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Nevada Environmental Restoration Project

Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 408: Bomblet Target Area Tonopah Test Range (TTR), Nevada

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Environmental Restoration Project

U.S. Department of Energy
National Nuclear Security Administration
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STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER) PLAN FOR CORRECTIVE ACTION UNIT 408: BOMBLET TARGET AREA TONOPAH TEST RANGE (TTR), NEVADA

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

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Approved by: /s/ Kevin Cabble Date: 3/23/2010

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Environmental Restoration Project

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List of Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
BDU	Bomblet Dummy Unit
bgs	Below ground surface
BIP	Blown in place
BLM	Bureau of Land Management
BLU	Bomb Live Unit
BMP	Best management practice
CAI	Corrective action investigation
CAS	Corrective action site
CAU	Corrective action unit
CBU	Cluster bomb unit
COC	Contaminant of concern
COPC	Contaminant of potential concern
CR	Closure report
CSM	Conceptual site model
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
DU	Depleted uranium
EPA	U.S. Environmental Protection Agency
FAL	Final action level
FFACO	*Federal Facility Agreement and Consent Order*
ft	Foot
GIS	Geographic Information Systems
GPS	Global Positioning System

List of Acronyms and Abbreviations *(Continued)*

HASL	Health and Safety Laboratory
HWAA	Hazardous waste accumulation area
ID	Identification
IDW	Investigation-derived waste
in.	Inch
lb	Pound
LCS	Laboratory control sample
m	Meter
MDC	Minimum detectable concentration
MEC	Munitions and explosives of concern
mi^2	Square mile
mm	Millimeter
MS	Matrix spike
MSD	Matrix spike duplicate
MTADS	Material Technical Assistance Data System
NAC	*Nevada Administrative Code*
NAD	North American Datum
NCRP	Nation Council on Radiation Protection and Measurements
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
NTSWAC	*Nevada Test Site Waste Acceptance Criteria*
NV/YMP	Nevada Yucca Mountain Project
PAL	Preliminary action level
PDA	Personal digital assistant
PPE	Personal protective equipment

List of Acronyms and Abbreviations (Continued)

PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	*Quality Assurance Project Plan*
QC	Quality control
RBCA	Risk-based corrective action
RBSL	Risk-based screening level
RCA	Radiologically controlled area
RCRA	*Resource Conservation and Recovery Act*
RL	Reporting Limit
RMA	Radioactive material area
RPD	Relative percent difference
SAA	Satellite accumulation area
SAC	Strategic Air Command
SAFER	Streamlined Approach for Environmental Restoration
SDG	Sample delivery group
SSTL	Site-specific target level
SVOC	Semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbons
TTR	Tonopah Test Range
U	Uranium
USAF	U.S. Air Force
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
VOC	Volatile organic compound
%R	Percent recovery

Executive Summary

This Streamlined Approach for Environmental Restoration Plan addresses the actions needed to achieve closure of Corrective Action Unit (CAU) 408, Bomblet Target Area (TTR). Corrective Action Unit 408 is located at the Tonopah Test Range and is currently listed in Appendix III of the *Federal Facility Agreement and Consent Order.* Corrective Action Unit 408 comprises Corrective Action Site TA-55-002-TAB2, Bomblet Target Areas. Clean closure of CAU 408 will be accomplished by removal of munitions and explosives of concern within seven target areas and potential disposal pits.

The target areas were used to perform submunitions related tests for the U.S. Department of Energy (DOE). The scope of CAU 408 is limited to submunitions released from DOE activities. However, it is recognized that the presence of other types of unexploded ordnance and munitions may be present within the target areas due to the activities of other government organizations.

The CAU 408 closure activities consist of:

- Clearing bomblet target areas within the study area.
- Identifying and remediating disposal pits.
- Collecting verification samples.
- Performing radiological screening of soil.
- Removing soil containing contaminants at concentrations above the action levels.

Based on existing information, contaminants of potential concern at CAU 408 include unexploded submunitions, explosives, *Resource Conservation Recovery Act* metals, and depleted uranium. Contaminants are not expected to be present in the soil at concentrations above the action levels; however, this will be determined by radiological surveys and verification sample results.

1.0 Introduction

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions needed to achieve closure of Corrective Action Unit (CAU) 408, Bomblet Target Area (TTR). Corrective Action Unit 408 is located at the Tonopah Test Range (TTR) (Figure 1-1) and is currently listed in Appendix III of the *Federal Facility Agreement and Consent Order* (FFACO), which was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense (DoD); and DOE, Legacy Management (FFACO, 1996; as amended March 2010).

Corrective Action Unit 408 comprises Corrective Action Site (CAS) TA-55-002-TAB2, Bomblet Target Areas. The CAU 408 Bomblet Target Area was originally identified during interviews with TTR personnel in 1993 and 1994 as an approximately 19-square-mile (mi^2) area of bomblet drops from Mid Target to central Antelope Lake (DOE/NV, 1994 and 1996b; SNL, 1992; Swaton, 1994). Based upon document reviews, personnel interviews, and preliminary investigations in 2006 where unexploded ordnance (UXO) personnel walked the flight paths to identify areas that contain evidence of bomblet testing, the CAU boundary was redefined to consist of seven discrete target areas (Cabble, 2007). See Section 2.0 for definition of the seven target areas.

The target areas were used to perform submunitions-related tests for the DOE. The scope of CAU 408 is limited to submunitions (on the surface and disposal pits) released from DOE activities and potentially contaminated soil from those activities. However, it is recognized that the presence of other types of UXO and munitions may be present within the target areas due to the activities of other government organizations. While some miscellaneous debris and munitions and explosives of concern (MEC) may be located and removed during CAU 408 activities, these are not considered to be part of the closure scope. If these items cannot be managed during CAU 408, they will be identified, the Global Positioning System (GPS) coordinates collected and recorded, and the responsible federal agency notified.

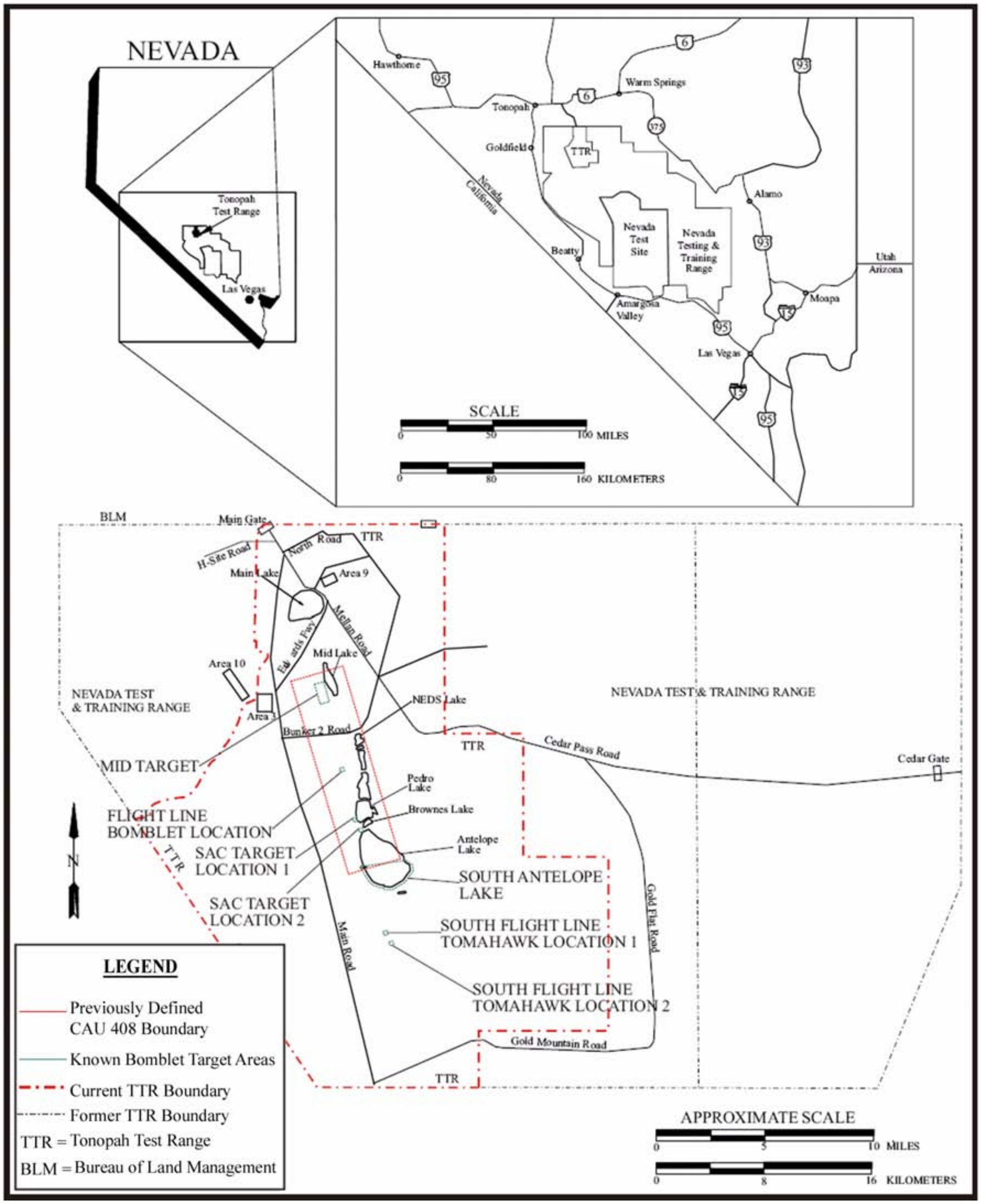

Figure 1-1
CAU 408 Bomblet Target Area (TTR)
Source: Modified from NNSA/NSO, 2006b

According to the FFACO (1996, as amended March 2010), a SAFER Plan may be performed when the following criteria are met:

- Conceptual corrective actions are clearly identified (although some degree of investigation may be necessary to select a specific corrective action before completion of the corrective action investigation [CAI]).
- Uncertainty of the nature, extent, and corrective action must be limited to an acceptable level of risk.
- The SAFER Plan includes decision points and criteria for making data quality objective (DQO) decisions.

The purpose of the CAI will be to document and affirm the decision for either clean closure, closure in place, or no further action; and to provide sufficient data to implement the corrective action. The actual corrective action selected will be based on characterization activities implemented under this SAFER Plan. This SAFER Plan identifies decision points developed in cooperation with the Nevada Division of Environmental Protection (NDEP), where the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) will reach consensus with NDEP before beginning any additional scope of work.

There is sufficient information and process knowledge from historical documentation and previous investigations (i.e., the expected nature and extent of contaminants of potential concern [COPCs]) to recommend clean closure as the corrective action objective for CAU 408. Should land use change in the future for CAU 408, DOE remains the responsible party for any future response actions required under the FFACO.

1.1 SAFER Process

The SAFER concept recognizes that technical decisions may be made based on incomplete but sufficient information, as well as the experience of the decision-makers. Uncertainties are addressed by developing conceptual site models (CSMs) that are verified by sampling, analysis, data evaluation, and onsite observations. The closure may proceed simultaneously with implementation of the corrective action as sufficient data are gathered to confirm or disprove the assumptions made in selecting the closure alternative. If, at any time during implementation of the corrective action, new information is developed that indicates the closure strategy should be revised, the decision-makers will be notified and the closure activities modified, as agreed upon, to more effectively protect human health and the environment.

The SAFER process combines elements of the DQO process and the observational approach to help plan and conduct corrective actions. The DQOs were used to define the type and quality of data needed to complete the investigation, manage uncertainty, and support decision-making. The purpose of the investigation phase in the SAFER process is to document and verify the adequacy of existing information, and collect sufficient information and data to support and implement the proposed closure strategy.

1.2 Summary of Proposed Corrective Actions

Closure of CAU 408 will be accomplished by conducting MEC response actions consisting of identification and removal of MEC associated with DOE activities. For purposes of this SAFER, it is assumed that all submunitions on the seven target areas are associated with DOE activities. This MEC response action will achieve clean closure meeting CAU 408 MEC criteria within the identified target areas of CAU 408. The CAU 408 MEC criteria are submunitions at the seven target areas and MEC within the disposal pits. The terms MEC and UXO are used interchangeably throughout this document and include military munitions that may pose a unique safety risk. These include discarded and abandoned munitions and munitions debris. All subsequent references to MEC, UXO, munitions, and submunitions in this document refer only to those associated with DOE activities.

As MEC guidance (DoD, 2008; EPA, 2005) and general MEC standards acknowledge that MEC response actions cannot determine with 100 percent certainty that all MEC/UXO are removed, the clean closure alternative will implement a best management practice (BMP) of posting UXO-hazard warning signs near the seven target areas. These signs will inform land users of the potential for encountering residual UXO hazards.

No contaminants of concern (COCs) are expected to be present in the soil. Contaminants of concern are defined as contaminants that exceed the final action levels (FALs). Explosives, metals, and depleted uranium (DU) have been identified as COPCs, and verification soil samples will be collected to verify whether they are present above FALs (i.e., COCs). If COCs are present, all soil containing COCs will be excavated and transported to an appropriate disposal facility.

The removal of DU fragments located on South Antelope Lake was originally identified as part of the clean closure activities for CAU 408; however, the removal of DU fragments was completed concurrently with CAU 484 closure activities. Depleted uranium removal is documented in the CAU 484 Closure Report (CR) (NNSA/NSO, 2007). Should DU be encountered during closure activities, it will be removed at that time.

1.3 SAFER Plan Contents

This SAFER Plan has been developed to support the closure of CAU 408 and includes the following:

- Section 1.0: Introduction
- Section 2.0: Unit Description
- Section 3.0: Data Quality Objectives
- Section 4.0: Field Activities and Closure Objectives
- Section 5.0: Reports and Records Availability
- Section 6.0: Investigation/Remediation Waste Management
- Section 7.0: Quality Assurance (QA)/Quality Control (QC)
- Section 8.0: References
- Appendix A: Project Organization
- Appendix B: Nevada Division of Environmental Protection Comments

This SAFER Plan was developed using guidance provided by the following documents:

- *Federal Facility Agreement and Consent Order* (1996, as amended March 2010)
- *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002)

2.0 Unit Description

Corrective Action Unit 408, Bomblet Target Area (TTR), is located on the TTR and includes seven targets where submunitions testing was conducted from the late 1960s to 1988 (BN, 2004). A testing and development program for improved submunition dispersion coverage and cluster bomb unit (CBU) accuracy was conducted to map bomblet dispersion patterns, provide input for engineering design, and document the accuracy of laser-guided CBU pods. Submunitions consist of various types of small spherical and cylindrical ordnance that range in size from 2 to 4 inches (in.). A submunition bomblet is defined as an intact ordnance item that was dispensed from a CBU. Dispersion testing included aerial drops of CBUs containing bomblets. After release from the aircraft, the CBUs would open and disperse the bomblets over the target areas. The bomblets used were mainly inert; however, several live tests (containing high explosives) were also conducted (Karas et al., 1993).

Corrective Action Unit 408 was originally identified as an approximately 19-mi^2 area extending from Mid Target to the middle of Antelope Lake (DOE/NV, 1994 and 1996b; SNL, 1992; Swaton, 1994). Records research of USAF Armament Laboratory Reports at Sandia Albuquerque, Eglin Air Force Base, and Maxwell Air Force Base; interviews with personnel; site visits; and geophysical surveys have redefined the investigation area to the following seven discrete target areas (Cabble, 2007) where bomblet testing occurred:

- Mid Target
- Flightline Bomblet Location
- Strategic Air Command (SAC) Target Location 1
- SAC Target Location 2
- South Antelope Lake
- South Flightline Tomahawk Location 1
- South Flightline Tomahawk Location 2

The lateral dispersion of bomblets around the target areas is expected to be minimal and mainly concentrated along the flightline axis. The aircraft dropping the submunitions ordnance on targets were directed by aircraft controllers on the ground who carefully positioned the aircraft such that the cameras and telemetry used to record the tests were safe from damage and in the correct position to record the data (BN, 2004). However, to account for possible inaccuracies in hitting the intended targets and to be conservative in estimating the lateral extent of bomblets, the CAU 408 SAFER investigation will include a 2,300-foot (ft) buffer zone. The 2,300-ft buffer distance was calculated as twice the distance of the farthest known bomblet drop location from the center of the target. The farthest documented bomblet drop from the center of a target was calculated to be approximately 1,150 ft at Mid Target based upon USAF Armament Laboratory Reports. The 2,300-ft buffer zone is defined as a width of 2,300 ft on either side of the flightline and a length of 2,300 ft north of the predefined Mid Target boundary extending to 2,300 ft south of the South Antelope Lake target area boundary. Because the Tomahawk targets and the Antelope Lake target are located off the axis of the flightline, a 2,300-ft buffer zone surrounding each Tomahawk target area and the entire extent of South Antelope Lake will also be applied. Therefore, for the purposes of this SAFER Plan, the CAU 408 boundary has been defined to include the specific target areas, including the 2,300-ft buffer zones. Figure 2-1 shows the bomblet target areas to be investigated and the expanded CAU 408 boundary.

2.1 Site Locations and Descriptions

2.1.1 Mid Target

Mid Target consisted of a 1,000-by-1,500-ft CBU grid and was the primary location of bomblet testing at TTR. Based upon visual inspections, personnel interviews, and research of USAF documents (Cabble, 2007), the boundary for Mid Target encompassed an area of approximately 320 acres. The GPS coordinates, reported in Universal Transverse Mercator (UTM) North American Datum (NAD) 1927 Zone 11 north meters, for the four corners of the Mid Target site are as follows:

Northwest Corner

- UTM Easting 524723
- UTM Northing 4182760

Northeast Corner

- UTM Easting 525466
- UTM Northing 4182920

Southwest Corner

- UTM Easting 525070
- UTM Northing 4181135

Southeast Corner

- UTM Easting 525841
- UTM Northing 4181318

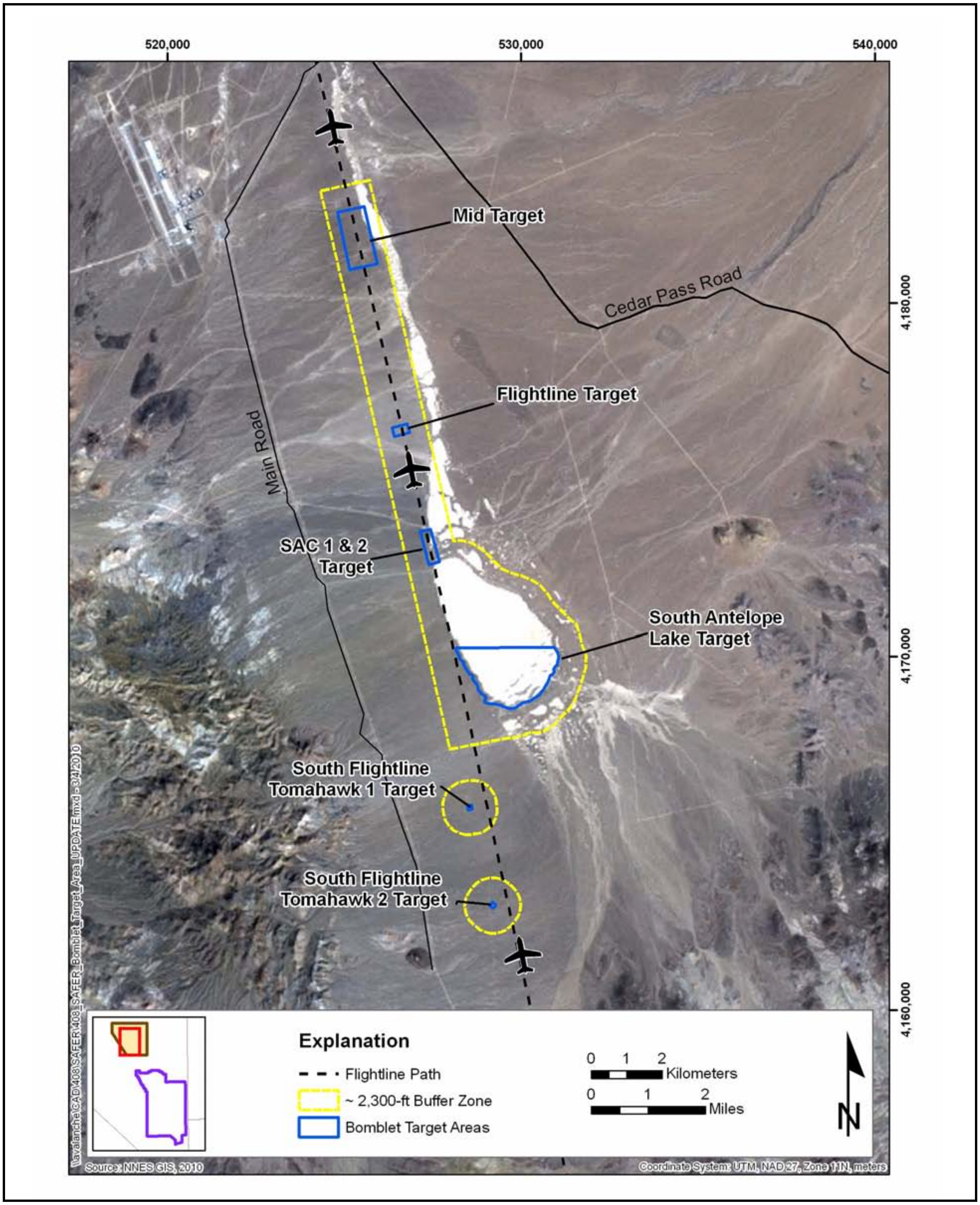

Figure 2-1
CAU 408, CAS TA-55-002-TAB2, Bomblet Target Areas

Known submunitions used at Mid Target include Bomb Live Unit (BLU)-61, BLU-63, BLU-97, and MK-118. One live test is known to have been conducted at Mid Target involving a submunition containing fuel-air explosive device (BLU-72) (Karas et al., 1993). A previous investigation included excavation and removal of a disposal pit located west of Mid Target (CAU 400) in 1995 (DOE/NV, 1996a). See Figure 2-1 for location and area for Mid Target.

2.1.2 Flightline Bomblet Location

The Flightline Bomblet Location is located on the flightline between NEDS Lake and Pedro Lake, and contains BLU-63 bomblets. Some previous cleanup is evident from field observations (i.e., piles of bomblets). This target was identified during a UXO evaluation of the flightline. Field evaluation suggests a single drop of two CBUs at this location.

Based upon visual inspections, personnel interviews, and research of USAF documents (Cabble, 2007), the boundary for the Flightline Bomblet Target location encompassed an area of approximately 28 acres. The area of the Flightline Bomblet Target location was expanded as defined in Revision 0 of the CAU 408 SAFER Plan beyond the observed piles of bomblets due to uncertainties in the actual target location (NNSA/NSO, 2006b). The GPS coordinates (UTM NAD 1927 N meters) for the four corners of the Flightline Bomblet Target site are as follows:

Northwest Corner

- UTM Easting 526269
- UTM Northing 4176667

Northeast Corner

- UTM Easting 526691
- UTM Northing 4176774

Southwest Corner

- UTM Easting 526327
- UTM Northing 4176420

Southeast Corner

- UTM Easting 526756
- UTM Northing 4176532

See Figure 2-1 for location and area for the Flightline Bomblet.

2.1.3 SAC Targets 1 and 2

The SAC Targets are two of several locations at TTR where cruise-missile-dispensed bomblets were tested. The SAC Target 1 consists of an area of disturbed ground as well as a subsurface geophysical anomaly, possibly indicating an area of buried debris. The SAC Target 2 contains an unknown prototype bomblet or dispensing mechanism on the ground surface.

Based upon visual inspections, personnel interviews, and research of USAF documents (Cabble, 2007), the boundary for the SAC Target locations encompassed an area of approximately 72 acres. The GPS coordinates (UTM NAD 1927 N meters) for the four corners of the SAC sites are as follows:

Northwest Corner

- UTM Easting 527054
- UTM Northing 4173733

Northeast Corner

- UTM Easting 527351
- UTM Northing 4173784

Southwest Corner

- UTM Easting 527306
- UTM Northing 4172785

Southeast Corner

- UTM Easting 527595
- UTM Northing 4172871

Historical documentation regarding the submunitions used at these target areas is limited; it is assumed that the bomblets at these two locations are similar in properties to bomblets at the other target areas. See Figure 2-1 for locations and areas for SAC Target 1 and SAC Target 2.

2.1.4 South Antelope Lake

South Antelope Lake was the identified location of numerous tests involving BLU-26, BLU-49, BLU-63, BLU-97, MK-118, and prototype munitions/submunitions (Cabble, 2007). At least one of the tests involved full-scale live bomblet tests on test vehicles (Karas et al., 1993). A prototype munition containing DU bomblets was also tested on South Antelope Lake; however, the exact location of the test is unknown. Bomblets referred to as Bomblet Dummy Unit (BDU) 63s and bomblets resembling the BLU-59 were dropped over Mid Lake and the southern portion of Antelope Lake (BN, 2004). Remediation of DU and DU-impacted soil was documented in the CAU 484 CR (NNSA/NSO, 2007). Buried ordnance debris may also be present on or around the lake as indicated by the geophysical data presented in Section 2.3. See Figure 2-1 for location and area for South Antelope Lake.

Based upon visual inspections, personnel interviews, and research of USAF documents (Cabble, 2007), the boundary for the South Antelope Lake target location encompasses an area of approximately 877 acres. The GPS coordinates (UTM NAD 1927 N meters) for defining the original borders of the South Antelope Lake target starting from the northwest corner and moving clockwise are as follows:

Northwest Corner

- UTM Easting 528146
- UTM Northing 4170385

Location 2

- UTM Easting 529517
- UTM Northing 4170442

Location 3

- UTM Easting 530983
- UTM Northing 417039

Location 4

- UTM Easting 530807
- UTM Northing 4169647

Location 5

- UTM Easting 530261
- UTM Northing 4168966

Location 6

- UTM Easting 529167
- UTM Northing 4168876

Location 7

- UTM Easting 528618
- UTM Northing 4169577

2.1.5 South Flightline Tomahawk Targets 1 and 2

The South Flightline Tomahawk target areas consist of two locations where submunitions were deployed from Tomahawk cruise missiles from 1983 to 1985. Aerial photos show evidence of disturbed ground surface, indicating the possible target locations. As little is known about the submunitions used at these target areas, it is assumed that the bomblets at these two locations are similar in properties to bomblets at the other target areas.

Based upon visual inspections, personnel interviews, and research of USAF documents (Cabble, 2007), the initial boundaries for the South Flightline Tomahawk locations encompassed an area of approximately 8 acres. Each target location is approximately 4 acres in size. The GPS coordinates (UTM NAD 1927 N meters) for the four corners of the South Flightline Tomahawk 1 target are as follows:

Northwest Corner

- UTM Easting 528401
- UTM Northing 4165977

Northeast Corner

- UTM Easting 528422
- UTM Northing 4165854

Southwest Corner

- UTM Easting 528519
- UTM Northing 4165997

Southeast Corner

- UTM Easting 528534
- UTM Northing 4165880

The GPS coordinates (UTM NAD 1927 N meters) for the four corners of the South Flightline Tomahawk 2 target are as follows:

Northwest Corner

- UTM Easting 529106
- UTM Northing 4163233

Northeast Corner

- UTM Easting 529025
- UTM Northing 4163141

Southwest Corner

- UTM Easting 529117
- UTM Northing 4163069

Southeast Corner

- UTM Easting 529203
- UTM Northing 4163161

See Figure 2-1 for locations and areas for the two South Flightline Tomahawk targets.

2.2 History and Process Knowledge

Historical information and process knowledge were used to define the following key points:

- Seven target locations have been identified, and locations are known (Cabble, 2007).
- The types of munitions from DOE-related testing are known (i.e., bomblets) (Karas et al., 1993; Swaton, 1994).
- The depth of the submunitions (bomblets) in the target areas is limited to 1 ft below grade (Cabble, 2007).
- Burial pits containing munitions debris from the target areas may be located in the target areas (Karas et al., 1993; Swaton, 1994).

Bomblets were tested during the Vietnam era for submunition dispersion coverage and CBU accuracy. When testing at Eglin Air Force Base was impaired by schedule conflicts, the TTR was promoted as an alternate testing facility because of its unique optical and radar capabilities. Testing began at Mid Target, where a 1,000-by-1,500-ft CBU grid was constructed (Swaton, 1994).

2.3 Characterization Data

Previous characterization data for CAU 408 are limited. Limited geophysical surveys using EM-61 and Material Technical Assistance Data System (MTADS) technology have been conducted at Mid Target, SAC Target, and Antelope Lake to provide preliminary data on the bomblet target areas (NNSA/NSO, 2006b). The data were processed for all three targets and provide useful information for planning and selecting the MEC detection technology for conducting the corrective action. Surveys on ten-meter (m) transects were conducted on portions of Mid Target and SAC Target as well as the southwestern boundary of Antelope Lake to provide a 10 percent coverage of each of the target areas. A more comprehensive survey with 100 percent coverage was conducted of the Antelope Lake dry lake bed. The geophysical data for Mid Target and SAC target were extrapolated to provide preliminary data such as the projected density of surface anomalies per acre. No subsurface anomalies were identified at Mid Target, while one subsurface anomaly was identified at SAC Target 1. The geophysical data for Antelope Lake indicate several subsurface anomalies exist that may be potential disposal pits. Initial geophysical results also indicate a high density of surface anomalies in specific areas of the lake bed (Zapata, 2007).

No previous soil samples have been collected at the CAU 408 bomblet target areas. However, previous investigations of disposal pits at CAUs 400 and 410 located within or adjacent to some target areas included sample collection and analysis for a variety of contaminants from historical UXO landfills and disposal pits, most specifically explosives and metals (DOE/NV, 1996a; NNSA/NSO, 2003). At CAU 400, following UXO removal and demolition, a total of 23 environmental soil samples were collected from the Bomblet Pit excavations and UXO processing areas at CAS TA-55-001-TAB2 and nine environmental samples from the bottom of the Five Points Landfill (CAS TA-19-001-05PT). The samples were analyzed for Toxicity Characteristic Leaching Procedure (TCLP) metals, TCLP semivolatile organic compounds (SVOCs), nitroamines/nitroaromatics (for explosives), and radionuclides (DOE/NV, 1996a). All analytical results were below action levels.

The CAU 400 Five Points Landfill excavation was approximately 375 by 80 by 10 ft deep, and resulted in the disposition of 200 spent rocket motors, five 105-millimeter (mm) inter projectiles, five inert MK-82 500-pound (lb) bombs, four half-round corrugated metal and steel structures, four rocket motor ignitors, six bomblets, and miscellaneous rocket motor parts. The remaining bomblet disposal pits in CAU 400 resulted in the removal of 22,228 bomblets; bomblet dispenser clamshell sections; one guidance section; two spent rocket motors; four unfuzed, inert MK-84 2,000-lb bombs; two unfuzed, inert MK-82 500-lb bombs; and other assorted debris (DOE/NV, 1996a).

Corrective Action Unit 410 comprises five CASs: TA-21-003-TANL, 09-21-001-TA09, TA-19-002-TAB2, TA-21-002-TAAL, and 03-19-001. Four disposal trenches/sites were investigated, sampled, and analyzed for volatile organic compounds (VOCs), SVOCs, metals, explosives, total petroleum hydrocarbons (TPH) (gas and diesel), and radionuclides. Two of the CASs had no UXO present (CASs TA-21-003-TANL and 09-21-001-TA09), and results of the six samples collected at these two CASs showed either no detections or detections below preliminary action levels (PALs) (NNSA/NSO, 2003). Analytical results for soil samples collected at CAS 03-19-001 indicated the only COC present in the soil at the site was TPH-DRO. The TPH-contaminated soil and burned debris were removed from the disposal site.

At the remaining two CASs in CAU 410 located at Bunker 2 and South Antelope Lake (TA-19-002-TAB2 and TA-21-002-TAAL) UXO was identified and removed from the excavated trenches. All verification sample results were below PALs with the exception of DU (NNSA/NSO, 2003). Upon completion of removal of DU, all verification sample results were below closure standards. The CAU 410 disposal trench excavation resulted in the removal and disposition of more than 1,000 pieces of ordnance, including Beehives, 155- and 105-mm rounds, fuses, BLU 63s, Mark-84 (2,000-lb) and Mark-82 (500-lb) bombs, dispensers, and a 2,000-lb sea mine. The Antelope Lake disposal trench at CAU 410 was approximately 100 by 75 by 14.5 ft deep.

Excavation of DU and DU-impacted soil was also completed under the CAU 484 investigation; therefore, the presence of DU-impacted surface soil at CAU 408 is not expected, although DU is expected to be present within the disposal pits. Documentation of the closure activities regarding DU-impacted soil and DU fragments are detailed in the CAU 484 CR (NNSA/NSO, 2007). At CAU 484, five CASs were clean closed: TA-52-001-TANL, CAS TA-52-004-TAAL, CAS TA-52-005-TAAL, CAS TA-52-006-TAPL, and CAS TA-54-001-TANL. Corrective Action Site RG-52-007-TAML (Davis Gun Penetrator Test) was closed in place and use restricted at four locations on Antelope Lake.

3.0 Data Quality Objectives

The DQO process is a seven-step systematic planning method used to plan data collection and field investigation activities and provide the framework for corrective action decisions for CAU 408, Bomblet Target Area (TTR). The seven steps of the DQO process presented in this report were developed according to the U.S. Environmental Protection Agency (EPA) *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). The DQOs are designed to ensure that data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommended corrective actions. Outputs from the DQO process will define: the objective of the data collection effort, the target population and CSM, the most appropriate type of data to collect, the closure standards, and the hold points where investigation findings will be reviewed with NDEP to obtain a consensus for a path forward.

During DQO discussions for CAU 408, data needed to resolve decision statements were identified, criteria for data collection and analysis were defined and agreed upon, and the appropriate QA/QC required for data collection activities were assigned. The individual QC measurements for the submunition removal activities and the analytical methods, reporting limits, and data quality indicators (DQIs) for laboratory analysis (e.g., precision and accuracy requirements) prescribed through the DQO process are provided in more detail in Section 7.0.

3.1 Summary of DQO Analysis

3.1.1 State the Problem (Step 1)

Step 1 of the DQO process describes the problem to be studied and develops a CSM to gain a sufficient understanding of the problem. The CSM for CAU 408 is defined in Section 3.2.5.

The problem statement for CAU 408 is: “Corrective Action Unit 408 is being investigated and closed because potential and known explosive hazards due to the presence of MEC/UXO and potential soil contamination related to DOE submunitions testing exist at locations within CAU 408 target areas.”

The objective of the study is to gather sufficient information during the implementation phase to resolve the decision statements listed in Section 3.1.2. Additional information is required to verify existing information, confirm the existence and extent of explosives hazards and/or soil contamination, and affirm the closure decision.

3.1.1.1 Background Information

The following sections present information on the physical setting, operational history, sources of potential contamination, and COPCs.

Physical Setting and Operational History – The CAU 408 target areas were used from the late 1960s to 1988 for the testing and development of improved submunition dispersion coverage and CBU accuracy (BN, 2004). Bomblet dispersion patterns were mapped at the target areas to provide input for engineering design and to document the accuracy of laser-guided CBU pods. Submunitions used for the testing consisted of various types of small spherical and cylindrical ordnance that ranged in size from 2 to 4 in. Dispersion testing included aerial drops of CBUs containing bomblets. After release from the aircraft, the CBUs would open and disperse the bomblets over the target areas. The bomblets used were mainly inert; however, at least one live test (containing high explosives) was also conducted (Karas et al., 1993).

The CAU 408 target areas are located in Cactus Flat and are relatively flat with no well-developed arroyos or erosional channels. The South Antelope Lake target area is located on a dry lake bed. Cactus Flat is an intermontane basin, typical of the Basin and Range Physiographic Province, surrounded by the Cactus Range to the southwest, the northern portion of Kawich Range to the east, and the Monitor Range to the north (DOE/NV, 1994). The central portion of Cactus Flat is underlain by thick sequences of valley-fill and/or lake and shoreline deposits. The surface is covered by deep thick soils that can range from poorly graded to well graded. The valley-fill material consists of poorly sorted sand, gravel and clay; whereas, the shoreline deposits are mainly composed of coarse to medium grained sand that is moderately well sorted. Total thickness of the alluvial deposits is unknown but may exceed 700 ft (DOE/NV, 1994). A moderately thick soil layer on top of playa deposits underlies the Antelope Lake area. These deposits are rich in clay and may form large cracks during dry periods as they are subject to significant shrinking and swelling. The deposits are underlain by a thick sequence of valley-fill alluvium consisting of gravel and coarse sand (DOE/NV, 1994).

The depth to alluvial groundwater near Antelope Lake is approximately 66 ft below ground surface (bgs), and depth to alluvial groundwater below Mid Target is approximately 230 to 262 ft bgs (DOE/NV, 1994). The depth to groundwater beneath Cactus Flat ranges from 90 to 600 ft bgs. Groundwater flows northwest between Cactus Peak and Monitor Hills and then southwest into Stonewall Flat and Gold Flat and ultimately discharges into Death Valley (DOE/NV, 1994 and 1996c).

***Sources of Potential Contamination and COPCs* –** The bomblets, which may contain high explosives, are the source of potential explosives hazards as well as soil contamination to the native surface/subsurface soil. In addition, bomblets on the South Antelope Lake target area may contain DU. Soil contamination is not expected at CAU 408; however, this will be confirmed by collecting and analyzing soil samples. Based on process knowledge, the only COPCs are high explosives (all bomblet areas), metals (i.e., lead and mercury; all bomblet areas), and DU (South Antelope Lake bomblet area and disposal pits).

3.1.2 Identify the Goal of the Study (Step 2)

Step 2 of the DQO process identifies the decision statements.

The goal of the study is to verify completion of surface clearance of each target area and remediation of disposal pits associated with CAU 408. The DQOs require identification of disposal pits and delineation of all submunition target areas.

The selected corrective action for CAU 408 is to clean close areas of submunition testing and disposal. This corrective action will be achieved by performing submunition removal activities and excavation of soil with COCs. Individual QC measurements for the submunitions removal and DQIs for laboratory analysis will be implemented to document that the procedures and acquired data can support the DQO for CAU 408. At the completion of CAU 408 closure activities, there will be a high degree of confidence that a comprehensive surface clearance of all areas of submunition target areas has been completed, and all disposal pits have been identified and remediated.

Decision statements for CAU 408 are:

1. Have all disposal pits been identified?
2. Have all hazardous materials in disposal pits been removed?
3. Have all areas impacted by submunitions (i.e., bomblets) been identified and delineated?
4. Have 100 percent of all areas impacted by submunitions been surface cleared of DOE-related submunitions?
5. Have all COCs (if present in soil) been removed?

3.1.2.1 Alternative Actions

If it is determined that any of the above decision statements are negative, additional investigation and/or excavation will be conducted. If MEC or contamination still exists and additional remediation would violate the conditions of the SAFER, then work will stop and a consensus will be reached with NDEP on the path forward before continuing the affected SAFER activities.

3.1.3 Identify Information Inputs (Step 3)

Step 3 of the DQO process identifies the information needed, determines sources of information, and identifies sampling and analysis methods that will allow reliable comparisons with FALs. Table 3-1 provides a summary of the information needs and information sources for each of the CAU 408 decision statements.

3.1.3.1 Information Needs

To confirm the CSM and determine the nature and extent of MEC and contamination, data must be collected to provide the following:

- Information demonstrating that all disposal pits have been identified and remediated.
- Information demonstrating that no contamination exceeding FALs remains.

Table 3-1
Data Quality Objective Decision Table

DQO Decision	Information Needs	Information Sources	Decision Unit	Target Population	Population Parameter	Action Level	Acceptance Criteria	False Negative	False Positive
Have all disposal pits been identified?	Evidence that no disposal pits remain	Geophysical surveys Mag and Dig[a]	CAS	Buried submunition debris	Observation of buried submunition debris in excavation or during surface clearance	Presence of buried submunition debris	Absence of buried submunition debris	All pre-defined potential disposal pit anomalies excavated Perform surface clearance on 100% of target areas Seeding, calibration, and excavation proofing (Section 7.1)	Verify that subsurface submunitions were placed for burial
Have all hazardous materials in the disposal pits been removed?	Evidence that no submunitions or contamination remains exceeding FALs	Observation Analytical verification samples	Each disposal pit	Hazardous debris and soil containing COCs	Observation of submunitions debris Analytical sample results	Presence of submunitions debris FALs	Absence of submunitions debris Analytical sample results less than FALs	Excavation will continue until native materials are encountered on each side and below the disposal pit	None
Have all areas impacted by DOE submunitions been identified and delineated?	Evidence that all areas impacted by submunitions and submunitions fragments are contained within study area	Mag and Dig[a] Observation	CAS	Areas impacted by submunitions	Geophysical instrument results Observation of submunitions debris	Presence of submunitions debris	Absence of submunitions debris observed in a radius of 200 ft from last observed submunitions debris and in the buffer zone Analytical sample results less than FALs	Seeding, calibration, and excavation proofing (Section 7.1) Perform surface clearance on 100% of target areas Verify that no submunitions debris are present within 200 ft of last observed submunitions debris or in the buffer zone	No submunitions debris in a radius of 200 ft from last observed submunitions debris will stop clearance of additional areas
Have all areas impacted by DOE submunitions been cleared?	Evidence that surface clearance has been performed on 100% of areas impacted by submunitions and submunitions fragments	GPS measurements	Each target area	Areas delineated to have been impacted by submunitions	Measurements of area	100% coverage of areas delineated to have been impacted by submunitions	Surface clearance has been completed on 100% of areas delineated to have been impacted by submunitions	Calibration of GPS Calculations of area	Calibration of GPS Calculations of area
Do any COCs remain?	Evidence that no contamination remains exceeding FALs	Analytical verification samples	Each target area and each disposal pit	Soil containing COCs	Analytical sample results	FALs	Analytical sample results less than FALs	Selection of sample locations MDCs less than FALs	Prevention of cross-contamination QA protocols

[a]See Section 3.1.3.2.

MDC = Minimum detectable concentration

- Information demonstrating that all areas impacted by MEC and submunitions fragments are contained within the study area.

- Information demonstrating that surface clearance has been performed on 100 percent of the areas impacted by submunitions and submunitions fragments.

3.1.3.2 Sources of Information

Information needed to answer the study questions will be generated by conducting a field investigation and implementing corrective actions as required by DQO decision criteria. These activities will include:

- Excavating locations indicated by geophysical measurements to identify disposal pits and remove submunitions.

- Conducting a surface clearance of submunitions using appropriate detection and removal technologies (e.g., magnetometers).

- Collecting analytical samples based on the presence of disposal pits or indications of soil contamination (e.g., elevated radiological field-screening results or soil discoloration).

Existing digital geophysical mapping, multispectral photographs, and surface radiological survey data have been analyzed to identify a list of geophysical anomalies that have the potential to represent disposal pits at the South Antelope Lake target area and SAC Target 1. The basis for the selection of these geophysical anomalies as potential disposal pit locations is presented in Section 3.1.7. The presence of a disposal pit in any target area (including the South Antelope Lake target area) will be determined during the surface clearance of all target areas. This will be determined using the surface clearance instruments to locate geophysical anomalies representing potential disposal pits, and excavating these anomalies to determine whether a disposal pit is present. Although the surface clearance geophysical instruments (Schonstedt magnetometers or equivalent) are being used for their ability to find a single bomblet at a depth of 1 ft, they are also capable of detecting a larger mass of metallic debris (such as a disposal pit) down to the expected depths of the disposal pits. Single ferrous objects or large concentrations of ferrous debris (such as a disposal pit) can be identified at deeper depths depending upon the material and burial orientation of the items. Based upon the instrument’s instruction manual (Schonstedt, 2003), the Schonstedt is capable of detecting an 18-in. length of 3/4 -in. pipe at depths up to 9 ft bgs. The instrument may also detect a 55-gallon drum at depths up to 10 ft bgs. Similar single items or concentrations of items exhibiting similar or more mass, like that in a disposal pit, would fall within the detection range of the Schonstedt.

Excavation or potholing of potential disposal pit locations will provide the information to decide whether the anomaly represents a disposal pit. Visual observations will determine whether the material excavated represents a location where debris has been buried.

"Mag and Dig" clearance surveys using handheld analog instrumentation (magnetometers) is the primary detection technology selected to detect, identify, and remove submunitions at CAU 408 submunition target areas and to detect bomblets up to 1 ft bgs. For conducting the surface clearance at all seven target areas identified within CAU 408, the target response depth is determined to be 1 ft bgs.

Mag and Dig surveys use grid systems and clearance lanes to provide and ensure full coverage of a survey area and to define lateral extent of the submunition test locations. Mag and Dig is a technology commonly used when MEC is not easily distinguishable from other metallic fragments and each anomaly must be investigated. When the instrument detects an anomaly, the operator will dig to identify the anomaly or place a small flag in the ground so the operator can return to dig and identify the anomaly. Advantages of analog geophysical surveys include:

- The ability of geophysical operator to use real-time field observations
- Determination of a precise anomaly location
- Anomalies that can be excavated immediately following and/or during the survey
- Operation with fewer vegetation and topographic constraints

Verification soil samples will be collected from biased locations. Samples will be collected from locations likely to be contaminated using appropriate sampling methods. The locations likely to be contaminated include areas with high concentrations of damaged or partially intact bomblets filled with high explosives, and areas where discrete pieces of DU are found. Soil samples collected from all bomblet areas will be analyzed for explosives and metals. In addition, soil samples collected from the South Antelope Lake area will be analyzed for isotopic uranium (U). Samples will be submitted to analytical laboratories meeting the quality criteria stipulated in the Industrial Sites QAPP (NNSA/NV, 2002). Validated data from analytical laboratories will be used to support DQO decisions. Sample collection and handling activities will follow standard procedures.

3.1.4 Define the Boundaries of the Study (Step 4)

Step 4 of the DQO process defines the target population and characteristics of interest, specifies the spatial boundaries and time constraints of that population pertinent for decision-making, determines practical constraints on data collection, and defines units on which decisions will be made.

3.1.4.1 Target Population

The populations of interest are buried submunition debris (i.e., disposal pits), areas impacted by submunitions, and soil containing any COC. Table 3-1 provides a summary of the target populations for each of the DQO decision statements.

3.1.4.2 Spatial Boundaries

The vertical boundary for surface clearances is a depth of 2 ft bgs, and for target area disposal pits the vertical spatial boundary is a depth of 20 ft bgs. The lateral spatial boundary has been established at 23,000 ft north of the northern edge of Mid Target, 23,000 ft south of the southern edge of the Southern Flightline Tomahawk 2 Target, and 23,000 ft on both sides of the flightline axis. If bomblets and/or contamination are identified outside these boundaries, the CSM will be reviewed with NDEP, and a determination will be agreed upon as to how to proceed.

3.1.4.3 Practical Constraints

Other constraints that may affect the ability to implement the SAFER include the following:

- Approval of this revision of the SAFER Plan
- Access restrictions at the TTR (e.g., military exercises, threatened and endangered species)

3.1.4.4 Define the Decision Units

The scale of decision-making for each of the DQO decision statements is provided in Table 3-1.

3.1.5 Develop the Analytical Approach (Step 5)

Step 5 of the DQO process defines the population parameters, develops the decision rules for drawing conclusions from findings, and specifies the action levels. Table 3-1 provides a summary of the population parameters and action levels for each of the DQO decision statements.

3.1.5.1 Population Parameters

The population parameter for the identification of disposal pits and areas impacted by submunitions is the observation of submunitions debris. The population parameter for determining whether all areas impacted by submunitions debris have been cleared of submunitions is the areal measurement of the cleared areas. The population parameter for COC contamination is each soil sample result that will be compared to the action levels.

3.1.5.2 Decision Rules

The decision rules are described in this section for each of the CAU 408 decision statements.

Decision Statement 1: Have all disposal pits been identified?

> If all of the potential disposal pit locations presented in Section 3.1.7 have been excavated and all of the potential disposal pit locations identified during the surface clearance operations have been verified, then it will be decided that all disposal pits have been identified. If this criterion has not been met, then additional excavations will be performed at the identified geophysical anomalies. Visual observations will determine whether the material excavated represents a location where debris has been buried.

Decision Statement 2: Have all hazardous materials in disposal pits been removed?

> If only native soil remains on the sides and bottom of a disposal pit excavation (i.e., no additional debris is observed) and verification sample results do not contain contamination at concentrations exceeding FALs, then it will be decided that all hazardous materials have been removed from the disposal pit. If this criterion has not been met, additional material will be excavated from the disposal pit.

Decision Statement 3: Have all areas impacted by submunitions (i.e., bomblets) been identified and delineated?

> If predefined target areas (including a 200-ft radius surrounding the last item observed or identified) and the visual inspection of buffer zones surrounding each target area are clear of submunitions debris, then it will be decided that the extent of the target area has been delineated. If this criterion has not been met, the boundary of the target area will be extended, and a surface clearance will be conducted over the extended area.

Decision Statement 4: Have 100 percent of all areas impacted by submunitions been surface cleared of DOE-related submunitions?

> If the areas covered by surface clearance traverses are adjacent and extend to the edges of the target area, then it will be decided that 100 percent of the target area has been surface cleared. If this criterion has not been met, additional surface clearance will be conducted.

Decision Statement 5: Have all COCs (if present in soil) been removed?

> If all analytical result concentrations from all verification samples are less than their corresponding FALs, then it will be decided that no COCs remain in the target area. If this criterion has not been met, soils containing COCs will be removed for disposal.

3.1.5.3 Action Level Determination and Basis

The action levels for each of the DQO decision statements are summarized in Table 3-1. Derivation of the action levels for soil contamination (i.e., PALs and the process for establishing FALs) is presented in Section 3.2.1.

3.1.6 Specify Performance or Acceptance Criteria (Step 6)

Step 6 of the DQO process specifies controls against false rejection and false acceptance decision errors and examines the consequences of making incorrect decisions. Setting acceptable limits on the likelihood of making decision errors requires the planning team to weigh the relative effects of threat to human health and the environment, expenditure of resources, and the consequences of an incorrect decision.

In general, confidence in DQO decisions will be established qualitatively by:

- Developing CSMs
- Testing the validity of the CSMs based on investigation results
- Evaluating the quality of the data based on performance criteria

3.1.6.1 False Negative Decision Error

This decision error would mean deciding that surface clearances are complete when they are not; all disposal pits have been remediated when they have not; or COCs are not present when they actually are. The potential consequence of a false negative decision error is an increased risk to human health and environment. The potential for a false negative decision error is reduced by meeting these criteria:

- Excavating at all potential disposal pit locations presented in Section 3.1.7 up to 10 ft bgs or the undisturbed native soil interface (if less than 10 ft bgs), and at all of the potential disposal pit locations identified during the surface clearance operations.

- Removing MEC and debris from disposal pits as verified by visual confirmation that native soil is present on all sides and the bottom of the excavation.

- Delineating target areas requiring surface clearance. The lateral boundaries of the areas impacted by submunitions will be defined by:

  - Conducting a visual inspection of all buffer zones to identify surface submunition debris.

  - Continuing the surface clearance beyond the target area boundary if necessary to establish a cleared area at least 200 ft beyond the last identified submunition. For example, if MEC were discovered during the visual evaluation of a target buffer zone, an area extending 200 ft surrounding the item would be surface cleared as described in Section 4.2.1.

- Completing the surface clearance of 100 percent of the areas impacted by submunitions, and investigating all potential submunition and potential disposal pit anomalies.

- Function-testing all handheld geophysical instruments at a geophysical system verification test strip daily (see Section 7.1.1) to ensure equipment is operating properly.

- Placing blind QC seeds (see Section 7.1.2) that consist of inert bomblets in each submunition test area to monitor anomaly detection performance during the submunition removal activities.

- Performing QA verification of submunition removal during surface clearance operations (see Section 7.1.3).
- Selecting soil sample locations from areas most likely to be contaminated (e.g., highest radiation survey readings, staining).
- Assessing the analytical and field survey results to ensure that all sample analyses and instrumentation have detection limits less than or equal to the corresponding action levels.
- Assessing the data against the DQIs of precision, accuracy, comparability, sensitivity, and completeness, and collecting the appropriate QC samples as defined in the Industrial Sites QAPP (NNSA/NV, 2002).

3.1.6.2 False Positive Decision Error

This decision error would mean deciding that surface clearances are not complete when they actually are; disposal pits are present when they are not; MEC and debris remain in disposal pits when they actually do not; or COCs are present when they actually are not present. The potential consequence of a false positive decision error is increased costs and project duration. A false positive decision error in determining whether a disposal pit is present will be controlled by ensuring that subsurface debris is associated with a pit that was excavated and used to place submunition waste, and that it is not present due to other mechanical disturbance (i.e., grading) or from surface cracking of the dry lake bed. False positive decision errors in Mag and Dig surveys are commonly encountered due to the inability of the magnetometer to differentiate between ferrous MEC and ferrous-containing debris or rocks. Each anomaly detected will be investigated to determine whether MEC-related, debris, or geologic origin. False positive decision errors in soil sampling are typically attributed to laboratory and/or sampling errors that could cause cross-contamination. To control against cross-contamination, decontamination of sampling equipment will be conducted according to established and approved procedures, and only clean sample containers will be used. In addition, QC samples such as field blanks, trip blanks, laboratory control samples (LCSs), and method blanks will be collected to minimize the risk of a false acceptance analytical result.

3.1.7 Develop the Plan for Obtaining Data (Step 7)

Results of the DQO analysis are used to develop the design of the sampling and analysis plan in Step 7 of the DQO process. The following summarizes the field activities to be conducted to meet the closure criteria.

All potential disposal pit locations identified in this section will be excavated to determine the presence or absence of buried submunitions waste (i.e., disposal pit). Each potential disposal pit location will be potholed at the center of the geophysical anomaly (i.e., the location of the highest probability of encountering waste) up to a depth of 10 ft bgs or to undisturbed native soil. If no waste is encountered within this depth, it will be determined that the potential disposal pit anomaly does not represent a disposal pit. If waste is encountered, the disposal pit will be remediated by removing the waste until all sides and the bottom of the excavation are composed of native soil. The potential disposal pit anomalies were identified based upon an analysis of the geophysical data collected by Zapata Engineering (Zapata, 2007). A total of 25 anomalies (24 on Antelope Lake and 1 at SAC Target 1) have been identified as potential disposal pits. Figure 3-1 shows the location of the 24 disposal pits on Antelope Lake.

A visual inspection will be conducted over the entire area defined by the CAU boundary as described in Section 1.0 to identify any submunition debris. This includes the areas defined as buffer zones around the target areas as defined in Section 2.0.

Surface clearance activities to identify MEC at the seven defined target areas encompassing the known submunition test area(s) will be conducted using Mag and Dig surveys. Each target area will receive a full coverage (100 percent) Mag and Dig surface clearance using handheld analog geophysical instruments (i.e., magnetometers). Geophysical anomalies detected by UXO Technicians will be evaluated to determine whether they represent submunitions or disposal pits. If identified as submunitions, they will either be blown in place (BIP), or removed and demilitarized as appropriate. If identified as potential disposal pits, they will be excavated to determine the presence of buried submunitions waste. If a disposal pit is identified, the pit materials will be inspected, removed, and disposed to meet clean closure. If MEC is identified, it will either be BIP or, if safe, removed and demilitarized as appropriate.

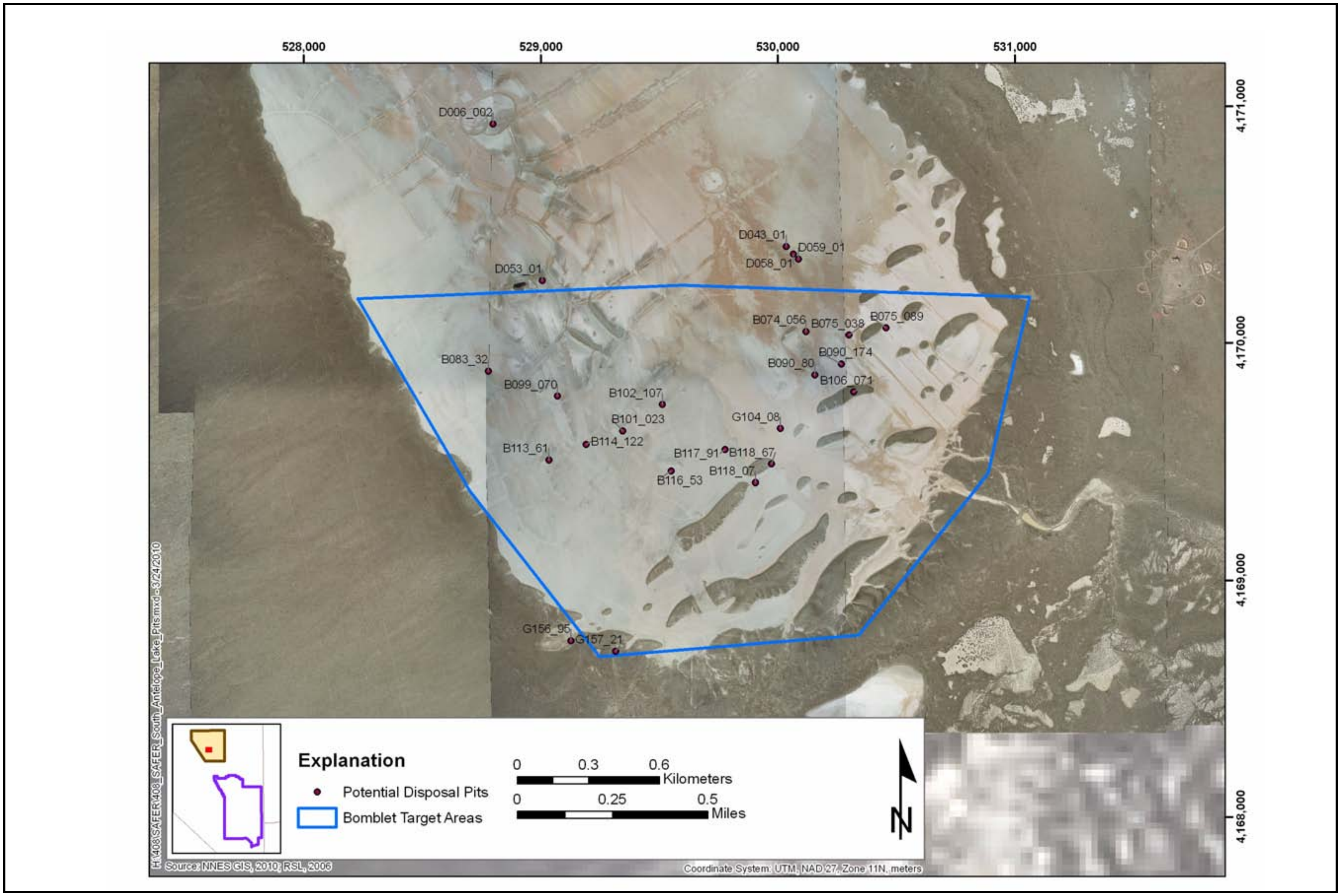

Figure 3-1
Geophysical Anomalies, South Antelope Lake, Tonopah Test Range

The lateral boundaries of each target area will be extended as necessary to ensure the boundaries of all areas impacted by submunitions are at least 200 ft beyond any identified submunition debris identified either by the surface clearance or the visual survey of the buffer zone.

After submunitions are removed or a disposal pit is remediated, soil verification samples will be collected as appropriate based on biasing factors, and analyzed for explosives, *Resource Conservation and Recovery Act* (RCRA) metals, and isotopic U (at South Antelope Lake). Biasing factors such as staining and radiation screening results will be used to determine the number and location of samples taken from disposal pits and surface areas. A minimum of three samples will be taken from each disposal pit. If contamination is found above action levels, the contaminated soil will be excavated and disposed.

3.2 Results of the DQO Analysis

3.2.1 Action Level Determination and Basis

The PALs presented in this section are to be used for site screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation, therefore streamlining the consideration of remedial alternatives. The risk-based corrective action (RBCA) process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006a). This process conforms with *Nevada Administrative Code* (NAC) Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2008a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2008b) requires the use of the American Society for Testing and Materials (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 (i.e., FALs) or to establish that corrective action is not necessary."

This RBCA process, summarized in Figure 3-2, defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- Tier 1 evaluation – sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the

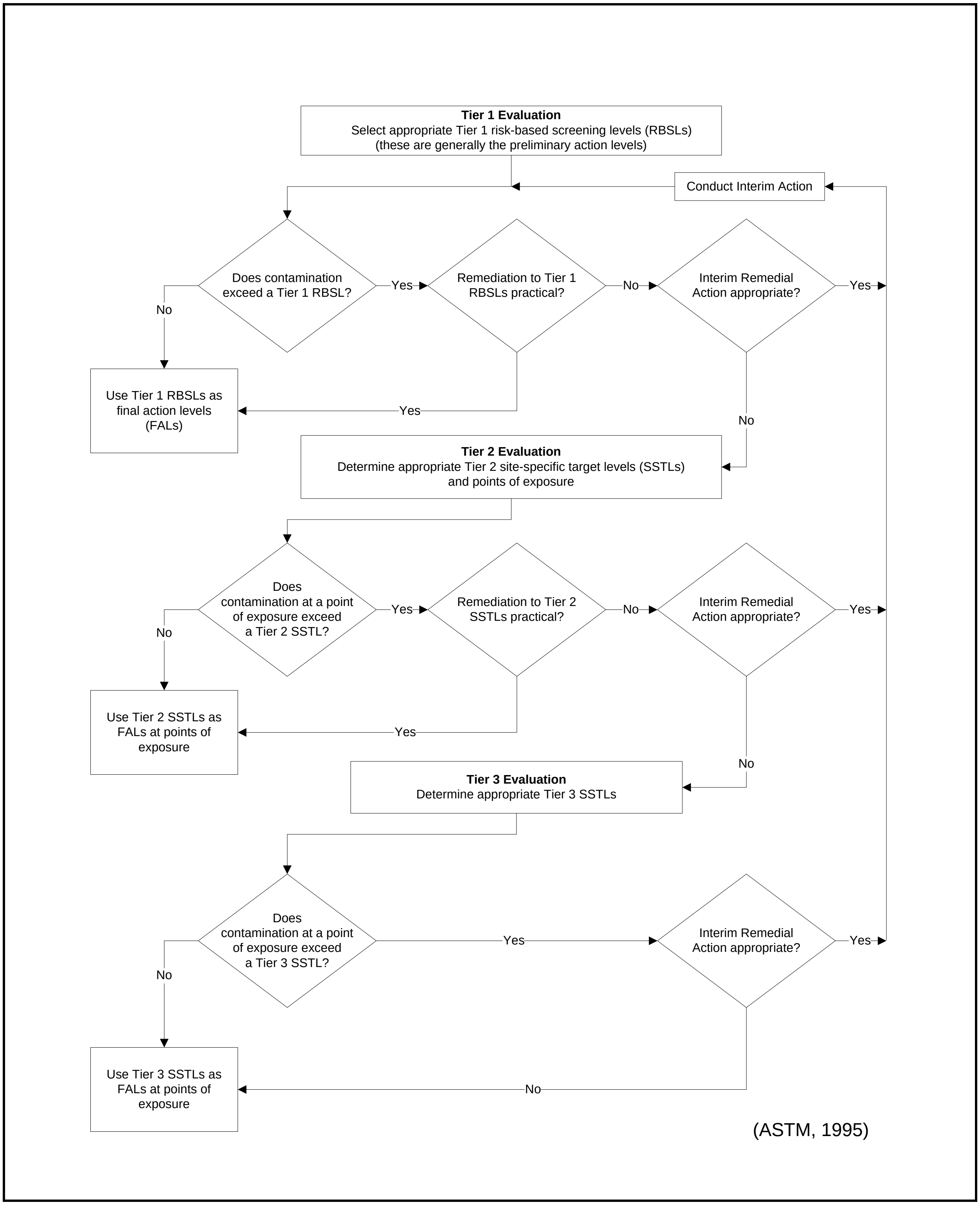

Figure 3-2
Risk-Based Corrective Action Decision Process

SAFER). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.

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

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

Evaluation of DQO decisions will be based on conditions at the site following completion of any corrective actions. Any corrective actions conducted will be reported in the CR. The FALs (along with the basis for their selection) will be defined in the CR, where they will be compared to laboratory results in the evaluation of site closure.

3.2.1.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the EPA Region 9 Risk-Based Preliminary Remediation Goals (PRGs) for chemical contaminants in industrial soils (EPA, 2008a). Background concentrations for RCRA metals will be used instead of PRGs when natural background concentrations exceed the PRG. Background is considered the mean plus two standard deviations of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established PRGs, the protocol used by the EPA Region 9 in establishing PRGs (or similar) will be used to establish PALs (EPA, 2008a). If used, this process will be documented in the CR.

3.2.1.2 Total Petroleum Hydrocarbon PALs

The PAL for TPH is 100 parts per million as listed in NAC 445A.2272 (NAC, 2008c).

3.2.1.3 Radionuclide PALs

The PALs for radiological contaminants (other than tritium) are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) using a 25-millirem-per-year dose constraint (Murphy, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). These PALs are based on the construction, commercial, and industrial land-use scenario provided in the guidance and are appropriate for the TTR based on future land uses.

3.2.2 Hypothesis Test

The baseline condition (i.e., null hypothesis) and alternative condition are:

- Baseline condition – closure objectives have not been met
- Alternative condition – closure objectives have been met

3.2.3 Statistical Model

A judgmental sampling design will be implemented to select sample locations and evaluate DQO decisions for CAS TA-55-002-TAB2.

3.2.4 Design Description/Option

Because individual sample results, rather than an average concentration, will be used to compare to FALs at the CAS, statistical methods to generate site characteristics will not be used. Adequate representativeness of the entire target population may not be a requirement to developing a sampling design. If good prior information is available on the target site of interest, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site does not contain unsafe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006).

All sample locations will be selected to satisfy the DQI of representativeness in that samples collected from selected locations will best represent the populations of interest. To meet this criterion for judgmentally sampled sites, a biased sampling strategy will be used for Decision I samples to target areas with the highest potential for contamination, if it is present anywhere in the CAS. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors. The Site Supervisor has the discretion to modify the judgmental sample locations, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

3.2.5 Conceptual Site Model and Drawing

The CSM is used to organize and communicate information about site characteristics. It reflects the best interpretation of available information and is based on historical documentation, personnel interviews, process knowledge, site visits, aerial photography, multispectral data, and preliminary geophysical surveys. The CSM describes the most probable scenario for current conditions at the site and defines the assumptions that are the basis for identifying appropriate data collection methods. Figure 3-3 graphically represents the CSM for CAU 408.

The primary CSM is considered the most probable scenario for current conditions at CAU 408. The CSM for CAU 408 assumes that submunition bomblets ranging in size from 2 to 4 in. that were dispensed from CBUs are present at the seven bomblet areas located on the TTR. Some previous cleanup of all submunition test areas is apparent but undocumented. An effective previous cleanup is assumed for the purposes of planning the surface clearance activities. While some miscellaneous debris (other than MEC) may be located and removed during CAU 408 field activities, it is not considered to be part of the closure scope. The primary CAU 408 closure scope is location and removal of MEC meeting CAU 408 MEC criteria within the identified targets.

The bomblets were designed to generate a minimal terminal velocity to impact surface targets and not to penetrate the ground surface. Therefore, they are assumed to be present on the ground surface to a maximum depth of 1 ft bgs. Submunitions were constructed of ferrous metals and will be detectable by geophysical methods (e.g., magnetometry).

Submunitions tests were conducted at Mid Target to assess ordnance and delivery package design. Therefore, submunitions at Mid Target are expected to be concentrated around the CBU grid with some longitudinal dispersion expected along the axis of aircraft travel. Lateral dispersion is expected

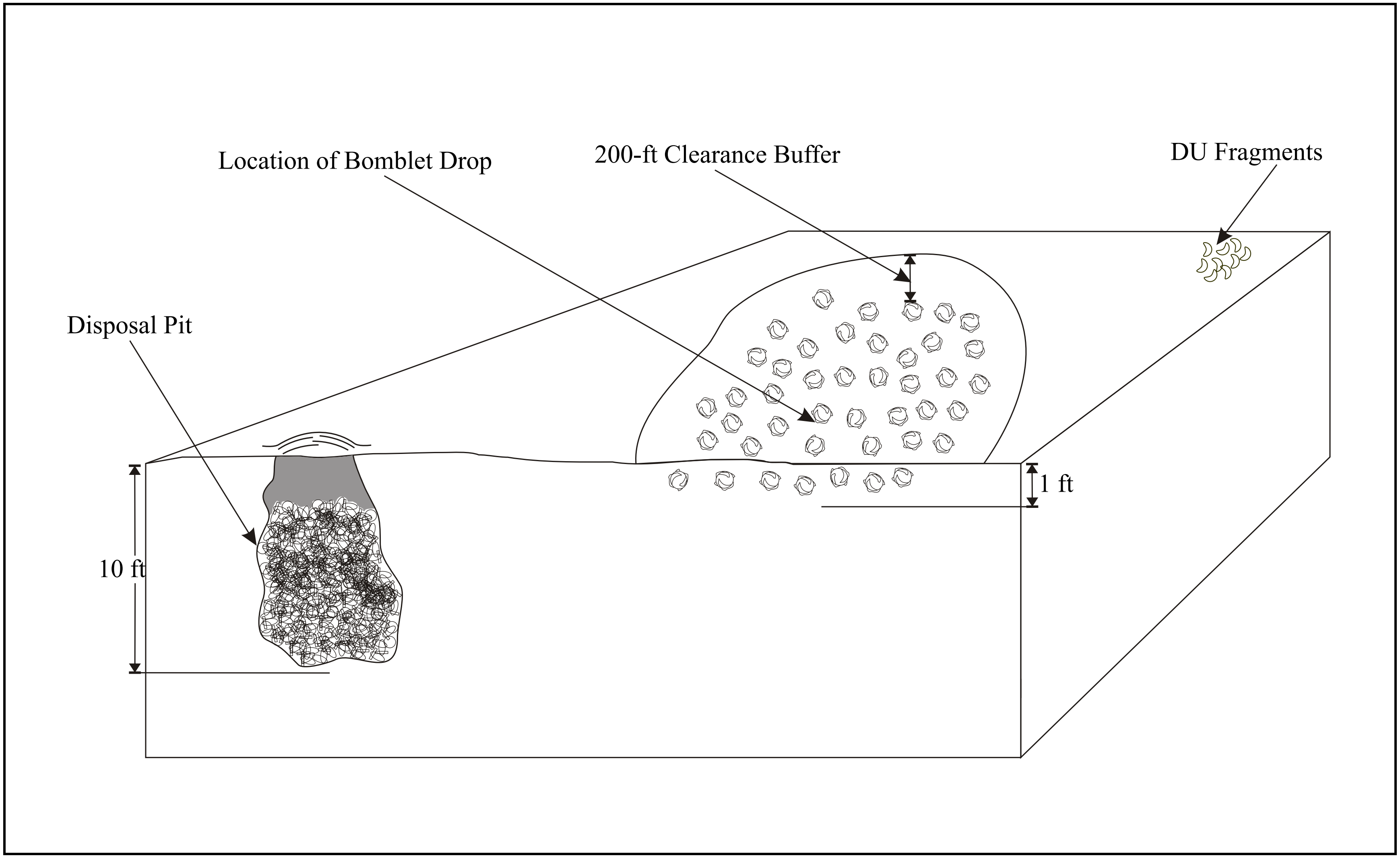

Figure 3-3
Conceptual Site Model Diagram for CAU 408
Source: Modified from NNSA/NSO, 2006b

to be minimal and concentrated along the flightline axis, resulting in a distribution along the flight path to be skewed in the long (late drop) direction, rather than symmetric about the target.

Submunitions tests were conducted at South Antelope Lake to assess material effects. The tests were restricted to the southern half of the lake so that concurrent tests on the northern half of the lake could continue unaffected. Therefore, submunitions are not expected to be located above the midline of the lake.

Due to the lack of specific information regarding submunitions testing at the remaining five target areas, the CSM for these areas is assumed to be the same as for Mid Target.

Historical site knowledge and interviews indicate that there is potential for submunitions and debris to be present in disposal pits located within any target location. Results from preliminary geophysical surveys using EM-61 detection technology at the South Antelope Lake target area support the existence of several subsurface anomalies with features resembling disposal pits. For the CAU 408 investigation, a disposal pit is defined as a man-made trench or pit in which MEC or munitions-related debris (e.g., target construction materials) are intentionally buried in the ground. Previous subsurface investigations at TTR (e.g., CAU 410 and 484) indicate that if a disposal pit exists, debris or MEC should be encountered within 10 ft bgs. In the case that buried debris is encountered within the anomalous area at an elevation shallower than 10 ft bgs, the area will be defined as a disposal pit.

The primary CSM assumes that upon detonation of the bomblets (high-order detonation), any hazardous constituents (i.e., high explosives) would be spent and would not impact the surrounding soil. In the case of low-order detonations (e.g., dud fires) or damaged intact bomblets, the potential for COPCs in soil increases. However, due to the limited live tests conducted at the CAU 408 targets, COPCs are not expected in soil above FALs. Physical hazards from unexploded bomblets are of concern. The majority of the tests used inert filler and no fuzing, or inert filler and live fuzing. Some tests involved live filler (high explosives) and live fuzing.

At the South Antelope Lake bomblet area, submunition tests containing DU are known to have been conducted; however, the specific test locations have not been documented. A radiological survey of the southern portion of the lake bed was conducted on South Antelope Lake to identify the presence of DU, and the site boundaries were delineated to define the lateral extent. Several areas containing DU rings and fragments were identified, excavated, and clean closed under CAU 484 (NNSA/NSO, 2007). Corrective Action Site RG-52-007-TAML (Davis Gun Penetrator Test) was closed in place and use restricted at four locations. These areas are outside the scope of CAU 408. If any DU remains in the South Antelope Lake target area, it is expected to be found in discrete surface areas with minimal soil impact or present within a disposal pit where the volume of DU-impacted soil is expected to be more extensive.

If additional elements that are outside the scope of the CSM are identified during remediation, the situation will be reviewed, and a recommendation will be made as to how to proceed. In such cases, NDEP will be notified and given the opportunity to comment on, or concur with, the recommendation. The CSM describes the most probable scenario for current conditions at the site and defines the assumptions that are the basis for identifying the future land use, contaminant sources, release mechanisms, migration pathways, exposure points, and exposure routes. The CSM is also used to support appropriate sampling strategies and data collection methods. The CSM has been developed for CAU 408 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs. Figure 3-4 depicts a tabular representation of the conceptual pathways to receptors from CAU 408 sources. If evidence of contamination not consistent with the CSM is identified during investigation activities, the situation will be reviewed, the CSM will be revised, the DQOs will be reassessed, and a recommendation will be made as to how best to proceed. In such cases, the DQO process participants will be notified and given the opportunity to comment on and/or concur with the recommendation.

The target areas were used to perform submunitions-related tests for the DOE. The scope of CAU 408 is limited to submunitions released from DOE activities. However, it is recognized that the presence of other types of UXO and munitions may be present within the target areas due to the activities of other government organizations.

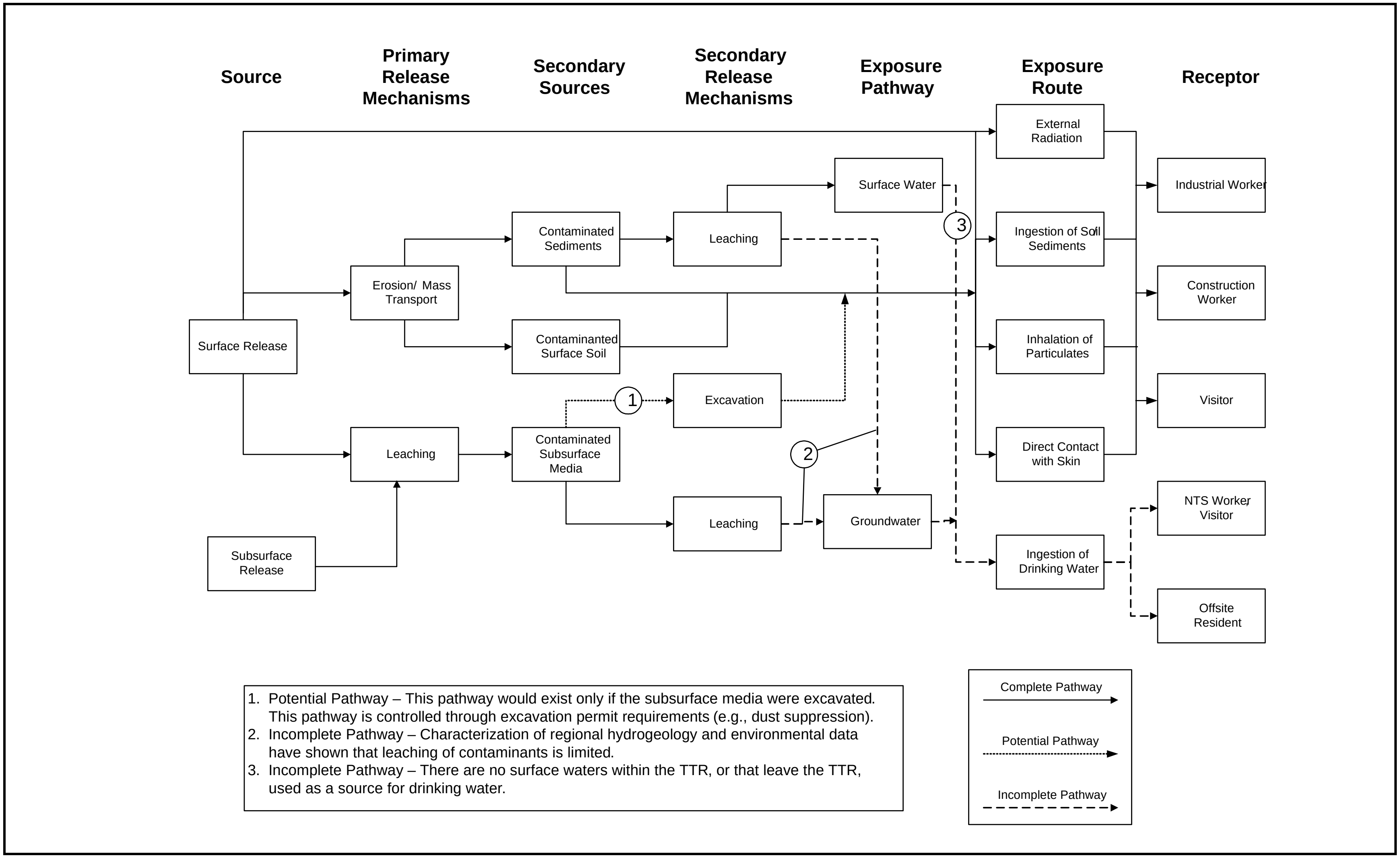

Figure 3-4
Potential Conceptual Site Model Diagram

4.0 Field Activities and Closure Objectives

This section of the SAFER Plan provides a description of the CAU 408 field activities and closure objectives. The objectives for the field activities are to complete an MEC surface clearance of each target area, remediate disposal pits associated with CAU 408, and verify that there are no COCs above action levels.

4.1 Contaminants of Potential Concern

The COPCs for CAU 408, based on site process knowledge and historical information, include explosives (all bomblet testing locations), RCRA metals (all bomblet testing locations), and DU (surface of South Antelope Lake and in disposal pits). No contaminants are expected to be present at concentrations above the action levels; however, this will be determined by verification sample results. Potentially affected media include the soil beneath or near bomblets or DU fragments.

4.2 Remediation

To achieve clean closure, an MEC response action consisting of surface clearance surveys and disposal pit excavations, to identify and remove submunitions will be implemented. Based on the currently available process knowledge, historical data and documentation, aerial photography (historical and recent), personnel interviews, and site visits, explosives hazards are known to exist due to potentially live and/or fuzed submunitions present within the seven target areas within CAU 408. No chemical or radiological COCs, except DU, are expected to be present at concentrations above the action levels at CAU 408; however, any COC identified will be clean closed by removing contaminated soil (including DU).

Radiological Field Screening – A handheld radiological survey instrument will be used to evaluate the sites for the presence of radiological contaminated debris and/or soil. A Radiological Control Technician will be on site during cleanup activities and will screen the debris before it is removed from the site to verify that levels of radiation do not exceed free-release criteria specified in Table 4-2 of the *Nevada Test Site* (NTS) *Radiological Control Manual* (NNSA/NSO, 2009a). In addition, if DU fragments or DU-impacted soils are located, the surrounding soil will be sampled to verify that the fragments were completely removed and that no residual radioactive contamination remains in the soil.

4.2.1 Surface Clearance

Submunitions and/or debris encountered within each target area boundary will be fully delineated, and the site boundary will be adjusted accordingly to include all submunitions found during the visual survey of the buffer zone and to maintain at least 200 ft from any submunitions found during the surface clearance.

A surface clearance will be performed using Mag and Dig surveys with handheld analog geophysical instruments on 100 percent of all target areas (approximately 1,900 acres) to detect and identify anomalies to a depth of approximately 1 ft bgs. Evaluations of each anomaly will be conducted by UXO Technicians to identify whether the anomaly is related to submunitions or a disposal pit. If a submunition is identified, the item will either be BIP or, if safe to move, removed for demilitarization at a designated area. If a disposal pit is identified, then the anomaly will be excavated as described in Section 4.2.2.

Schonstedt Ordnance Locators are handheld analog instruments that use vertical fluxgate gradiometer technology to identify and locate ferrous materials. Anomaly selection using analog systems such as a Schonstedt used in audio mode or by monitoring meter deflections provide the ability to discern relative size and relative signal strength. Because small MEC (submunitions) are a target objective and due to the instrument's inherent limitations in differentiating MEC from non-MEC anomaly sources based on anomaly characteristics, all detected anomalies to 1 ft bgs will be investigated.

Before the start of Mag and Dig clearance activities, a grid system will be established across each target area using a predetermined layout developed using a Geographic Information Systems (GIS) database. The grids will be set across each target area to ensure full coverage is obtained. The grid system provides a means of tracking progress, defining boundaries for the clearance areas, navigation for the UXO Team, and site survey control for data management and anomaly classification. During Mag and Dig operations, each UXO Team is assigned a grid for investigation and subsequent removal actions. The UXO Teams will identify and confirm they are in the specific preassigned grid and begin marking at regularly spaced intervals along the grid bounds to delineate the lanes to be cleared of MEC. Depending on site conditions, the lanes may be pin-flagged or roped. The lane spacing and grid size will be selected in the field based on site conditions, target size, and density of anomalies. Lane spacing adjustment will be determined on a case-by-case basis at each target area in the field. Locations of MEC items will be recorded using an electronic data entry program on a handheld personal digital assistant (PDA). Data entered into the PDA will be transferred to the project database daily or weekly for tracking and incorporation into the project GIS.

4.2.2 Disposal Pits

Disposal Pit Investigation and Remediation – The information necessary to satisfy the closure criteria for the disposal pit investigation will be generated by excavating all of the potential disposal pit locations identified in Section 3.1.7 to determine the presence or absence of buried submunitions waste (i.e., disposal pit). Each potential disposal pit location will be potholed at the center of the geophysical anomaly (i.e., the location of the highest probability of encountering waste) up to a depth of 10 ft bgs or the undisturbed native soil. If no waste is encountered within this depth, it will be determined that the potential disposal pit anomaly does not represent a disposal pit. If waste is encountered, the disposal pit will be remediated by removing the waste until all sides and the bottom of the excavation are composed of native soil.

Disposal pits that are identified will be excavated and remediated to meet clean closure. Debris present within a disposal pit (or excavation if not a disposal pit) will be evaluated by UXO Technicians to identify whether debris is MEC related. If MEC is identified, the item will either be BIP or, if safe to move, removed for demilitarization at a designated area.

4.2.3 Soil Investigations

Soil Sampling – The information necessary to satisfy the closure criteria for verification sampling will be generated for each target area by collecting and analyzing soil samples generated during the field investigation. Verification soil samples will be collected from soil beneath and/or adjacent to areas indicating the potential for explosives and/or DU contamination to determine whether a COC above action levels exists. If a COC is present, verification samples will be collected from the approximate bottom of the excavation and at lateral boundaries after soil removal is conducted.

If COCs are present, or it is decided that COCs may be present based on the presence of biasing factors, a corrective action of removal for disposal will be implemented and additional verification samples taken from biased locations within the excavation.

4.2.4 Hold/Decision Points

During closure activities, certain conditions affecting the project schedule and budget may require decisions before continuing work.

Work may be temporarily suspended until the issue can be satisfactorily resolved should any of the following unexpected conditions occur:

- Conditions outside the scope of work are encountered.
- Spatial boundaries as defined in Section 3.1.4.2 have been exceeded.

If either of these conditions occur, work will be suspended and NDEP will be notified. Work will continue upon resolution and NDEP approval.

4.3 Verification

The information necessary to satisfy the closure criteria for each of the DQO decision statements is presented below:

Decision Statement 1: Have all disposal pits been identified?

> All of the potential disposal pit locations identified in Section 3.1.7 and all of the potential disposal pit anomalies identified by surface clearance activities have been excavated to determine the presence or absence of buried submunitions waste (i.e., disposal pit).

Decision Statement 2: Have all hazardous materials in disposal pits been removed?

> Only native soil remains on the sides and bottom of a disposal pit excavation (i.e., no additional debris is observed), and verification sample results do not contain contamination at concentrations exceeding FALs.

Decision Statement 3: Have all areas impacted by submunitions (i.e., bomblets) been identified and delineated?

Submunitions debris is not identified in the buffer zone visual survey beyond the target area boundary, and no submunitions debris is identified during Mag and Dig operations within 200 ft of the target area boundary.

Decision Statement 4: Have 100 percent of all areas impacted by submunitions been surface cleared of DOE-related submunitions?

The areas covered by surface clearance traverses are adjacent and extend to the target area boundary.

Decision Statement 5: Have all COCs (if present in soil) been removed?

All analytical result concentrations from all verification samples are less than their corresponding FALs.

4.4 Closure

The following activities, at a minimum, have been identified for closure of this CAS:

- Clearing bomblet target areas within the study area.
- Identifying and remediating disposal pits.
- Collecting verification samples.
- Performing radiological screening of soil
- Removing soil containing contaminants at concentrations above the action levels.

After remediation and waste management activities are completed, the following actions will be implemented before site closure:

- Removing all equipment, wastes, debris, materials, signage and fencing associated with the CAI.

- Grading site to pre-investigation condition, as necessary (unless changed condition is necessary under a corrective action).

- Inspecting site and certifying that restoration activities have been completed.

- Posting UXO-hazard warning signs near the target areas as a BMP.

4.5 Duration

Table 4-2 provides a tentative duration of activities (in calendar days) for SAFER activities. The amount of days is contingent upon a variety of factors, including site conditions, subcontractor availability, depth of contamination, and extent of ordnance surveillance activities.

Table 4-2
Duration of Field Activities

Activity	Duration (Days)
Site Preparation	5
Disposal Pit Investigation	66
Submunition Surface Clearance Activities	154
Verification Sample Collection	30
Data Verification, Validation, And Assessment	42
Closure Report	52
Waste Management And Disposition	180

5.0 Reports and Records Availability

Reports generated during ongoing field activities will be provided to NDEP upon request. Historic information and documents referenced in this plan are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Federal Sub-Project Director. This document is provided to NDEP and available in the NNSA/NSO public reading rooms located in Las Vegas and Carson City, Nevada, or by contacting the appropriate NNSA/NSO Federal Sub-Project Director.

6.0 Investigation/Remediation Waste Management

Management of investigation-derived waste (IDW) will be based on regulatory requirements, field observations, process knowledge, and laboratory results from CAU 408 investigation samples.

Disposable sampling equipment, personal protective equipment (PPE), and rinsate are considered potentially contaminated waste only by virtue of contact with potentially contaminated media (e.g., soil) or potentially contaminated debris (e.g., construction materials). Therefore, sampling and analysis of IDW, separate from analyses of site investigation samples, may not be necessary for all IDW. However, if associated investigation samples are found to contain contaminants above regulatory levels, conservative estimates of total waste contaminant concentrations may be made based on the mass of the waste, the amount of contaminated media contained in the waste, and the maximum concentration of contamination found in the media. Direct samples of IDW may also be taken to support waste characterization.

Sanitary, hazardous, radioactive, and/or mixed waste, if generated, will be managed and disposed of according to applicable DOE orders, U.S. Department of Transportation (DOT) regulations, state and federal waste regulations, and agreements and permits between DOE and NDEP.

6.1 Waste Minimization

Investigation activities are planned to minimize IDW generation. This will be accomplished by incorporating the use of process knowledge, visual examination, and/or radiological survey and swipe results. When possible, disturbed media (e.g., soil removed during trenching) or debris will be returned to its original location. Contained media (e.g., soil managed as waste) as well as other IDW will be segregated to the greatest extent possible to minimize generation of hazardous, radioactive, or mixed waste. Hazardous material used at the sites will be controlled to limit unnecessary generation of hazardous or mixed waste. Administrative controls, including decontamination procedures and waste characterization strategies, will minimize waste generated during investigations.

6.2 Anticipated Waste Streams

Waste streams expected to be generated from CAU 408 investigation and onsite MEC treatment activities include:

- Personal protective equipment and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls).
- Decontamination rinsate.
- Environmental media (e.g., soil).
- Munitions debris, scrap metal, and other debris (e.g., construction materials).

The onsite management and ultimate disposition of wastes will be determined based on a determination of the waste type (e.g., sanitary, low-level, hazardous, hydrocarbon, mixed), or the combination of waste types. A determination of the waste type will be guided by several factors, including, but not limited to, the analytical results of samples either directly or indirectly associated with the waste, historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring/screening results, and/or radiological survey/swipe results.

6.2.1 Sanitary Waste

Sanitary IDW generated at each CAS will be collected, managed, and disposed of according to the sanitary waste management regulations and the permits for operation of the NTS U10c Industrial Waste Landfill (or TTR Industrial Landfill).

Sanitary IDW generated at each CAS will only be collected in plastic bags, sealed, labeled with the CAS number from each site in which it was generated, and dated. The waste will then be placed in an approved roll-off box location. The number of bags of sanitary IDW placed in the roll-off box will be counted as they are placed in the roll-off box, noted in a log, and documented in the Field Activity Daily Log. These logs will provide necessary tracking information for ultimate disposal in the NTS U10c Industrial Waste Landfill (or TTR Industrial Landfill).

6.2.2 Low-Level Radioactive Waste

Radiological swipe surveys and/or direct-scan surveys will be conducted on MEC, munitions debris, and scrap metal generated during MEC clearance surveys and disposal pit remediation. Reusable sampling equipment and the PPE and disposable sampling equipment waste streams exiting a radiological controlled area (RCA) may also have radiological swipe surveys and/or direct-scan surveys conducted. This allows for the immediate segregation of radioactive waste from waste that may be unrestricted regarding radiological release. Removable contamination limits, as defined in Table 4-2 of the NTS Radiological Control Manual (NNSA/NSO, 2009a), will be used to determine whether such waste may be declared unrestricted regarding radiological release versus being declared radioactive waste. Direct sampling of the waste may be conducted to aid in determining whether a particular waste unit (e.g., drum of soil) contains low-level radioactive waste, as necessary. Waste that is determined to be below the values of Table 4-2, by either direct radiological survey/swipe results or through process knowledge, will not be managed as potential radioactive waste but will be managed according to the appropriate section of this document. Wastes in excess of Table 4-2 values will be managed as potential radioactive waste and according to this section and any other applicable sections of this document.

Low-level radioactive waste, if generated, will be managed according to the contractor-specific waste certification program plan, DOE orders, and the requirements of the current version of the *Nevada Test Site Waste Acceptance Criteria* (NTSWAC) (NNSA/NSO, 2009b). Potential radioactive waste packages containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated radioactive material area (RMA) or RCA when full or at the end of an investigation phase. The waste packages will remain at the RMA pending certification and disposal under NTSWAC requirements (NNSA/NSO, 2009b).

6.2.3 Hazardous Waste

Corrective Action Unit 408 will have waste accumulation areas established according to the needs of the project. Satellite accumulation areas (SAAs) and hazardous waste accumulation areas (HWAAs) will be managed consistent with the requirements of federal and state regulations (CFR, 2009; NAC, 2008a). The generation and management of liquid hazardous waste is not anticipated; however, if it is generated, it shall be packaged in compliant, compatible containers, and managed in appropriate secondary containment. While not anticipated, hazardous wastes may be found and generated from the investigation and excavation of potential disposal pits. If found, hazardous wastes, other than UXO, may be managed near the disposal pit without packaging so long as the wastes are solid, nonleaking, and may be safely accumulated and managed without further impact to human health and the environment (e.g., covered and bermed), pending final packaging for disposal shipment as applicable. Unexploded ordnance will be moved and accumulated for as long as required to facilitate safe and efficient onsite treatment. Therefore, UXO may be accumulated in HWAAs as-is and without packaging, palletizing, or other handling.

The HWAAs will be covered under a site-specific emergency response and contingency action plan until the waste is determined to be nonhazardous or all containers of hazardous waste have been removed from the storage area. Hazardous waste will be characterized according to the requirement of Title 40 *Code of Federal Regulations* 261 (CFR, 2009). Any waste determined to be hazardous will be managed and transported according to RCRA and DOT requirements to a permitted treatment, storage, and disposal facility.

All RCRA-regulated treatment (e.g., demolition) of MEC/UXO shall be performed according to the conditions of an NDEP-approved RCRA Emergency Treatment Permit and the MEC Work Plan. All MEC/UXO identified during the CAU 408 field activities will either be treated (e.g., detonated) in the original position found (i.e., BIP), or deemed safe to move short distances, relocated, repositioned, and/or accumulated to facilitate efficient treatment. The UXO moved or otherwise handled during Mag and Dig surface clearance activities is not subject to management as RCRA-hazardous waste at the TTR. However, MEC/UXO identified during investigation of the subsurface anomalies in the South Antelope Lake and SAC targets, and moved or otherwise handled (i.e, not BIP), will be subject to management as RCRA-hazardous waste once moved from the original position found and will be managed according to applicable federal and state regulations and disposal facility acceptance criteria.

The MEC/UXO and/or other hazardous wastes generated shall be accumulated and managed in one or more SAAs or HWAAs. If MEC/UXO is removed from a disposal pit for future treatment, the MEC/UXO shall be managed in the SAA/HWAA until treatment. A RCRA Emergency Treatment Permit shall be obtained from NDEP, and the MEC/UXO will be treated per the MEC Work Plan and the RCRA Emergency Treatment Permit. If other (non-MEC) RCRA-hazardous wastes are found and accumulated, the SAA/HWAA shall remain in place until the accumulated wastes are shipped off site for treatment/disposal. All MEC/UXO rendered inert will be disposed at U10C Landfill at the NTS.

6.2.4 Hydrocarbon Waste

Hydrocarbon soil waste containing more than 100 milligrams per kilogram of TPH will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed of at a designated hydrocarbon landfill (NDEP, 1997a and b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method according to Nevada regulations.

6.2.5 Mixed Low-Level Waste

Mixed waste, if generated, shall be managed and dispositioned according to RCRA requirements (CFR, 2009), agreements between NNSA/NSO and the State of Nevada, and DOE requirements for radioactive waste. The waste will be marked with the words “Hazardous Waste Pending Analysis and Radioactive Waste Pending Analysis.” Waste characterized as mixed will not be stored for a period of time that exceeds the requirements of RCRA unless subject to agreements between NNSA/NSO and the State of Nevada. The mixed waste shall be transported via an approved hazardous waste/radioactive waste transporter to the NTS transuranic waste storage pad for storage pending treatment or disposal. Mixed waste with hazardous waste constituent concentrations below Land Disposal Restrictions may be disposed of at the NTS Area 5 Radioactive Waste Management Site if the waste meets NTSWAC requirements (NNSA/NSO, 2009b), the NTS NDEP permit for a Hazardous Waste Management Facility (NDEP, 2005), and the RCRA Part B Permit Application for Waste Management Activities at the NTS (DOE/NV, 1999). Mixed waste constituent concentrations exceeding Land Disposal Restrictions will require development of a treatment and disposal plan under the requirements of the Mutual Consent Agreement between DOE and the State of Nevada (NDEP, 1995).

7.0 Quality Assurance/Quality Control

For the closure activities described in this plan, the overall objective is to collect accurate and defensible data to support the implementation of corrective actions for CAU 408. The following sections discuss the QC activities for MEC detection methods, collection of required QC samples in the field, and QA requirements for laboratory/analytical data to achieve closure.

7.1 Quality Control Measures for MEC Surface Clearance (Mag and Dig)

7.1.1 Daily Magnetometer Check

Before starting work each day, a check shall be conducted on all magnetometers (Schonstedts) being used in the field for Mag and Dig operations. Simulated items the size of the smallest known ordnance items (BLU-26 and 40mm grenade) will be placed at depths of 1 ft and 6 in., and on the surface and marked with a stake indicating the locations of the items. Each magnetometer to be used that day must be able to detect all items. Failure to detect all items will indicate that the instrument is not functioning properly and will not be used for Mag and Dig clearance operations.

7.1.2 Blind Seeding

Blind seeding consists of burying an item simulating a bomblet at a depth of 1 ft in a random location that is not known to clearance personnel. A blind seed will be placed at a rate of at least one seed in every four consecutive grids. The project UXO QC Officer in consultation with the Site Supervisor will determine the locations of the seed items. The locations of the seed items will be recorded in the QC log based on geographical coordinates and grid ID. The locations of the buried items will be monitored by the UXO QC Officer to verify that normal clearance operations are effective in identifying and removing the item. Failure to detect a blind seed would require an analysis be conducted to determine the appropriate corrective action to ensure that all grids meet the clearance quality standard.

7.1.3 Grid Inspections

The UXO QC Officer will verify that the clearance of each grid meets the clearance quality standard for surface clearance operations using the following two criteria:

- Independent clearance verification of a portion of each grid, using the same methodology as the initial clearance, does not produce any additional submunitions
- The standard clearance technique is successful in locating all blind seeds.

Independent clearance verification will consist of a second surface clearance conducted by the UXO QC Officer over a portion of each grid. The default portion of each grid for independent clearance will be set at 25 percent. If no submunitions have been found by independent clearance verification in four consecutive grids, the independent clearance portion will be reduced to 10 percent. Conversely, if a submunition is found by independent clearance in any grid, the independent inspection portion of each grid will revert back to 25 percent and the Senior UXO Supervisor will determine whether corrective actions need to be implemented. If a submunition is found by independent clearance in each of three consecutive grids, a root cause analysis will be conducted and a corrective action will be implemented to ensure that all grids meet the clearance quality standard. Figure 7-1 presents the decision logic for implementing grid inspection QC measures.

7.2 Sample Collection Activities

Field QC samples will be collected according to established procedures. Field QC samples are collected and analyzed to aid in determining the validity of environmental sample results. The number of required QC samples depends on the types and number of environmental samples collected. As determined in the DQO process, the minimum frequency of collecting and analyzing QC samples for this CAI, include:

- Field duplicates (1 per 20 environmental samples)
- Field blanks (1 per 20 environmental samples, 1 per day, or 1 per target area)
- Laboratory QC samples (1 per 20 environmental samples)

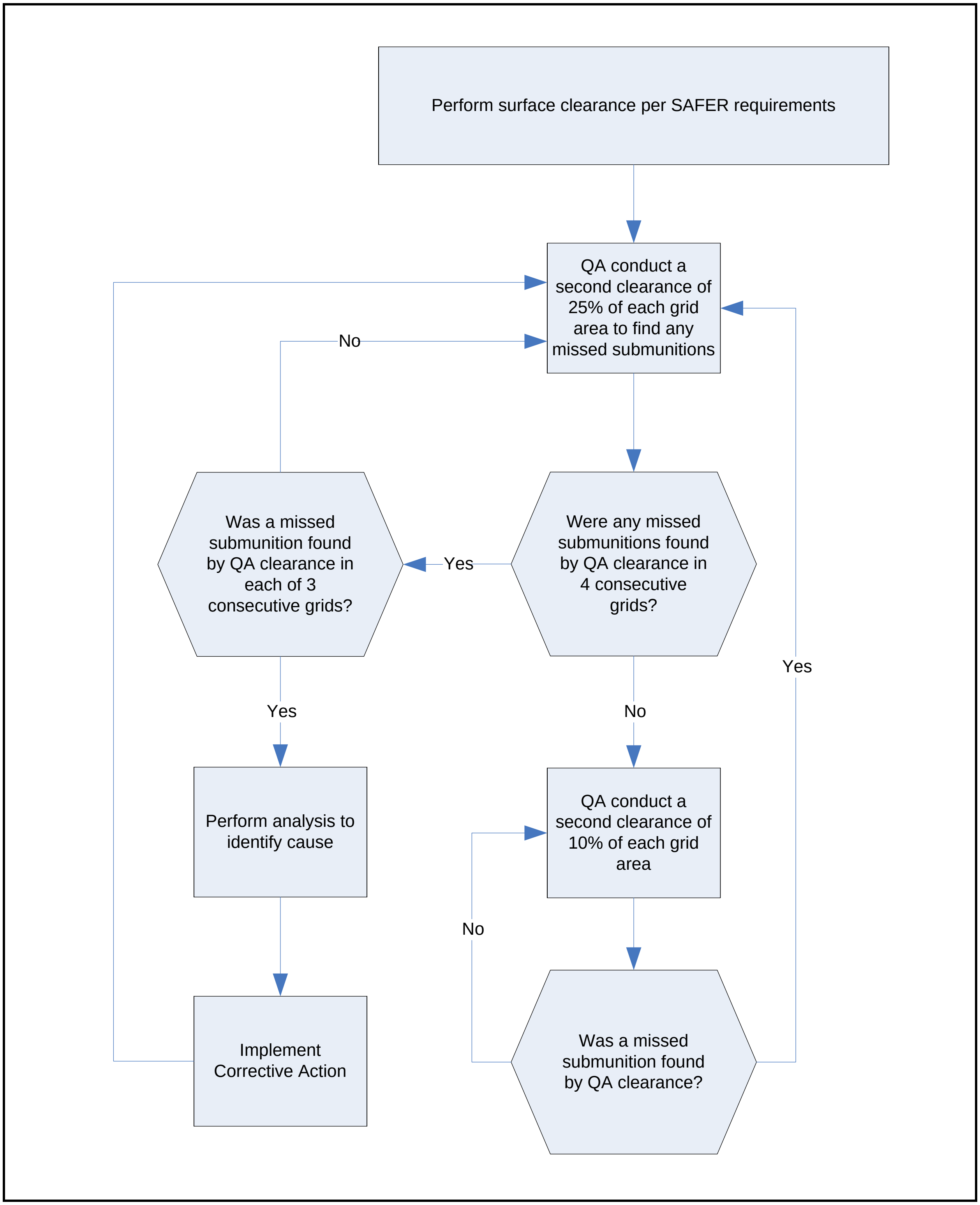

Figure 7-1
Decision Logic for Implementing Grid Inspection Quality Control Measures

- Trip blanks (1 per sample cooler containing volatile organic compound environmental samples)
- Equipment rinsate blanks (1 per sampling event)
- Source blanks (1 per uncharacterized lot of source material)

Additional QC samples may be submitted based on site conditions at the discretion of the Task Manager or Site Supervisor. Field QC samples shall be analyzed using the same analytical procedures implemented for associated environmental samples. Additional details regarding field QC samples are available in the Industrial Sites QAPP (NNSA/NV, 2002).

7.3 Applicable Laboratory/Analytical Data Quality Indicators

The DQIs are qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of data. Data quality indicators are used to evaluate the entire measurement system and laboratory measurement processes (i.e., analytical method performance) as well as to evaluate individual analytical results (i.e., parameter performance). The quality and usability of data used to make DQO decisions will be assessed based on the following DQIs:

- Precision
- Accuracy/bias
- Representativeness
- Comparability
- Completeness
- Sensitivity

Table 7-1 provides the established analytical method/measurement system performance criteria for each of the DQIs and the potential impacts to the decision if the criteria are not met. The following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data. The criteria for precision and accuracy in Tables 7-2 and 7-3 may vary from information in the Industrial Sites QAPP as a result of the laboratory used or updated/new methods (NNSA/NV, 2002).

7.3.1 Precision

Precision is a measure of the repeatability of the analysis process from sample collection through analysis results. It is used to assess the variability between two equal samples.

Table 7-1
Laboratory/Analytical Data Quality Indicators

DQI	Performance Criteria	Impact on Decision If Performance Criteria Not Met
Precision	Variations between duplicates (field and lab) and original sample should not exceed analytical method-specific criteria.	Estimated data within sample delivery group (SDG) will be evaluated for their usability. If data are determined to be unusable, data shall not be used in decision, and completeness will be assessed.
Accuracy	Laboratory control sample results and matrix spike results should be within analytical method-specific criteria.	Estimated data within SDG will be evaluated for its usability. If estimated data are biased low and below the decision threshold, the data shall not be used in decision and completeness criteria will be assessed.
Sensitivity	Detection limits of laboratory instruments must be less than action level for COCs.	Cannot determine whether COCs are present at levels of concern; therefore, investigation objectives cannot be met.
Comparability	Equivalent samples analyzed using same analytical methods, same units of measurement, and detection limits must be used for like analyses.	Inability to use data collected.
Completeness	100% of samples must be submitted to the laboratory, 100% of the requested analyses must be performed, 80% of analytes must be determined to be valid.	1) Decision of whether extent of contamination has been bounded cannot be determined. Impacts to decisions will be assessed. 2) Decision of whether COCs above action levels remain in soil cannot be determined. Impacts to decisions will be assessed.
Representativeness	Correct analytical method performed for appropriate COCs: valid data reflects appropriate target population.	Cannot identify COCs or estimate concentration of COCs; therefore, cannot make decision(s) on target population.

Determinations of precision will be made for field duplicate samples and laboratory duplicate samples. Field duplicate samples will be collected simultaneously with samples from the same source under similar conditions in separate containers. The duplicate sample will be treated independently of the original sample in order to assess field impacts and laboratory performance on precision through a comparison of results. Laboratory precision is evaluated as part of the required laboratory internal QC program to assess performance of analytical procedures. The laboratory sample duplicates are an aliquot, or subset, of a field sample generated in the laboratory. They are not a separate sample but a split, or portion, of an existing sample. Typically, laboratory duplicate QC samples may include matrix spike duplicate (MSD) and LCS duplicate samples for organic, inorganic, and radiological analyses.

Table 7-2
Analytical Requirements for Chemical COPCs for CAU 408

Analysis	Matrix	Analytical Method (SW-846)[a]	MDC[b]	Laboratory Precision	Laboratory Accuracy (%R)
ORGANICS					
Explosives	All	8330	< FALs	Lab-specific[c]	Lab-specific[c]
INORGANICS					
Metals	All	6010	< FALs	RPD 35% (non-aqueous)[d] 20% (aqueous)[d] Absolute Difference[e] ±2x RL (non-aqueous)[e] ±1x RL (aqueous)[e]	MS Sample 75-125%R[a] LCS 80-120%R[e]
Mercury	Aqueous	7470			
	Non-aqueous	7471			

[a]*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 2008b).
[b]The MDC is the lowest concentration that can be reliably achieved within specified limits of accuracy and precision.
[c]RPD and %R performance criteria are developed by the analytical laboratory according to approved procedures.
[d]*Sampling and Analysis Plan Guidance and Template* (EPA, 2000).
[e]*USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004).

MS = Matrix spike
RL = Reporting limit
RPD = Relative percent difference
%R = Percent recovery

Precision is a quantitative measure used to assess overall analytical method and field-sampling performance as well as to assess the need to “flag” (qualify) individual parameter results when corresponding QC sample results are not within established control limits.

The criteria used for the assessment of inorganic chemical precision when both results are greater than or equal to 5x reporting limit (RL) are 20 percent and 35 percent for aqueous and soil samples, respectively. When either result is less than 5x RL, a control limit of ±1x RL and ±2x RL for aqueous and soil samples, respectively, is applied to the absolute difference.

The criteria used for the assessment of organic chemical precision are based on professional judgment using laboratory-derived control limits. The criteria used for the assessment of radiological precision when both results are greater than or equal to 5x MDC are 20 percent and 35 percent for aqueous and soil samples, respectively. When either result is less than 5x MDC, the normalized difference (ND) should be between -2 and +2 for aqueous and soil samples.

Table 7-3
Analytical Requirements for Radionuclides for CAU 408

Analysis	Matrix	Analytical Method	MDC[a]	Laboratory Precision	Laboratory Accuracy (%R)
Gamma-Emitting Radionuclides					
Gamma Spectroscopy	Aqueous	EPA 901.1[b]	< FALs	RPD 35%[c] ND[d] -2<ND[d]<2	LCS 80-120%R
	Non-aqueous	HASL-300[e]			
Other Radionuclides					
U-238	All	HASL-300[e]	< FALs	RPD 35%[c] ND[d] -2<ND[d]<2	LCS 80-120%R Chemical Yield 30-105%R (not applicable for tritium and gross alpha/beta) MS Sample 61-140%R (tritium and gross alpha/beta only)

[a]The MDC is the lowest concentration of a radionuclide present in a sample and can be detected with a 95% confidence level.
[b]*Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA, 1980).
[c]*Sampling and Analysis Plan Guidance and Template* (EPA, 2000).
[d]ND is not RPD; rather, it is another measure of precision used to evaluate duplicate analyses. The ND is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997).
[e]*The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300 (DOE, 1997).

HASL = Health and Safety Laboratory

Any values outside the specified criteria do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. The performance metric for assessing the DQI of precision on DQO decisions (see Table 7-1) is that at least 80 percent of sample results for each measured contaminant are not qualified due to duplicates exceeding the criteria. If this performance is not met, an assessment will be conducted on the impacts to DQO decisions specific to affected contaminants and CASs and presented in the CR.

7.3.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement to the true value. It is used to assess the performance of laboratory measurement processes.

Accuracy is determined by analyzing a reference material of known parameter concentration or by reanalyzing a sample to which a material of known concentration or amount of parameter has been added (spiked). Accuracy will be evaluated based on results from three types of spiked samples: MS, LCS, and surrogates (organics). The LCS sample is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS will be prepared with each batch of samples for analysis by a specific measurement.

The criteria used for the assessment of inorganic chemical accuracy are 75 to 125 percent for MS recoveries and 80 to 120 percent for LCS recoveries. For organic chemical accuracy, MS and LCS laboratory-specific percent recovery criteria developed and generated in-house by the laboratory according to approved laboratory procedures are applied. The criteria used for the assessment of radiochemical accuracy are 80 to 120 percent for LCS and MS recoveries.

Values outside the specified criteria do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. Factors beyond laboratory control, such as sample matrix effects, can cause the measured values to be outside of the established criteria. Therefore, the entire sampling and analytical process may be evaluated when determining the usability of the affected data.

The performance metric for assessing the DQI of accuracy on DQO decisions (Table 7-1) is that at least 80 percent of the sample results for each measured contaminant are not qualified for accuracy. If this performance is not met, an assessment will be conducted on the impacts to DQO decisions specific to affected contaminants and CASs and presented in the CR.

7.3.3 Representativeness

Representativeness is the degree to which sample characteristics accurately and precisely represent characteristics of a population or an environmental condition (EPA, 2002). Representativeness is assured by carefully developing the CAI sampling strategy during the DQO process such that false negative and false positive decision errors are minimized. Meeting the criteria listed below will assure that sample results will adequately represent actual site characteristics:

- For judgmental sampling, having a high degree of confidence that the sample locations selected will identify COCs if present.
- Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.
- Having a high degree of confidence that the sample locations selected will identify the extent of COCs.

These are qualitative measures that will be used to assess measurement system performance for representativeness. The assessment of this qualitative criterion will be presented in the CR.

7.3.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 2002). The criteria for the evaluation of comparability will be that all sampling, handling, preparation, analysis, reporting, and data validation were performed using approved standard methods and procedures. This will ensure that data from this project can be compared to regulatory action levels that were developed based on data generated using the same or comparable methods and procedures. An evaluation of comparability will be presented in the CR.

7.3.5 Completeness

Completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. For judgmental sampling, completeness will be evaluated using both a quantitative measure and a qualitative assessment. The quantitative measurement to be used to evaluate completeness is presented in Table 7-1 and is based on the percentage of measurements made that are judged to be valid. For the judgmental sampling approach, the completeness goal is 80 percent. If this goal is not achieved, the dataset will be assessed for potential impacts on making DQO decisions.

The qualitative assessment of completeness is an evaluation of the sufficiency of information available to make DQO decisions. This assessment will be based on meeting the data needs identified in the DQOs and will be presented in the CR. Additional samples will be collected if it is determined that the number of samples do not meet completeness criteria.

7.3.6 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest (EPA, 2002). The evaluation criterion for this parameter will be that measurement sensitivity (detection limits) will be less than or equal to the corresponding FALs. If this criterion is not achieved, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives, which will be presented in the CR.

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Appendix A

Project Organization

A.1.0 Project Organization

The NNSA/NSO Federal Sub-Project Director for Industrial Sites is Kevin Cabble. He can be reached at (702) 295-5000.

The identification of the project Health and Safety Officer and the Quality Assurance Officer can be found in the Field Management Plan. However, personnel are subject to change, and it is suggested that the NNSA/NSO Federal Sub-Project Director be contacted for further information. The Task Manager will be identified in the *FFACO Monthly Activity Report* before the start of field activities.

Appendix B

Nevada Division of Environmental Protection Comments

(2 Pages)

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Streamlined Approach for Environmental Restoration Plan for Corrective Action Unit 408: Bomblet Target Area, Tonopah Test Range, Nevada	**2. Document Date:**	8/20/2009
3. Revision Number:	1	**4. Originator/Organization:**	Stoller-Navarro
5. Responsible NNSA/NSO Federal Sub-Project Director:	Kevin J. Cabble	**6. Date Comments Due:**	8/20/2009
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Tim Murphy, Ted Zaferatos, Jeff MacDougall, NDEP, 486-2850, extensions 231, 2	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	11. Type*	12. Comment	13. Comment Response	14. Accept
1.) Section 3.1.4.2 Spatial Boundaries, Page 23	Mandatory	It is believed that the references to 23,000 feet were intended to be 2,300 feet in three places. Change if appropriate.	The 23,000' spatial boundary is different than the 2,300' buffer zone boundary. The spatial boundary is intended to be the distance beyond which the conceptual site model would be invalid. The 23,000' spatial boundary was established as 10 times the buffer zone boundary.	
2.) Section 4.3 Verification, Page 42	Mandatory	The Decision Statements are written as if the work has been concluded. As of this date, the work has just begun.	The DQO decisions will be resolved following completion of corrective actions as it has already been determined that corrective action is required.	
3.) Section 5.0 Reports and Records Availability, Page 45	Mandatory	The paragraph leaves the impression that NDEP must ask for reports. A Closure Report must be prepared and delivered to NDEP.	This paragraph refers to field reports and other documentation generated during the field activities and the Final SAFER document. The last sentence of the paragraph will be revised for clarity as follows: "This document is provided to NDEP, and is available in the NNSA/NSO public reading rooms located in Las Vegas and Carson City, Nevada, or by contacting the appropriate NNSA/NSO Federal Sub-Project Director."	

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

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7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Tim Murphy, Ted Zaferatos, Jeff MacDougall, NDEP, 486-2850, extensions 231, 2	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	11. Type*	12. Comment	13. Comment Response	14. Accept
4.) Section 6.2.3 Hazardous Waste, Page 49, 3rd Paragraph	Mandatory	The wording assumes that an Emergency Treatment Permit has been issued. Note that a permit does not exist and conditions cannot be predicted.	Revise the 1st sentence of the 3rd paragraph as follows, "All RCRA-regulated treatment........according to the conditions of an NDEP-approved RCRA-emergency treatment permit and the MEC work plan." Revise the 4th paragraph as follows: "The MEC/UXO and/or other hazardous wastes generated shall be accumulated and managed in one or more HWAAs or SAAs. If MEC/UXO is removed from a disposal pit for future treatment, the MEC/UXO shall be managed in the SAA/HWAA until treatment. A RCRA Emergency Treatment Permit shall be obtained from NDEP, and the MEC/UXO will be treated per the MEC work plan and the Emergency Treatment Permit. If other (non-MEC)RCRA-hazardous wastes are found and accumulated, the SAA/HWAA shall remain in place until the accumulated wastes are shipped offsite for treatment/disposal. All MEC/UXO rendered inert will be disposed at U10C Landfill at the NTS."	

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