated response requiring closer inspection were undertaken such that the coils were passed directly over the entire area surveyed.

Figure G.1-7 is a plot of the Channel 1 data. The metallic debris present in the area induced a wide range of instrument responses, from a low of -22 mV to a high of 11,939 mV for the Channel 1 data. To focus the discussion, Figure G.1-7 shows only instrument responses above 1,000 mV. Displaying the data in this manner still captures the relevant data, as a single lead brick near surface yields an instrument response of around 3,000 mV and the lead pads discussed earlier each yield an instrument response in excess of 10,000 mV.

Figure G.1-7 shows two areas (labeled “Piping?”) that had elevated instrument response. There is no metal visible at the surface that might explain these areas of elevated instrument response. Although the response is consistent with lengths of buried piping, the source has not been verified. All of the remaining areas of elevated instrument response are associated with metal or reinforced concrete visible at the surface. There is no indication of a landfill containing significant metallic debris within the area surveyed.

G.1.8 Survey Results for the C-09 Lead Plate Area

The C-09 Lead Plate area, surveyed on December 3, 2012, includes an area suspected of potentially containing buried metallic debris. The area is generally flat. Numerous pieces of metallic debris, including lead bricks and lead plates, were removed from this site before the survey. The intent of the survey, conducted with the coils mounted on the wheels as shown in Figure G.1-2, was to investigate whether or not the debris at the surface was an indication of an underlying landfill. Each traverse of the survey was immediately adjacent to the last, causing the coils to be passed directly over the entire



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure G.1-7
Balloon Pad Area Survey Results

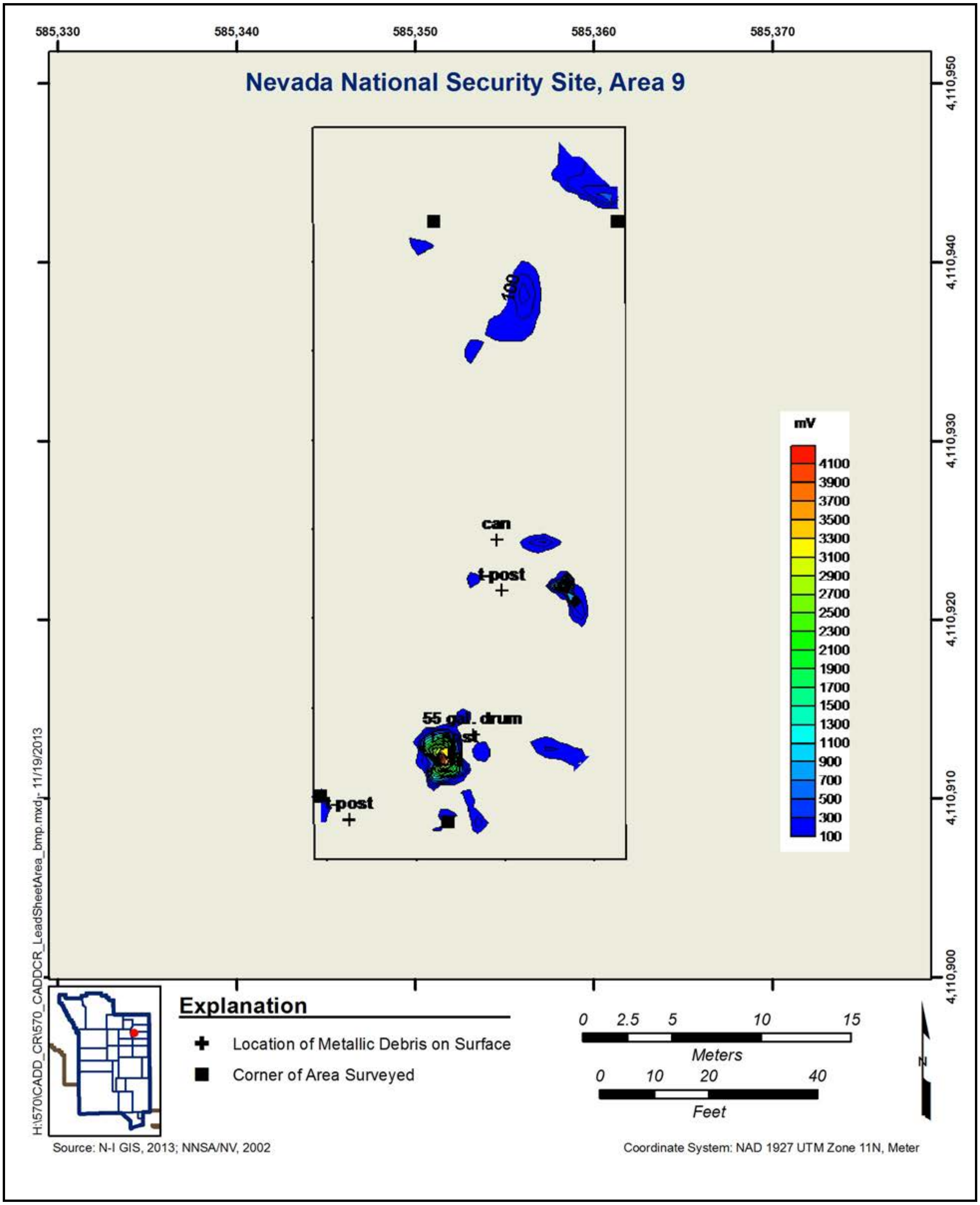
area surveyed. The metallic debris present in the area induced a wide range of instrument responses, from a low of -17 mV to a high of 4,593 mV for the Channel 1 data.

Figure G.1-8 is a plot of the Channel 1 data. The highest instrument response detected was in the south–central portion of the area surveyed around 585,351 m East and 4,110,912 m North. This instrument response is due to a steel drum and surrounding t-posts set up as the site’s satellite accumulation area. The remaining areas of elevated instrument response are smaller in magnitude and scattered. There is no indication of a landfill containing significant metallic debris within the area surveyed.

G.1.9 Conclusions

Five areas within CAU 570 were surveyed for the presence of buried metal. Of the five areas, the Balloon Pad area was the largest in aerial extent. With the exception of two areas of elevated instrument response at the Balloon Pad (which have signatures one would expect from buried piping), no significant areas of elevated instrument response were discovered that were not potentially associated with metal or reinforced concrete observed at the surface. No potential areas with significant amounts of buried metal indicative of landfills were discovered.

Although all of the major areas of elevated instrument response detected appear to be associated with metallic surface debris or reinforced concrete, this assumption cannot be verified until the debris is removed and another survey completed.



Source: N-I GIS, 2013; NNSA/NV, 2002

Coordinate System: NAD 1927 UTM Zone 11N, Meter

Figure G.1-8
C-09 Lead Plate Area Survey Results

G.2.0 References

Geonics, see Geonics Limited.

Geonics Limited. 2005. *Computer Program Manual (Survey Data Reduction Manual), SAT61MK2*, Version 2.20. Mississauga, Ontario, Canada.

Geonics Limited. 2013. ”Products” web page featuring photograph of EM61-MK2A. As accessed at http://geonics.com/html/products.html on 11 September. Mississauga, Ontario, Canada.

Golden Software. 2012. *Surfer Version 7*. Golden, CO.

N-I GIS, see Navarro-Intera Geographic Information Systems.

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

Navarro-Intera Geographic Information Systems. 2013. ESRI ArcGIS Software.

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

Appendix H

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 570: Area 9 Yucca Flat Atmospheric Test Sites, Nevada National Security Site, Nevada	**2. Document Date:**	9/30/2013
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NFO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	11/1/2013
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850 ext. 233	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	**11. Type***	**12. Comment**	**13. Comment Response**	**14. Accept**
1.) Executive Summary, Page ES-3, 1st Paragraph, 3rd Sentence	Mandatory	Third sentence is not grammatically correct.	The last two sentences of the paragraph were modified to read, "The preferred 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 DOE, National Nuclear Security Administration Nevada Field Office provides the following recommendations:"	
2.) Section 1.1, Page 3, 5th Paragraph, 1st Sentence	Mandatory	Verify CAS number.	CAS number was corrected to read "CAS 09-99-01" on pages 3, A105, and A106.	
3.) Section 1.1, Page 4, 2nd Paragraph, 1st Sentence	Mandatory	1st sentence: insert the phrase, "to surface soils" after the word, "release". A brief clarification of the type of releases, i.e., atmospheric deposition of radionuclides from UGT venting, etc., and their approximate time periods from the listed UGTA tests would be helpful.	The phrase "to surface soils" was inserted after the word "release" and a sentence was added to the end of the paragraph which reads, "The releases from these tests occurred from 1962 to 1970 and consisted of atmospheric deposition of radionuclides."	
4.) Section 2.1.1, Page 11, 1st Paragraph	Mandatory	Second to last sentence, add the following to end of sentence:..."listed in Section 1.1..."	"Listed in Section 1.1" was added to the end of the sentence.	
5.) Section 2.1.1, Page 12, 2nd Paragraph	Mandatory	Add brief assessment about how the results of the TRS/TLD sampling validated the CSM regarding UGTA release sites specifically; i.e., were any patterns of release detected by sampling?	The second sentence of the last paragraph of Section 2.1.1 was modified to read, "The contamination pattern of the radionuclides at Study Group 1 and UGTA Releases is consistent with the CSM in that ..."	

UNCONTROLLED When Printed

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Corrective Action Decision Document/Closure Report for Corrective Action Unit 570: Area 9 Yucca Flat Atmospheric Test Sites, Nevada National Security Site, Nevada	**2. Document Date:**	9/30/2013
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NFO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	11/1/2013
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850 ext. 233	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	11. Type*	12. Comment	13. Comment Response	14. Accept
6.) Section 2.3.1, Page 22, 1st Paragraph	Mandatory	Re-write: "At CAU 570, radiological contaminants exceeded Tier I action levels at Study Groups 1, 2, and 4, and lead exceeded Tier I action levels at Study Group 3."	The sentence was rewritten as suggested.	
7.) Section 3.0, Page 27, 2nd Paragraph	Mandatory	Re-write 1st sentence: "At CAU 570, contaminants were present in environmental samples from only two locations, A137 and A007."	The sentence in question was rewritten as follows. "At CAU 570, COCs were detected in environmental samples from only two locations: A137 and A007."	
8.) Section A.3.1.2, Page A-19, 1st Paragraph	Mandatory	UGTA Release sites have been discussed in relation to Study Group 1, but have not been shown on any figure; suggest indicate their locations as appropriate.	The second to the last sentence in Section A.3.1.2 was modified to read, "Figure A.3-1 presents a graphic representation of the data from the TRS and the location of UGTA Releases." Figure A.3-1 was modified to show the locations of UGTA Releases.	
9.) Figure A.3-1, Page A-20	Mandatory	Clarify that the TRSs at Study Group 1 did/did not include the Eagle HCA. No elevated MOBs are shown in this area because contaminated debris is within a soil mound and not distributed on the surface.	Figure A.3-1 was modified to show that the extent of the TRSs did not include the HCAs or the craters where stability studies have not been conducted.	
10.) Section A.3.3.3, Page A-29, 2nd Paragraph	Mandatory	Add additional figure explanation after 1st sentence ending in A007: "A statistical plot for the correlation analysis between TED values and radiation survey values is shown at the lower right corner of the figure".	A sentence was added at the end of the second paragraph of Section A.3.3.3 which reads, "A statistical plot for the correlation analysis between TED values and radiation survey values is shown at the lower right corner of the figure."	

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11.) Section A.3.7, Page A-49, 2nd Paragraph	Mandatory	Last sentence: change "will decay" is "predicted to decay"	The change was made as suggested.	
12.) Figures A.3-5 and A.3-6, Pages A-50 and A-51	Mandatory	Add additional figure explanations IAW comment 10.	A sentence was added to the end of the first paragraph of Section A.3.7 which reads, "A statistical plot for the correlation analysis between TED values and radiation survey values is shown at the lower left corner of each figure."	
13.) Section A.5.5, Page A-71, 1st Paragraph	Mandatory	2nd sentence says "lead bricks/plates" were removed for recycling; 5th sentence says lead pads, closure in place was selected as corrective action. The decision method of removing/not removing types and quantities of lead debris and scrap is not clear.	The second sentence of the first paragraph of Section A.5.5 was modified to read, "Because of the ease of accessibility, the lead bricks/plates ..." The fifth, sixth, and seventh sentences of the first paragraph of Section A.5.5 were modified to read, "In the case of the lead pads, because of the way the lead pads were affixed to large cement foundations and the potential for worker exposure to contaminants, the corrective action of closure in place with an FFACO UR was selected for this area. The area that encompasses the lead pads is shown on Figure A.5-3. The FFACO UR that includes the lead pads is presented in Attachment D-1."	
14.) Section A.5.7, Page A-72, 1st Paragraph	Mandatory	What is "debris"? Clarify.	Section A.5.7 was modified to read, "As a BMP, the debris (e.g., scrap metal, porcelain, wood, nails) from the debris field was collected and disposed of as low-level waste."	

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15.) Section A.6.2, Page A-84, 1st Paragraph	Mandatory	Since samples were taken at depth below land surface (up to 130 cm), should the sentence read, "...surface and sub-surface contamination for the soil piles"?	The last sentence of the first paragraph of Section A.6.2 was moved to the end of the second paragraph of Section A.6.2 and modified to read, "A revision to the CSM was necessary to include subsurface soil."	
16.) Section A.7.2, Page A-93, 1st Paragraph	Mandatory	Second to last sentence: please add a brief statement summarizing the analytical results in relation to regulatory thresholds, i.e., did not exceed, etc.	A sentence was added prior to the last sentence of the first paragraph of Section A.7.2 which reads, "No analytical results exceeded regulatory criteria."	
17.) Section A.7.2.3, Page A-99, 2nd Paragraph	Mandatory	Last sentence: verify acronym.	Acronym is defined beneath Table A.7-1. The last sentence of the first paragraph of Section A.7.2.3 was modified to read, "The Recycled Lead Materials were shipped to TMMC (see Attachment D-2)."	
18.) Table A.9-1, Page A-106	Mandatory	"Corrective Action" column: please note implementation of new URs as applicable.	In the "Corrective Action" column of Table A.9-1, both CASs with "Closure in Place" as a CAA alternative were modified to include the words, "with FFACO UR."	
19.) Section C.1.2, Page C-5, 2nd Paragraph	Mandatory	4th sentence: "...no soils samples were collected from craters..."; add "because_________" (safety, logistics, etc.)	The words "because the craters were not determined to be stable and therefore were unsafe to enter" were added to the end of the 4th sentence of the second paragraph of Section C.1.2.	
20.) Section D.1.0, Page D-1, 1st Paragraph	Mandatory	1st sentence: clarify "...NNSS low-level landfill"	The second sentence of Section D.1.1 was modified to read, "Soil containing the COCs was excavated and placed in lined intermodal containers for disposal at the NNSS Area 5 RWMC."	

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21.) Attachment D-1, Admin and FFACO UR Figures, Tesla T-9, Eagle B-9A	Mandatory	Please maintain consistency between Admin and UR boundary with previous forthcoming documents; i.e., CAU 105 used red FFACO UR boundaries, blue Admin UR boundaries.	The adminstrative boundaries identified in Attachment D-1 will be identified with a blue line and the GIS SOP has been updated to maintain consistency (Red lines for FFACO boundaries, Blue lines for Administrative boundaries).	
22.) General		Although not done in response to specific comments from NDEP, editorial changes have been addressed throughout the document, which include spelling and acronym corrections.		
23.) Page A-71, Section A.5.5, Next to Last Sentence and Last Sentence: Figure A.5-3; and Figure for UR on CAS 09-23-15		An additional comment was received from a reviewer which states: These two sentences and the figures do not match. The sentences state that the FFACO is shown on Figure A.5-3 and Figure A.5-3 does not indicate and FFACO UR (legend does not call out UR) and the areas indicated on this figure do not match the FFACO UR areas in the figure used in Appendix D for the FFACO UR and CAS 09-23-15.	The last two sentences of the paragraph were modified to read, "The area that encompasses the lead pads is shown on Figure A.5-3. The FFACO UR that includes the lead pads is presented in Attachment D-1." The title of Figure A.5-3 was changed to read, "Study Group 3 Locations."	
24.) Page A-75, Section A.6.1.1, First Sentence		An additional comment was received from a reviewer which states: This sentence says that visual inspections were used to identify potential areas where contamination was found at other CAUs. What does that have to do with this CAU (Study Group)? In the previous sections for the other Study Groups the Visual Inspections call out what was done for the visual inspection at that Study Group - Shouldn't this be the same?	Section A.6.1.1 was modified to read, "Visual inspections were used to identify drainages, windrows, soil piles, staked areas, and disturbed areas."	

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25.) Page A-78, Section A.6.1.4.1, Last Sentence and Figure A.6-1		An additional comment was received from a reviewer which states; This sentence says that Figure A.6-1 shows TLD Locations, Figure A.6-1 says it is "Sample Locations." It does not say anything on the figure (legend) about TLD Locations and if the location of the TLDs are supposed to be depicted by the "Dxx" number. Table A.6-2 lists 37 TLDs and Figure A.6-1 only shows 12, not 37.	The last sentence of Section A.6.1.4.1 was modified to read, "See Figure A.6-1 for sample locations." Figure A.6-1 was modified so that all Study Group 4 sample locations were identified with their sample location number.	
26.) Page A-80, Section A.6.1.4.2, First Sentence and Table A.6-3		An additional comment was received from a reviewer which states: This sentence says that there were fifty-five soil samples collected however in the table it says 56 samples - which is correct? Fix either the text in the sentence or the figures in the table so that they match.	The text was changed to fifty-six.	
27.) Page A-84, Section A.6.2 and Page B-13, Section B.1.4, Last Sentence		An additional comment was received from a reviewer which states: Page A-84 says that a revision to the CSM was necessary, however, on Page B-13 it says that no revisions to the CSM were necessary - which is correct? Fix text to reflect whether revisions to the CSM were necessary or not.	The last sentence in Section B.1.4 was modified to read, "All data collected during the CAI supported the CSM, and a revision to the CSM as described in Section A.6.2 was necessary."	

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28.) Page A-85, Section A.6.3.1, First Sentence		An additional comment was received from a reviewer which states: Section A.6 is about Study Group 4, this sentence talks about dose that a receptor would received at Study Group 1 - should this say Study Group 4? Fix number of Study Group if appropriate.	The text in question was modified to read, "Study Group 4."	
29.) Page D-3, Sentence Beneath Wording for UR Sign		An additional comment was received from a reviewer which states: The sentence reads "The FFACO UR signs posted at the lead pads reads as follows:" and there is nothing after this - I think this is supposed to be the sentence before the wording of the sign - and the sentence before the wording of the sign has slightly different wording. Remove sentence after the sign wording and fix sentence before sign wording if appropriate.	The final sentence in Section D.1.4 was removed and the sentence just before the sign wording was changed to read, "The FFACO UR signs for the lead pads and contaminated waste pile read as follows:"	
30.) UR Form for CAS 02-23-07		An additional comment was received from a reviewer which states: Coordinates listed say starting at the Southeast Point - however, when you look at the aerial photo, the point listed on the form as Southeast really appears to be the South Point (see similar listing for UR on CAS 09-99-01). Fix Coordinate listing on the UR Form.	The coordinates in the table were rearranged and the figure was updated to agree with the table.	

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31.) All Use Restriction Forms, Contact Information		An additional comment was received from a reviewer which states: The correct wording that should go here is "NNSA/NFO Soils Federal Activity Lead" not "Director." Fix Contact information on all UR forms.	The contact information on all UR forms was changed to "NNSA/NFO Soils Federal Activity Lead."	
32.) Page 2 of Use Restriction Form for CASs 09-23-10 and 09-23-15, Comments Section		An additional comment was received from a reviewer which states: The wording used here is not complete - the last part of the last sentence is missing. Fix sentence	The last sentence of the comments section of all URs was modified to read, "Permission to conduct any restricted activities within the area requires prior notification to NDEP."	
33.) Page E-8, Table E.1-2; Page E-10; and Page E-14, Second Paragraph		An additional comment was received from a reviewer which states: The amounts listed in these three places are inconsistent with the estimate for Clean Closure - Table E.1-2 says ' approximately 7.9M'; Page E-10 says 'exceeds 8M', and Page E-14 says '4.2M for Sugar and 1M for Eagle' which together don't total 7.9M or exceed 8M. Fix text so amounts quoted for Clean Closure are consistent.	The cost estimate in Table E.1-2 was changed from $7,900,000 to $5,200,000. The estimated cost for Clean Closure identified in the last paragraph of Section E.1-5 was changed to $5.2 million.	

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34.) Bottom of Page E-12 and Page E-13		An additional comment was received from a reviewer which states: This section (E.2.0) is about Recommended Alternatives for all CASs in CAU 570, the last sentence of Page E-12 says, "In addition to the corrective action identified above, the following action will be implemented as a BMP." Then on page E-13 the paragraph describing the BMP doesn't state where you are doing the Administrative URs. Since the statement at the bottom of page E-12 only refers to "actions identified above", it is unclear where you will be doing the BMP of Administrative URs. Suggest calling out in the paragraph on Page E-13 which CASs will have Administrative URs.	The CAS numbers of 02-23-07 & 09-99-01 were added to the end of the last sentence in the second to last paragraph of Section E.2.0.	
35.) Appendix G, Page 3 and Figure 3		An additional comment was received from a reviewer which states: The last sentence on page 3 says, "The location where the brick was found is indicated on Figure 3." When you look at Figure 3 it is nearly impossible to determine where the lead brick was found. The text is listed over the top of the survey areas and not only can you not read the text for the brick, you cannot read a lot of the other text here as well. Suggest relabeling this figure so the text is readable.	The figures have been re-formatted to look similar to the rest of the figures throughout the document. The identifiers such as 'lead brick' have been placed in locations so that reading the figures is easier.	

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