RECORD OF TECHNICAL CHANGE

Technical Change No. 1

Project/Job No. DP04 090

Project/Job Name Corrective Action Investigation Plan for CAU 357: Mud Pits and Waste Dump

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

Laura Pastor

(Full Name)

Task Manager

(Title)

Description of Change

1. **Section 2.4 Closure Standards.** Change the 5th bullet in the section to the following:

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

2. **Section A.1.4.2 Determine the Basis for the Preliminary Action Levels.** Change the 5th bullet to the following:

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

Eliminate Potassium-40 as a radionuclide COPC within the Gamma Spectrometry analysis.

3. **Section 6.2 Laboratory/Analytical Quality Assurance** Replace the 5th column (including related notes) in Table 6-3 with the following PALs for the corresponding analytes in soil:

   - Americium-241 7.62E+00
   - Cesium-137 7.30E+00
   - Cobalt-60 1.61E+00
   - Europium-155 8.11E+01
   - Plutonium-238 7.76E+00
   - Plutonium-239/240 7.62E+00
   - Strontium-90 5.03E+02
   - Uranium-234 8.59E+01
   - Uranium-235 1.05E+01
   - Uranium-238 7.78E+00

4. **Sections 7.0 and A.2.0 References.** Add the following references:


Justification for change

Through ongoing discussions between DOE and NDEP it was determined that the PALs currently being used for the site investigations are not practical and should be replaced with dose-based action levels. In an agreement between NDEP and DOE (approved March 9, 2004) the PALs to be used for evaluating the potential radioactive contamination in soils will be based on an acceptable dose as specified by the NCRP Report No. 129 and DOE 5400.5 guidance rather than a comparison to background values. The use of the new radiological PALs has been accepted and approved for use in the planning and evaluation phase of the site investigations.

Potassium-40 (K-40) is a naturally occurring unstable isotope of potassium with a half-life of 1.3 x 10E+09 years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, foods, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration. There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

The project time will be (Increased)(Decreased)(Unchanged) by approximately 0 days.

Applicable Project-Specific Document(s): Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 357: Mud Pits and Waste Dump Nevada Test Site, Nevada, Revision 0, June 2003.

CC: Approved By: Kevin Cabble, Acting Project Manager Industrial Sites Project

Date 3-15-04

Jasmin Appenzeller-Wing, Acting Division Director Environmental Restoration Division

Date 3-15-04

NDEP Concurrence Yes No Date

NDEP Signature

Contract Change Order Required Yes No

Contract Change Order No.
Justification for change

Through ongoing discussions between DOE and NDEP it was determined that the PALs currently being used for the site investigations are not practical and should be replaced with dose-based action levels, in agreement between NDEP and DOE (approved March 8, 2004) the PALs to be used for evaluating the potential radioactive contamination in soils will be based on an acceptable dose as specified by the NCRP Report No. 129 and DOE 8402.5 guidance rather than a comparison to background values. The use of the new radiological PALs has been accepted and approved for use in the planning and evaluation phase of the site investigations.

Potassium-40 (K-40) is a naturally occurring unstable isotope of potassium with a half-life of 1.3 x 10E+09 years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, foods, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration. There are no reported activities at the NTB that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

The project time will be (Increased) (Decreased) (Unchanged) by approximately 0 days.

Applicable Project-Specific Document(s): Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 357: Mud Pits and Waste Dump Nevada Test Site, Nevada, Revision 0, June 2003.

CC: 

Approved By: 

Kevin Cable, Acting Project Manager  
Industrial Sites Project  

Date: 3/15/04

Jeanne Appelgren, Acting Division Director  
Environmental Restoration Division  

Date: 3/15/04

NDEP Comment: 
Yes 
No  
Date: 3/19/04  

NDEP Signature:  

Contract Change Order Request: 
Yes 
No  

Contract Change Order No.:  

2
Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 357: Mud Pits and Waste Dump Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

June 2003

Approved for public release; further dissemination unlimited.
RECORD OF TECHNICAL CHANGE

Technical Change No. ____________  
Project/Job No. DP04 090  
Project/Job Name Corrective Action Investigation Plan for CAU 357: Mud Pits and Waste Dump  
Date 3/10/04

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

Laura Pastor  
Task Manager

(Name)  
(Title)

Description of Change

1. Section 2.4 Closure Standards. Change the 5th bullet in the section to the following:

"The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993)."

2. Section A.1.4.2 Determine the Basis for the Preliminary Action Levels. Change the 5th bullet to the following:

"The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993)."

Eliminate Potassium-40 as a radionuclide COPC within the Gamma Spectrometry analysis.

3. Section 6.2 Laboratory/Analytical Quality Assurance Replace the 5th column (including related notes) in Table 6-3 with the following PALs for the corresponding analytes in soil:

- Americium-241 7.62E+00
- Cesium-137 7.30E+00
- Cobalt-60 1.61E+00
- Europium-155 8.11E+01
- Plutonium-238 7.78E+00
- Plutonium-239/240 7.62E+00
- Strontium-90 5.03E+02
- Uranium-234 8.59E+01
- Uranium-235 1.05E+01
- Uranium-238 7.78E+00

4. Sections 7.0 and A.2.0 References. Add the following references:


Justification for change

Through ongoing discussions between DOE and NDEP it was determined that the PALs currently being used for the site investigations are not practical and should be replaced with dose-based action levels. In an agreement between NDEP and DOE (approved March 9, 2004) the PALs to be used for evaluating the potential radioactive contamination in soils will be based on an acceptable dose as specified by the NCRP Report No. 129 and DOE 5400.5 guidance rather than a comparison to background values. The use of the new radiological PALs has been accepted and approved for use in the planning and evaluation phase of the site investigations.

Potassium-40 (K-40) is a naturally occurring unstable isotope of potassium with a half-life of 1.3 x 10E+09 years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, foods, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration. There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

The project time will be (Increased)(Decreased)(Unchanged) by approximately 0 days.

Applicable Project-Specific Document(s): Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 357: Mud Pits and Waste Dump Nevada Test Site, Nevada, Revision 0, June 2003.

CC:

Approved By: Kevin Cabble

Date 3-15-04

NDEP Concurrence Yes No Date

NDEP Signature

Contract Change Order Required Yes No

Contract Change Order No.
Justification for change

Through ongoing discussions between DOE and NDEP, it was determined that the PALs currently being used for the site investigations are not practical and should be replaced with dose-based action levels. In an agreement between NDEP and DOE (approved March 9, 2004) the PALs to be used for evaluating the potential radioactive contamination in soils will be based on an acceptable dose as specified by the NCRP Report No. 129 and DOE 5400.5 guidance rather than a comparison to background values. The use of the new radiological PALs has been accepted and approved for use in the planning and evaluation phase of the site investigations.

Potassium-40 (K-40) is a naturally occurring unstable isotope of potassium with a half-life of $1.3 \times 10^6$ years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, food, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration. There are no reported activities at the NTB that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

The project time will be (Increased) (Decreased) (Unchanged) by approximately 0 days.


CC:

Approved By:  

Kevin Cahill, Acting Project Manager  
Industial Sites Project  

3/15/04

James Appleton, Acting Division Director  
Environmental Restoration Division  

3/15/04

NDEP Concurrence: Yes No  
Date: 3/19/04

NDEP Signature

Contract Change Order Requested: Yes No

Contract Change Order No.
Available for public sale, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 800.553.6847
Fax: 703.605.6900
Email: orders@ntis.fedworld.gov
Online ordering: http://www.ntis.gov/ordering.htm

Available electronically at http://www.doe.gov/bridge

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
Phone: 865.576.8401
Fax: 865.576.5728
Email: reports@adonis.osti.gov

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.
STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER) PLAN FOR CORRECTIVE ACTION UNIT 357: MUD PITS AND WASTE DUMP NEVADA TEST SITE, NEVADA

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

Controlled Copy No.: ___

Revision No.: 0

June 2003

Approved for public release; further dissemination unlimited.
STREAMLINED APPROACH FOR
ENVIRONMENTAL RESTORATION (SAFER) PLAN
FOR CORRECTIVE ACTION UNIT 357:
MUD PITS AND WASTE DUMP
NEVADA TEST SITE, NEVADA

Approved by: ________________________________  Date: _____________

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: ________________________________  Date: _____________

Runore C. Wycoff, Division Director
Environmental Restoration Division
## Table of Contents

List of Figures .............................................................. vi
List of Tables ............................................................... ix
List of Acronyms and Abbreviations .................................... x
Executive Summary ......................................................... ES-1

1.0 Introduction ............................................................. 1
  1.1 SAFER Process ....................................................... 3
  1.2 Summary of Corrective Actions .................................... 5
  1.3 SAFER Work Plan Contents ........................................ 5

2.0 Unit Description ...................................................... 7
  2.1 History .............................................................. 8
    2.1.1 History - Mud Pits ........................................... 8
    2.1.1.1 History - Mud Pit - CAS 07-09-02 ....................... 10
    2.1.1.2 History - Mud Pit - CAS 07-09-03 ....................... 10
    2.1.1.3 History - Mud Pit - CAS 07-09-04 ....................... 11
    2.1.1.4 History - Mud Pit - CAS 07-09-05 ....................... 11
    2.1.1.5 History - Mud Pit - CAS 08-09-01 ....................... 11
    2.1.1.6 History - Mud Pit - CAS 08-09-02 ....................... 11
    2.1.1.7 History - Mud Pit - CAS 08-09-03 ....................... 12
    2.1.1.8 History - Mud Pit - CAS 10-09-02 ....................... 12
    2.1.1.9 History - Mud Pit - CAS 10-09-04 ....................... 12
    2.1.1.10 History - Mud Pit - CAS 10-09-05 ..................... 13
    2.1.1.11 History - Mud Pit; Stains; Material - CAS 10-09-06 .. 13
  2.1.3 History - Lead Bricks - CAS 04-26-03 ....................... 14
  2.1.4 History - Boxes; Pipes - CAS 01-99-01 ..................... 14

  2.2 Site Location and Description .................................. 14
    2.2.1 Site Location and Description - Mud Pit - CAS 07-09-02 .. 15
    2.2.2 Site Location and Description - Mud Pit - CAS 07-09-03 .. 17
    2.2.3 Site Location and Description - Mud Pit - CAS 07-09-04 .. 19
    2.2.4 Site Location and Description - Mud Pit - CAS 07-09-05 .. 21
    2.2.5 Site Location and Description - Mud Pit - CAS 08-09-01 .. 23
    2.2.6 Site Location and Description - Mud Pit - CAS 08-09-02 .. 23
    2.2.7 Site Location and Description - Mud Pit - CAS 08-09-03 .. 25
    2.2.8 Site Location and Description - Mud Pit - CAS 10-09-02 .. 28
    2.2.9 Site Location and Description - Mud Pit - CAS 10-09-04 .. 30
    2.2.10 Site Location and Description - Mud Pit - CAS 10-09-05 .. 32
2.2.11 Site Location and Description - Mud Pit; Stains; Material - CAS 10-09-06 ................................................. 32
2.2.12 Site Location and Description - Waste Dump - CAS 25-15-01 ......... 34
2.2.13 Site Location and Description - Lead Bricks - CAS 04-26-03 ........... 37
2.2.14 Site Location and Description - Boxes; Pipes - CAS 01-99-01 .......... 37

2.3 Process Knowledge .................................................. 41
2.3.1 Process Knowledge - Mud Pits .................................... 42
2.3.1.1 Process Knowledge - Mud Pit - CAS 07-09-02 .................. 43
2.3.1.2 Process Knowledge - Mud Pit - CAS 07-09-03 .................. 43
2.3.1.3 Process Knowledge - Mud Pit - CAS 07-09-04 .................. 43
2.3.1.4 Process Knowledge - Mud Pit - CAS 07-09-05 .................. 44
2.3.1.5 Process Knowledge - Mud Pit - CAS 08-09-01 .................. 44
2.3.1.6 Process Knowledge - Mud Pit - CAS 08-09-02 .................. 44
2.3.1.7 Process Knowledge - Mud Pit - CAS 08-09-03 .................. 45
2.3.1.8 Process Knowledge - Mud Pit - CAS 10-09-02 .................. 45
2.3.1.9 Process Knowledge - Mud Pit - CAS 10-09-04 .................. 46
2.3.1.10 Process Knowledge - Mud Pit - CAS 10-09-05 ................. 46
2.3.1.11 Process Knowledge - Mud Pit; Stains; Material - CAS 10-09-06 ................................................. 46

2.3.2 Process Knowledge - Waste Dump - CAS 25-15-01 .................. 47
2.3.3 Process Knowledge - Lead Bricks - CAS 04-26-03 .................. 48
2.3.4 Process Knowledge - Boxes; Pipes - CAS 01-99-01 .................. 48

2.4 Closure Standards ................................................... 48

3.0 Field Activities and Closure Objectives .................................. 50

3.1 Contaminants of Potential Concern ..................................... 51
3.2 Remediation .................................................................. 51
3.2.1 Determining if COCs are Present ..................................... 52
3.2.1.1 Mud Pit CASs (07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 07-09-03, 10-09-02, 10-09-03, 10-09-04, 10-09-05, and 10-09-06) ................................................. 54
3.2.1.2 Waste Dump CAS 25-15-01 ........................................ 55
3.2.1.3 Lead Bricks CAS 04-26-03 ......................................... 57
3.2.1.4 Boxes; Pipes CAS 01-99-01 ........................................ 59

3.2.2 Determining the Extent of Contamination ............................ 60
3.2.2.1 Mud Pit CASs 07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 07-09-03, 10-09-02, 10-09-03, 10-09-04, 10-09-05, and 10-09-06) ................................................. 61
3.2.2.2 Waste Dump CAS 25-15-01 ........................................ 61
3.2.2.3 Lead Bricks CAS 04-26-03 ......................................... 61
3.2.2.4 Boxes; Pipes CAS 01-99-01 ........................................ 62
# Table of Contents (Continued)

- **3.3** Verification ................................................................. 62
- **3.4** Data Quality Objectives ..................................................... 63
- **3.5** Closure .............................................................................. 63
- **3.6** Duration .............................................................................. 64

- **4.0** Reports and Records Availability ............................................ 66

- **5.0** Investigation/Remediation Waste Management .............................. 67
  - **5.1** Waste Minimization ............................................................. 67
  - **5.2** Potential Waste Forms ......................................................... 68
    - **5.2.1** Sanitary Waste ............................................................... 68
      - **5.2.1.1** Special Sanitary .......................................................... 70
    - **5.2.2** Hazardous Waste ............................................................ 70
    - **5.2.3** Polychlorinated Biphenyls ................................................. 73
    - **5.2.4** Low-Level Waste ............................................................. 73
    - **5.2.5** Mixed Waste ................................................................. 74

- **6.0** Quality Assurance/Quality Control ............................................. 76
  - **6.1** Quality Control Field Sampling Activities .................................. 76
  - **6.2** Laboratory/Analytical Quality Assurance .................................... 77

- **7.0** References ........................................................................... 83

## Appendix A - Data Quality Objectives Worksheets

- **A.1.0** Data Quality Objectives (DQO) Process ................................. A-1
  - **A.1.1** CAS-Specific Information ................................................ A-1
    - **A.1.1.1** CAS-Specific Background Information ................................ A-3
      - **A.1.1.1.1** Mud Pit, CAS 07-09-02 .............................................. A-5
      - **A.1.1.1.2** Mud Pit, CAS 07-09-03 .............................................. A-7
      - **A.1.1.1.3** Mud Pit, CAS 07-09-04 .............................................. A-11
      - **A.1.1.1.4** Mud Pit, CAS 07-09-05 .............................................. A-13
      - **A.1.1.1.5** Mud Pit, CAS 08-09-01 .............................................. A-15
      - **A.1.1.1.6** Mud Pit, CAS 08-09-02 .............................................. A-18
      - **A.1.1.1.7** Mud Pit, CAS 08-09-03 .............................................. A-20
      - **A.1.1.1.8** Mud Pit, CAS 10-09-02 .............................................. A-22
      - **A.1.1.1.9** Mud Pit, CAS 10-09-04 .............................................. A-25
      - **A.1.1.1.10** Mud Pit, CAS 10-09-05 ............................................ A-27
      - **A.1.1.1.11** Mud Pit; Stains; Material, CAS 10-09-06 ..................... A-29
      - **A.1.1.1.12** Waste Dump, CAS 25-15-01 ..................................... A-32
      - **A.1.1.1.13** Lead Bricks, CAS 04-26-03 ..................................... A-36
      - **A.1.1.1.14** Boxes; Pipes, CAS 01-99-01 ..................................... A-36


Table of Contents (Continued)

A.1.2 Step 1, State the Problem ............................................. A-40
  A.1.2.1 DQO Planning Team Members .................................. A-40
  A.1.2.2 Describe the Problem ........................................... A-41
  A.1.2.3 Develop Conceptual Site Models ............................... A-41
    A.1.2.3.1 CSM #1 for Mud Pits, Waste Dump, and Lead Bricks CASs .................................. A-44
    A.1.2.3.2 CSM #2 for Boxes; Pipes CAS ............................ A-50
A.1.3 Step 2, Identify the Decisions ..................................... A-53
  A.1.3.1 Develop a Problem and Decision Statement(s) ............. A-53
  A.1.3.2 Alternative Actions to the Decision .......................... A-53
A.1.4 Step 3, Identify the Inputs to the Decision ..................... A-55
  A.1.4.1 Information Needs and Sources ............................... A-55
  A.1.4.2 Determine the Basis for Preliminary Action Levels ......... A-61
    A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods ................................ A-62
      A.1.4.3.1 Geophysical Surveys .................................. A-62
      A.1.4.3.2 Geodetic Surveys ..................................... A-62
      A.1.4.3.3 Field Screening ....................................... A-62
      A.1.4.3.4 Soil Sampling ......................................... A-63
      A.1.4.3.5 Analytical Program ................................... A-63
A.1.5 Step 4, Define the Boundaries of the Study ..................... A-65
  A.1.5.1 Define the Target Population ................................. A-65
  A.1.5.2 Determine the Spatial and Temporal Boundaries ............ A-67
  A.1.5.3 Identify Practical Constraints ................................ A-68
  A.1.5.4 Define the Scale of Decision Making ......................... A-69
A.1.6 Step 5, Develop a Decision Rule ................................ A-69
  A.1.6.1 Specify the Population Parameter ........................... A-69
  A.1.6.2 Choose an Action Level ....................................... A-69
  A.1.6.3 Decision Rule ................................................ A-69
A.1.7 Step 6, Specify Tolerable Limits on Decision Errors .......... A-70
  A.1.7.1 False Rejection Decision Error .............................. A-71
  A.1.7.2 False Acceptance Decision Error ............................ A-72
  A.1.7.3 Quality Assurance/Quality Control .......................... A-73
A.1.8 Step 7, Optimize the Design for Obtaining Data ................ A-74
  A.1.8.1 CSM #1: For Mud Pit CASs 07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 08-09-03, 10-09-02, 10-09-04, 10-09-05, 10-09-06, Waste Dump CAS 25-15-01, and Lead Bricks CAS 04-26-03 .................................. A-76
  A.1.8.2 CSM #2 for CAS 01-99-01, Boxes; Pipes ..................... A-96
A.2.0 References .................................................................. A-99
**Table of Contents (Continued)**

Appendix B - Project Organization

B.1.0  Project Organization ................................................................. B-1

Appendix C - NDEP Comment Responses
## List of Figures

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Nevada Test Site, Nye County, Nevada</td>
<td>2</td>
</tr>
<tr>
<td>1-2</td>
<td>CAU 357 Closure Decision Process</td>
<td>4</td>
</tr>
<tr>
<td>2-1</td>
<td>Overall View of Return Mud Pit</td>
<td>9</td>
</tr>
<tr>
<td>2-2</td>
<td>Overall View of Suction Mud Pit</td>
<td>9</td>
</tr>
<tr>
<td>2-3</td>
<td>CAU 357, CAS 07-09-02, Mud Pit</td>
<td>16</td>
</tr>
<tr>
<td>2-4</td>
<td>CAU 357, CAS 07-09-03, Mud Pit</td>
<td>18</td>
</tr>
<tr>
<td>2-5</td>
<td>CAU 357, CAS 07-09-04, Mud Pit</td>
<td>20</td>
</tr>
<tr>
<td>2-6</td>
<td>CAU 357, CAS 07-09-05, Mud Pit</td>
<td>22</td>
</tr>
<tr>
<td>2-7</td>
<td>CAU 357, CAS 08-09-01, Mud Pit</td>
<td>24</td>
</tr>
<tr>
<td>2-8</td>
<td>CAU 357, CAS 08-09-02, Mud Pit</td>
<td>26</td>
</tr>
<tr>
<td>2-9</td>
<td>CAU 357, CAS 08-09-03, Mud Pit</td>
<td>27</td>
</tr>
<tr>
<td>2-10</td>
<td>CAU 357, CAS 10-09-02, Mud Pit</td>
<td>29</td>
</tr>
<tr>
<td>2-11</td>
<td>CAU 357, CAS 10-09-04, Mud Pit</td>
<td>31</td>
</tr>
<tr>
<td>2-12</td>
<td>CAU 357, CAS 10-09-05, Mud Pit</td>
<td>33</td>
</tr>
<tr>
<td>2-13</td>
<td>CAU 357, CAS 10-09-06, Mud Pit; Stain; Material</td>
<td>35</td>
</tr>
<tr>
<td>2-14</td>
<td>CAU 357, CAS 25-15-01, Waste Dump</td>
<td>36</td>
</tr>
<tr>
<td>2-15</td>
<td>CAU 357, CAS 04-26-03, Lead Bricks</td>
<td>38</td>
</tr>
<tr>
<td>2-16</td>
<td>CAU 357, CAS 01-99-01, Boxes; Pipes - “Building 1-31.2e1”</td>
<td>39</td>
</tr>
<tr>
<td>A.1-1</td>
<td>CAU 357, CAS Location Map</td>
<td>A-4</td>
</tr>
<tr>
<td>A.1-2</td>
<td>CAU 357, CAS 07-09-02, Mud Pit</td>
<td>A-6</td>
</tr>
<tr>
<td>A.1-3</td>
<td>CAU 357, CAS 07-09-03, Mud Pit</td>
<td>A-8</td>
</tr>
<tr>
<td>A.1-4</td>
<td>CAU 357, CAS 07-09-04, Mud Pit</td>
<td>A-12</td>
</tr>
<tr>
<td>A.1-5</td>
<td>CAU 357, CAS 07-09-05, Mud Pit</td>
<td>A-14</td>
</tr>
<tr>
<td>A.1-6</td>
<td>CAU 357, CAS 08-09-01, Mud Pit</td>
<td>A-17</td>
</tr>
<tr>
<td>A.1-7</td>
<td>CAU 357, CAS 08-09-02, Mud Pit</td>
<td>A-19</td>
</tr>
</tbody>
</table>
**List of Figures (Continued)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1-8</td>
<td>CAU 357, CAS 08-09-03, Mud Pit</td>
<td>A-21</td>
</tr>
<tr>
<td>A.1-9</td>
<td>CAU 357, CAS 10-09-02, Mud Pit</td>
<td>A-23</td>
</tr>
<tr>
<td>A.1-10</td>
<td>CAU 357, CAS 10-09-04, Mud Pit</td>
<td>A-26</td>
</tr>
<tr>
<td>A.1-11</td>
<td>CAU 357, CAS 10-09-05, Mud Pit</td>
<td>A-28</td>
</tr>
<tr>
<td>A.1-12</td>
<td>CAU 357, CAS 10-09-06, Mud Pit; Stains; Material</td>
<td>A-31</td>
</tr>
<tr>
<td>A.1-14</td>
<td>CAU 357, CAS 04-26-03, Lead Bricks</td>
<td>A-37</td>
</tr>
<tr>
<td>A.1-15</td>
<td>CAU 357, CAS 01-99-01, Boxes; Pipes - “Building 1-31.2e1”</td>
<td>A-39</td>
</tr>
<tr>
<td>A.1-16</td>
<td>CAU 357, CSM #1: For Mud Pits, Waste Dump, and Lead Bricks</td>
<td>A-45</td>
</tr>
<tr>
<td>A.1-17</td>
<td>Typical Mud Pit Cross Section Illustrating Idealized Sampling Locations</td>
<td>A-48</td>
</tr>
<tr>
<td>A.1-18</td>
<td>CAU 357 CSM #2: For Boxes; Pipes-Cut Away View of Building 1-31.2e1</td>
<td>A-51</td>
</tr>
<tr>
<td>A.1-19</td>
<td>CAU 357 Closure Decision Process</td>
<td>A-54</td>
</tr>
<tr>
<td>A.1-20</td>
<td>CAU 357, CAS 07-09-02, Mud Pit</td>
<td>A-78</td>
</tr>
<tr>
<td>A.1-21</td>
<td>CAU 357, CAS 07-09-03, Mud Pit</td>
<td>A-79</td>
</tr>
<tr>
<td>A.1-22</td>
<td>CAU 357, CAS 07-09-04, Mud Pit</td>
<td>A-80</td>
</tr>
<tr>
<td>A.1-23</td>
<td>CAU 357, CAS 07-09-05, Mud Pit</td>
<td>A-81</td>
</tr>
<tr>
<td>A.1-24</td>
<td>CAU 357, CAS 08-09-01, Mud Pit</td>
<td>A-82</td>
</tr>
<tr>
<td>A.1-25</td>
<td>CAU 357, CAS 08-09-02, Mud Pit</td>
<td>A-83</td>
</tr>
<tr>
<td>A.1-26</td>
<td>CAU 357, CAS 08-09-03, Mud Pit</td>
<td>A-84</td>
</tr>
<tr>
<td>A.1-27</td>
<td>CAU 357, CAS 10-09-02, Mud Pit</td>
<td>A-85</td>
</tr>
<tr>
<td>A.1-28</td>
<td>CAU 357, CAS 10-09-04, Mud Pit</td>
<td>A-86</td>
</tr>
<tr>
<td>A.1-29</td>
<td>CAU 357, CAS 10-09-05, Mud Pit</td>
<td>A-87</td>
</tr>
<tr>
<td>A.1-30</td>
<td>CAU 357, CAS 10-09-06, Mud Pit; Stains; Material</td>
<td>A-88</td>
</tr>
</tbody>
</table>
## List of Figures (Continued)

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1-32</td>
<td>CAU 357, CAS 04-26-03, Lead Bricks</td>
<td>A-95</td>
</tr>
<tr>
<td>A.1-33</td>
<td>CAU 357, CAS 01-99-01, Boxes; Pipes - “Building 1-31.2e1”</td>
<td>A-98</td>
</tr>
</tbody>
</table>
# List of Tables

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES.1-1</td>
<td>Summary of CASs Conceptual Site Model and Expected Closure</td>
<td>ES-3</td>
</tr>
<tr>
<td>2-1</td>
<td>CAS Coordinates</td>
<td>15</td>
</tr>
<tr>
<td>3-1</td>
<td>COPCs for CASs in CAU 357</td>
<td>52</td>
</tr>
<tr>
<td>3-2</td>
<td>Summary of CASs Conceptual Site Model and Expected Closure</td>
<td>65</td>
</tr>
<tr>
<td>5-1</td>
<td>Waste Management Regulations and Requirements</td>
<td>69</td>
</tr>
<tr>
<td>6-1</td>
<td>Laboratory/Analytical Data Quality Indicators</td>
<td>78</td>
</tr>
<tr>
<td>6-2</td>
<td>Analytical Requirements for CAU 357</td>
<td>79</td>
</tr>
<tr>
<td>6-3</td>
<td>Analytical Requirements for Radionuclides for CAU 357</td>
<td>82</td>
</tr>
<tr>
<td>A.1-1</td>
<td>DQO Participants</td>
<td>A-2</td>
</tr>
<tr>
<td>A.1-2</td>
<td>Constituents Used in Drilling Mud</td>
<td>A-10</td>
</tr>
<tr>
<td>A.1-3</td>
<td>Identified Information/Data Needs to Resolve Decision</td>
<td>A-57</td>
</tr>
<tr>
<td>A.1-4</td>
<td>Contaminants of Potential Concern for CAU 357 CASs</td>
<td>A-64</td>
</tr>
</tbody>
</table>
## List of Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bgs</td>
<td>Below ground surface</td>
</tr>
<tr>
<td>BN</td>
<td>Bechtel Nevada</td>
</tr>
<tr>
<td>CAS</td>
<td>Corrective Action Site</td>
</tr>
<tr>
<td>CAU</td>
<td>Corrective Action Unit</td>
</tr>
<tr>
<td>CFR</td>
<td><em>Code of Federal Regulations</em></td>
</tr>
<tr>
<td>CLP</td>
<td>Contract Laboratory Program</td>
</tr>
<tr>
<td>COC</td>
<td>Contaminant of concern</td>
</tr>
<tr>
<td>COPC</td>
<td>Contaminant of potential concern</td>
</tr>
<tr>
<td>CR</td>
<td>Closure Report</td>
</tr>
<tr>
<td>CSM</td>
<td>Conceptual site model</td>
</tr>
<tr>
<td>DNAPL</td>
<td>Dense, nonaqueous phase liquids</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>DOE/NV</td>
<td>U.S. Department of Energy, Nevada Operations Office</td>
</tr>
<tr>
<td>DOT</td>
<td>U.S. Department of Transportation</td>
</tr>
<tr>
<td>DQI</td>
<td>Data quality indicators</td>
</tr>
<tr>
<td>DQO</td>
<td>Data quality objective</td>
</tr>
<tr>
<td>DRI</td>
<td>Desert Research Institute</td>
</tr>
<tr>
<td>ECI</td>
<td>Environmental Compliance Inventory</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>ERD</td>
<td>Environmental Restoration Division</td>
</tr>
<tr>
<td>FADL</td>
<td>Field activity daily logs</td>
</tr>
<tr>
<td>FFACO</td>
<td><em>Federal Facility Agreement and Consent Order</em></td>
</tr>
<tr>
<td>FID</td>
<td>Flame-ionization detector</td>
</tr>
<tr>
<td>FSL</td>
<td>Field-screening level</td>
</tr>
<tr>
<td>FSR</td>
<td>Field-screening results</td>
</tr>
<tr>
<td>ft</td>
<td>Foot (feet)</td>
</tr>
</tbody>
</table>
**List of Acronyms and Abbreviations (Continued)**

GC  Gas Chromatograph  
GPS  Global Positioning System  
HASP  *Health and Safety Plan*  
HWAA  Hazardous waste accumulation area  
IDW  Investigation-derived waste  
in.  Inch(es)  
ISMS  Integrated Safety Management System  
kt  Kiloton  
LCM  Lost circulation material  
LLNL  Lawrence Livermore National Laboratory  
LLW  Low-level radioactive waste  
LNAPL  Light nonaqueous phase liquid  
mg/kg  Milligram(s) per kilogram  
mi  Mile(s)  
MRL  Minimum reporting level  
MS/MSD  Matrix spike/matrix spike duplicate  
MX  Missile experiment  
NAC  *Nevada Administrative Code*  
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*  
PA  Preliminary Assessment  
PAI  Professional Analysis, Inc.  
PAL  Preliminary action level  
PCB  Polychlorinated biphenyls
**List of Acronyms and Abbreviations** *(Continued)*

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PID</td>
<td>Photoionization detector</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
</tr>
<tr>
<td>ppm</td>
<td>Part(s) per million</td>
</tr>
<tr>
<td>PRG</td>
<td>Preliminary remediation goal</td>
</tr>
<tr>
<td>QA</td>
<td>Quality assurance</td>
</tr>
<tr>
<td>QAPP</td>
<td><em>Quality Assurance Project Plan</em></td>
</tr>
<tr>
<td>QC</td>
<td>Quality control</td>
</tr>
<tr>
<td>RadSafe</td>
<td>Radiation Safety</td>
</tr>
<tr>
<td>RCA</td>
<td>Radioactive Controlled Area</td>
</tr>
<tr>
<td>RCRA</td>
<td><em>Resource Conservation and Recovery Act</em></td>
</tr>
<tr>
<td>REECo</td>
<td>Reynolds Electrical &amp; Engineering Co., Inc.</td>
</tr>
<tr>
<td>RMA</td>
<td>Radioactive Materials Area</td>
</tr>
<tr>
<td>R-MAD</td>
<td>Reactor Maintenance, Assembly, and Disassembly</td>
</tr>
<tr>
<td>RTC</td>
<td>Record of Technical Change</td>
</tr>
<tr>
<td>RWMS</td>
<td>Radioactive Waste Management Site</td>
</tr>
<tr>
<td>RWP</td>
<td>Radiological Work Permit</td>
</tr>
<tr>
<td>SAA</td>
<td>Satellite Accumulation Area</td>
</tr>
<tr>
<td>SAFER</td>
<td>Streamlined Approach for Environmental Restoration</td>
</tr>
<tr>
<td>SAIC</td>
<td>Science Applications International Corporation</td>
</tr>
<tr>
<td>SDWS</td>
<td><em>Safe Drinking Water Standards</em></td>
</tr>
<tr>
<td>Shaw</td>
<td>Shaw Environmental, Inc.</td>
</tr>
<tr>
<td>SSHASP</td>
<td>Site-specific health and safety plan</td>
</tr>
<tr>
<td>SSL</td>
<td>Soil screening level</td>
</tr>
<tr>
<td>SVOC</td>
<td>Semivolatile organic compounds</td>
</tr>
<tr>
<td>TCLP</td>
<td>Toxicity characteristic leaching procedure</td>
</tr>
<tr>
<td>TPH</td>
<td>Total petroleum hydrocarbons</td>
</tr>
</tbody>
</table>
**List of Acronyms and Abbreviations (Continued)**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSCA</td>
<td>Toxic Substances Control Act</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile organic compound</td>
</tr>
<tr>
<td>yd³</td>
<td>Cubic yards</td>
</tr>
</tbody>
</table>
Executive Summary

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses closure for Corrective Action Unit (CAU) 357, Mud Pits and Waste Dump, identified in the Federal Facility Agreement and Consent Order. Corrective Action Unit 357 consists of the 14 following Corrective Action Sites (CASs) located in Areas 1, 4, 7, 8, 10, and 25 of the Nevada Test Site:

- 07-09-02, Mud Pit
- 07-09-03, Mud Pit
- 07-09-04, Mud Pit
- 07-09-05, Mud Pit
- 08-09-01, Mud Pit
- 08-09-02, Mud Pit
- 08-09-03, Mud Pit
- 10-09-02, Mud Pit
- 10-09-04, Mud Pit
- 10-09-05, Mud Pit
- 10-09-06, Mud Pit; Stains; Material
- 01-99-01, Boxes; Pipes
- 04-26-03, Lead Bricks
- 25-15-01, Waste Dump

This plan provides the methodology for field activities needed to gather the necessary information for closing each CAS. There is sufficient information and process knowledge from historical documentation and investigations of similar sites regarding the expected nature and extent of potential contaminants to recommend closure of CAU 357 using the SAFER process.

The Data Quality Objective process developed for this CAU identified the following expected closure options: (1) investigation and confirmation that no contamination exists above the preliminary action levels (PALs) leading to a no further action declaration, (2) characterization of the nature and extent of contamination leading to closure in place with use restrictions, or (3) clean closure by remediation and verification. The expected closure options were selected based on available information including contaminants of potential concern, future land use, and assumed risks. A decision flow process was developed to outline the collection of data necessary to achieve closure. There are two decisions that need to be answered for closure. Decision I is to conduct an investigation to determine if contaminants of potential concern (COPCs) are present in concentrations exceeding the PALs. If COPCs are found to be present above PALs, Decision II will include an investigation to determine the
extent of contamination and generate the information necessary to select a corrective action alternative to complete closure of the site.

The following text summarizes the types of activities that will support the closure of CAU 357:

- Perform site preparation activities (e.g., utilities clearances, geophysical surveys).
- Perform housekeeping activities for debris at various CASs, as required.
- Collect environmental samples from designated target populations (i.e., mud/soil cuttings) and submit for laboratory analysis.
- Perform site characterization activities to define the nature and extent of contamination in order to select an appropriate corrective action alternative. Collect environmental samples from biased locations to confirm or disprove the presence of COCs (i.e., nature of contamination) if this data does not already exist. Collect environmental samples from designated target populations (e.g., clean soil adjacent to contaminated soil) and submit for laboratory analyses to define the extent of contamination.
- Determine if no further action is the preferred alternative if no contaminants are detected above PALs.
- Determine if clean closure is the preferred closure alternative. If clean closure is preferred, the material to be remediated will be removed, disposed of as waste, and verification samples will be collected from remaining soil.
- Determine if closure in place is the preferred closure alternative. If closure in place is preferred, the appropriate use restrictions will be implemented.
- Confirm the preferred closure option is sufficient to protect human health and the environment or select an alternative closure option based on validated analytical data, site observations, and professional judgement.
- All closure activities for CAU 357 will be documented in a Closure Report.

Historical information and process knowledge identified sources of potential contamination for the boxes and pipes, lead bricks, mud pits, and waste dump. See Table ES.1-1 for a summary of the available information for all the CASs.
Under the *Federal Facility Agreement and Consent Order*, the SAFER Plan will be submitted to the Nevada Division of Environmental Protection (NDEP) for approval. Field work will be conducted following approval of the plan. On completion of the field activities, a Closure Report will be prepared and submitted to the NDEP for review and approval.

### Table ES.1-1
Summary of CASs Conceptual Site Model and Expected Closure

<table>
<thead>
<tr>
<th>CAS</th>
<th>Potential Release Mechanisms of COCs</th>
<th>Conceptual Site Model: Release Pathways of COCs</th>
<th>Expected Closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud Pits - 07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 08-09-03, 10-09-02, 10-09-04, 10-09-05</td>
<td>Potential COPCs, liquid or solid, released from mud pit to native soils below</td>
<td>Limited vertical movement of contaminants on the surface to shallow subsurface soils</td>
<td>Close in place with use restriction</td>
</tr>
<tr>
<td>10-09-06, Mud Pit; Stains; Materials</td>
<td>Potential COPCs, liquid or solid, released from mud pit to native soils below</td>
<td>Limited vertical movement of contaminants on the surface to shallow subsurface soils</td>
<td>Close in place with use restriction</td>
</tr>
<tr>
<td>25-15-01, Waste Dump</td>
<td>Potential COPCs, liquid or solid, released from waste dump to native soils below</td>
<td>Limited vertical movement of contaminants near the surface to shallow subsurface soils</td>
<td>Close in place with use restriction</td>
</tr>
<tr>
<td>04-26-03, Lead Bricks</td>
<td>Lead from lead bricks to nearby soils</td>
<td>Limited vertical movement</td>
<td>N/A</td>
</tr>
<tr>
<td>01-99-01, Boxes; Pipes</td>
<td>Potential COPCs, liquid or solid, released from inside the building to soils outside</td>
<td>Limited horizontal movement of contaminants to surface soils and then vertically to shallow subsurface soils</td>
<td>Closure in place</td>
</tr>
</tbody>
</table>

N/A = Not applicable, this is a housekeeping corrective action.
1.0 Introduction

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions necessary for the closure of Corrective Action Unit (CAU) 357, Mud Pits and Waste Dump, identified in the Federal Facility Agreement and Consent Order (FFACO) (1996). This CAU contains Corrective Action Sites (CASs) located within Area 1, Area 4, Area 7, Area 8, Area 10, and Area 25 of the Nevada Test Site (NTS). The NTS is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1). The 14 CASs that comprise CAU 357 are as follows:

- 07-09-02, Mud Pit
- 07-09-03, Mud Pit
- 07-09-04, Mud Pit
- 07-09-05, Mud Pit
- 08-09-01, Mud Pit
- 08-09-02, Mud Pit
- 08-09-03, Mud Pit
- 10-09-02, Mud Pit
- 10-09-04, Mud Pit
- 10-09-05, Mud Pit
- 10-09-06, Mud Pit; Stains; Material
- 01-99-01, Boxes; Pipes
- 04-26-03, Lead Bricks
- 25-15-01, Waste Dump

There is sufficient information and process knowledge from historical documentation and investigations of similar sites (i.e., the expected nature and extent of contaminants of potential concern [COPCs]) to recommend closure of CAU 357 using the SAFER process (FFACO, 1996). The Data Quality Objectives (DQOs) developed for CAU 357 identified data gaps that require additional data collection prior to identifying and implementing the preferred closure alternative for each CAS. A decision-based approach has been chosen to address the data collection activities. Decision I determines if COPCs are present in concentrations exceeding preliminary action levels (PALs). If COPCs are present above PALs, a Decision II investigation will be conducted to determine the extent of contamination and generate the information necessary to support the appropriate corrective action alternative to complete closure of the site.
Figure 1-1
Nevada Test Site, Nye County, Nevada
1.1 SAFER Process

The objective of the SAFER process is to document and verify the adequacy of existing information, collect sufficient information and data to affirm the closure decision, and to provide sufficient data to implement the corrective action, if necessary. This process uses DQOs to define the type and quality of data needed to complete the investigation, manage uncertainty, and conduct decision making.

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 that are verified by sampling and analyses, data evaluation, on-site observations. The remediation and closure may proceed simultaneously with site characterization as sufficient data are gathered to confirm or disprove the assumptions made in selecting the closure method. If at any time during site closure new information is developed which indicates that the closure method should be revised, the decision makers will be notified and the closure activities modified, as agreed upon, to more appropriately protect human health and the environment.

The decision process for closure of CAU 357 is summarized in Figure 1-2. This process starts with the initial investigation in which the appropriate target population(s) within each CAS (defined in the DQO process, Appendix A) is sampled. If contaminants are detected at concentrations that are above the PALs, the nature and extent of contamination has to be delineated. The process continues with additional sampling; however, contingencies are built into the process in the event new information is identified which indicates that the selected, preferred closure option should be revised. The process ends with closure of the site based on laboratory analytical results of the environmental samples and the preparation of a Closure Report. Corrective action alternatives of closure-in-place and clean closure will be evaluated for each CAS with contaminants above PALs.

Decision points which require a consensus be reached between the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office (NNSA/NSO), and the Nevada Division of Environmental Protection (NDEP) prior to continuing are indicated in Figure 1-2.
Perform site preparation activities and collect preliminary field data

Conceptual site model

Configuration of mud pit and other sites

Identify potential remedial options

Are areas most likely to be contaminated located with high confidence?

Yes

No*

Proceed to a Decision II investigation

Yes*

Have COCs been defined?

Yes

Characterize contamination through additional sampling

Decision I
Conduct biased sample collection and analyze for COPCs in target population

Identify which COPCs are present for each CAS

Are COPCs detected above PALs for the target population?

Yes

Site is below action levels; no further action required, prepare closure report

No*

No

Determine extent of contamination through additional biased sampling

Has extent of contamination been determined?

Yes*

Evaluate closure alternatives of clean closure or close-in-place

Yes

Select closure alternative*

No

Notify decision makers

Is there concurrence to continue investigation?

Yes*

Place CAS in complex CAU

No*

Remove material and collect verification samples

If clean closure, determine volume of material to be remediated

If close-in-place, determine appropriate use restrictions and implement*

Are verification samples below PALs?

Yes*

Investigation complete; prepare closure report

No

*DOE and NDEP will be notified prior to proceeding

CAU 357 Closure Decision Process
1.2 **Summary of Corrective Actions**

This section summarizes the types of activities that will support the closure of CAU 357. Additional details regarding these activities are given in Section 3.0 and Appendix A:

- Perform site preparation activities (e.g., utilities clearances, geophysical surveys).
- Perform housekeeping activities for debris at various CASs, as required.
- Collect environmental samples from designated target populations (i.e., mud/soil cuttings) and submit for laboratory analysis.
- Perform site characterization activities to define the nature and extent of contamination in order to select an appropriate corrective action alternative. Collect environmental samples from biased locations to confirm or disprove the presence of COCs (i.e., nature of contamination) if this data does not already exist. Collect environmental samples from designated target populations (e.g., clean soil adjacent to contaminated soil) and submit for laboratory analyses to define the extent of contamination.
- Determine if no further action is the preferred alternative if no contaminants are detected above PALs.
- Determine if clean closure is the preferred closure alternative. If clean closure is preferred, the material to be remediated will be removed, disposed of as waste, and verification samples will be collected from remaining soil.
- Determine if closure in place is the preferred closure alternative. If closure in place is preferred, the appropriate use restrictions will be implemented.
- Confirm the preferred closure option is sufficient to protect human health and the environment or select an alternative closure option based on validated analytical data, site observations, and professional judgement.

All closure activities for CAU 357 will be documented in a Closure Report.

1.3 **SAFER Work Plan Contents**

This SAFER Plan has been developed to support the proposed data collection and closure activities for CAU 357. The format of this Plan is as follows:
• **Section 1.0** provides an introduction to this project and the SAFER process.

• **Section 2.0** provides site locations and descriptions.

• **Section 3.0** provides a description of the field activities and closure objectives.

• **Section 4.0** provides the reports and records to be generated during the investigation and closure activities.

• **Section 5.0** discusses the waste management issues for the investigation and remediation.

• **Section 6.0** discusses the project quality assurance (QA) and quality control (QC) requirements.

• **Section 7.0** provides a list of cited references.

• **Appendix A** provides the DQOs formulated for this CAU.

• **Appendix B** provides the Project Organization.

• **Appendix C** provides NDEP comments.
2.0 **Unit Description**

For CAU 357, all the CASs are found within the Yucca Flats except CAS 25-15-01: Waste Dump. Yucca Flats is a highly faulted intermountain basin, typical of the Basin and Range Physiographic Province. This province is characterized by a series of mountain ranges that trend north to south. The basin is surrounded by upland cenozoic volcanic, mesozoic plutonic, and paleozoic sedimentary rocks. The basin is being filled by coalescing alluvial fans emerging from the surrounding up faulted mountains. These alluvial fans include deposits of debris flows, sheet wash, and braided streams. Other sediments which contribute to the alluvium section are wind-blown sands and playa deposits. The average thickness of this layer is approximately 984 feet (ft) (LLNL, 1982).

Groundwater beneath Yucca Flats occurs within valley-fill, welded-tuft, bedded-tuft, and lower carbonate aquifers, and within tuff, upper clastic, and lower clastic aquitards. Groundwater flow in Yucca Flat is generally northeast to southwest. The depth to groundwater generally ranges from 535 to 1,915 ft below ground surface (bgs). Beneath the west-central and southwestern parts of the valley, the area is underlain chiefly by the upper clastic aquitard. The zone of saturation is considerably shallower and is more than a thousand feet higher in levels in the eastern two thirds of the valley. Yucca Flat is hydraulically connected with the aquitard beneath northern most Frenchman Flat. Significant lateral discharge through this strip is unlikely (Winograd et al., 1971). Groundwater flow in Yucca Flat is generally in the southwest direction (DOE/NV, date unknown). Average annual rainfall in Yucca Flat was reported as 6.31 inches (in.) (DRI, 1985).

The Waste Dump in Area 25, CAS 25-15-01, is found in Jackass Flats, which is an intermountain basin. Jackass Flats lies within the Alkali Flat-Furnace Creek Ranch subbasin and is typical of the Basin and Range Physiographic Province. The basin is surrounded on the southwest by a low-lying drainage divide, on the northwest by the southeastern slopes of Lookout Peak, on the north and northeast by small rugged hills, and on the south by northern slopes of Skull Mountain (DRI, 1988). The erosion of the surrounding Tertiary and Paleozoic uplands fill the basin and has created a layer of alluvium and colluvium with a depth of up to 1,025 ft (USGS and AEC, 1964). The depth of the local alluvium layer, existence of localized caliche, and depth to bedrock was not determined.
Groundwater levels in Jackass Flats range from 2,388 to 2,469 ft above sea level (USGS, 1997). Groundwater flow is generally to the southward direction toward Lathrop Wells, and ultimately to discharge points in the Amargosa River Valley. Average annual rainfall in Jackass Flats was reported as 4 in. (DRI, 1988).

The soil surrounding the CASs is typical desert alluvium mostly composed of fine soil and rock particles, and includes a range from coarse pebbles to loose rocks measuring up to 8 in. in diameter. The remainder of this section presents the description of CAU 357 including history, location, process knowledge, and closure standards.

2.1 History

The following sections provide brief operational histories of the 14 CASs that comprise CAU 357. Eleven CASs are mud pits related to drilling activities on the NTS. CAU 357 also consists of a CAS that is a waste dump, a CAS that contains scattered lead bricks, and a CAS with a building (1-31.2e1). None of the CASs in CAU 357 are in use and all have the current status of inactive and abandoned (FFACO, 1996).

2.1.1 History - Mud Pits

The mud pits in this CAU are by-products of drilling activities conducted at the NTS in support of the underground nuclear weapons testing. Drilling mud was typically used during drilling activities to both cool and lubricate the drill bit, suspend the drill cuttings, and assist in carrying the cuttings back to the surface where they would be deposited in a nearby mud pit (e.g., return pit) (REECo, 1994; Witt, 2000). Drilling mud was also used to stabilize the wall of the drilled hole to keep the hole from collapsing (Witt, 2000).

During typical pretest drilling, two mud pits were used to provide water and to receive drill cuttings, drill fluid, and/or circulated drilling material (Butler, 2000; Wilkes, 2000a). These mud pits were referred to as the return pit and the suction pit. There were instances where the emplacement hole for a test would be drilled, but the test would not be performed. These abandoned holes were referred to as “non-shot holes,” and are still considered pretest. Mud pits associated with CAU 357 are consistent with pretest or non-test mud pits. Figures 2-1 and 2-2 provide a view of both a return and a suction mud pit within this CAU.
Figure 2-1
Overall View of Return Mud Pit

Figure 2-2
Overall View of Suction Mud Pit
The initial drilling mud was often transported to the drill site in Baker tanks. Fresh water would be stored in the suction pit (the smaller of the two pits), until it was injected in the drill hole along with the drilling mud. As the drilling proceeded, drilling mud and drill cuttings were brought up to the surface and discharged into the return pit via a blooey line. Heavy drill cuttings and other dense materials settled at the bottom of the return pit, which was sloped to a channel leading to the suction pit. After the dense materials settled, the remaining fluid flowed through the channel into the suction pit and was subsequently pumped out for reuse in the drilling operations. A weir box was used within the channel to regulate the flow of fluids between the two pits. This process continued recirculating the fluid until the drilling activities ceased (Wilkes, 2000a and b; Witt, 2000).

Additional details regarding each mud pit CAS (e.g., associated emplacement holes and pit configuration) are discussed in the following sections.

### 2.1.1.1 History - Mud Pit - CAS 07-09-02

This mud pit is believed to have supported the drilling activities for Borehole UE-7L which supported the Rudder test sponsored by Lawrence Livermore National Laboratory (LLNL) that occurred December 28, 1976 (DOE/NV, 2000c). This mud pit is located 50 ft west of Borehole UE-7L. Hole UE-7L was an exploratory hole and reports conflict as to actual period of drilling, it was either completed on May 29, 1986 (RSN, 1991), or September 4, 1981 (Fenix & Scisson Inc., 1983). The site was first identified December 12, 1991, by Reynolds Electrical & Engineering Co., Inc. (REECo) for their Environmental Compliance Inventory (ECI) survey form (REECo, 1991b). In addition, IT Corporation, Las Vegas, personnel conducted a site visit on January 9, 2002 (IT, 2002). Subsequent to performing the activities detailed in this report, IT Corporation’s contract with the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office was novated to Shaw Environmental, Inc. (Shaw). As a result of this novation and to standardize reporting, all IT Corporation activities associated with this project are herein referred to as Shaw.

### 2.1.1.2 History - Mud Pit - CAS 07-09-03

The site was first identified on September 2, 1993, by Shaw personnel during field activities. A preliminary investigation was performed on January 9, 2002 (IT, 2002). The source of the mud is unknown.
2.1.1.3 History - Mud Pit - CAS 07-09-04

The mud pit was first identified during field activities conducted by Shaw personnel on September 2, 1993. This site appears to be a mud staging area and not a traditional mud pit. It is believed to have supported multiple drilling activities within Area 7 (IT, 2002). The source of the mud is unknown.

2.1.1.4 History - Mud Pit - CAS 07-09-05

Historical record review indicates that this mud pit may have supported two separate drilling operations: (1) an emplacement hole (U-7n), completed February 24, 1966 (Fenix & Scisson, 1966), which was drilled to a total depth of 600 ft with a bit diameter of 86 in. (RSN, 1991); and (2) an exploratory hole (UE-7n) that was suspended on April 14, 1976 (Fenix & Scisson, 1976), having achieved 75 ft total depth using a 36-in. bit (RSN, 1991). These drilling activities are associated with the Bourbon test, conducted on January 20, 1967, which was sponsored by LLNL (DOE/NV, 2000c). The site was first identified for the FFACO by Shaw field personnel on September 1, 1993 (FFACO, 1996).

2.1.1.5 History - Mud Pit - CAS 08-09-01

This mud pit is believed to have supported the exploratory drill hole named UE-8h, which is associated with the Cyathus test that occurred March 6, 1970, and was sponsored by LLNL (DOE/NV, 2000c). The drilling of UE-8h was completed on April 23, 1971. The CAS 08-09-01, Mud Pit, was first identified for the FFACO during September 2, 1993, field activities by Shaw personnel (FFACO, 1996).

2.1.1.6 History - Mud Pit - CAS 08-09-02

It is believed that the mud pit supported post-test activities associated with the Baneberry test, which occurred December 18, 1970, and was sponsored by LLNL (DOE/NV, 2000c). The Baneberry test vented and released radioactive fallout. On March 1, 1971, the post-test drill hole (U-8d PS #2A), which is associated with this mud pit, was drilled (Fenix & Scisson, 1971a). The site was first identified for the FFACO on August 31, 1993, by Shaw field personnel during field activities (FFACO, 1996).
2.1.1.7 History - Mud Pit - CAS 08-09-03

It is believed that these two mud pits (it is unclear from the documentation which pit is the return and which is the suction) supported post-test activities associated with the Baneberry test, which occurred December 18, 1970, and was sponsored by LLNL (DOE/NV, 2000c). The Baneberry test vented and released radioactive fallout. On April 26, 1971, the post-test drill hole (U-8d PS #3A), which is associated with this mud pit, was completed (Fenix & Scisson, 1972b). The site was first identified for the FFACO on August 31, 1993, by Shaw field personnel during field activities. Shaw personnel conducted a site reconnaissance visit on January 9, 2002 (IT, 2002).

2.1.1.8 History - Mud Pit - CAS 10-09-02

These two mud pits are believed to have supported the emplacement drill hole U-10as, which was completed on July 24, 1971 (Fenix & Scisson, Inc., 1971b). This drill activity is associated with the Pinedrops-Bayou, Pinedrops-Sloat, and Pinedrops-Tawny tests, which occurred on January 10, 1974 (RSN, 1991). The site was first identified during the original REECo ECI survey conducted in 1990 when it was designated as an open pre-emplacement mud pit(s) west of the potential crater at U-10as (REECo, 1991b). The mud pit was most likely created to support drilling operations at U-10as, but the mud pit may also have been used during other drilling operations. Consequently, exact dates during which the mud pit was utilized were not identified, and the chemical and physical constituents used at the mud pits is unknown. Shaw personnel conducted a site reconnaissance visit on January 9, 2002 (IT, 2002).

2.1.1.9 History - Mud Pit - CAS 10-09-04

The mud pit of CAS 10-09-04 is associated with drill hole U-10aj-G located approximately 60 ft to the west. The past uses of this site were not clearly documented. It is assumed that the primary waste disposed to this mud pit was the pretest drill cuttings from the U-10ajG emplacement hole. It is uncertain if any other waste was disposed there. The site was not part of the original REECo ECI survey conducted in 1990. It was identified in the U.S. Department of Energy: Environment, Safety, and Health Compliance Assessment of the Nevada Test Site (DOE, 1990). Shaw personnel attempted to conduct a site reconnaissance visit on January 9, 2002; however, dose rates, due to the emination of gamma photons from the nearby CAS 10-09-03, prevented a thorough inspection to determine what
debris and other constituents may be part of the site. No drill logs were located for drill hole U-10aj-G which is assumed, by proximity, to be associated with this mud pit; therefore, it was not possible to determine when the drilling occurred.

2.1.1.10 History - Mud Pit - CAS 10-09-05

It was not determined when this mud pit was constructed or what activities it supported. This CAS was not part of the original REECo ECI survey conducted in 1990. It was first identified by a Shaw field crew on August 24, 1993, for the environmental sites inventory. It is not known from historical documentation when this “mud” pit was constructed, what its past uses were, which drilling operation (if any) was involved, or which test it might have supported. It is possible that this pit was a “borrow pit” for construction of nearby roads, and not as a mud pit for drilling operations. Shaw personnel conducted a site visit on January 9, 2002, where it was observed that the pit did not appear to contain a mud bottom that is similar, or typical, to other mud pits previously investigated (IT, 2002).

2.1.1.11 History - Mud Pit; Stains; Material - CAS 10-09-06

This mud pit is believed to have supported activities associated with the drilling of U-10am #5 experimental hole. U-10am #5 was completed on June 21, 1969 (RSN, 1991), in support the Tun-D test conducted on December 10, 1969, which was sponsored by LLNL (DOE/NV, 2000c). The past uses of this site were not determined due to the lack of operational knowledge. Consequently, exact dates during which the mud pit was utilized were not identified. The site was not part of the original REECo ECI survey. It was first identified for the FFACO by Shaw field personnel on October 12, 1993. Shaw personnel conducted a site reconnaissance visit on January 9, 2002 (IT, 2002).


The waste dump is thought to have been constructed after 1976 and prior to 1981, but the period of operation is unknown. A former REECo employee, working under the Westinghouse Electric Corporation Contract for the Missile Experiment (MX) Program, stated that he had used the dump prior to the MX program as a disposal site for objects that were disassembled as part of the process to clear the location for MX tower construction (Center for Land Use Interpretation, 1996). The MX Program operated from 1978 to 1983, at the Reactor Maintenance, Assembly, and Disassembly (R-MAD) Facility. It cannot be confirmed that this was the only period of activity. The site was
designated as a sanitary landfill during the original 1990 REECo ECI survey (REECo, 1991a); although, it was later determined that the site location was incorrectly described in that document. Shaw personnel visited the site May 6, 1998; July 14, 1999; and January 11, 2002.

2.1.3 History - Lead Bricks - CAS 04-26-03

The lead bricks are believed to have been left in situ from activities associated with the Apple-1, Fox, Kepler, and Nancy tests, which occurred between 1952 through 1957. The site was first identified in the October 23, 1990 (REECo, 1991a). Shaw personnel conducted a reconnaissance site visit on January 19, 2002 (IT, 2002). This site is located within posted Radioactive Materials Area (RMA) that is contaminated with fused radiologically contaminated soil (i.e., trinity glass).

2.1.4 History - Boxes; Pipes - CAS 01-99-01

Designed by the engineering department of Union Carbide, Building 1-31.2e1 was erected for Project 31.2, *Damage to Commercial and Industrial Buildings Exposed to Nuclear Effects*, as a blast-resistant control room. The structure is in good condition and is listed on the NTS historical building register (DRI, 2000), which means impacts to the building during characterization must be minimized. The building was constructed as a support facility for Operation Teapot. As part of Operation Teapot, the weapons-related Apple-2 atmospheric test, which had a yield of 29 kilotons (kt), was conducted in Area 1 on May 5, 1955, (DOE/NV, 2000c).

The “scientific hardware” within Building 1-31.2e1 may not be related to Apple-2 and most probably is reflective of the structure’s reuse during the Galileo test (DRI, 2000). The site was first identified during the original REECo ECI survey conducted in 1990 (REECo, 1991b). Shaw field personnel conducted a reconnaissance site visit on February 19, 2002.

2.2 Site Location and Description

The CASs within CAU 357 are located within Area 1, Area 4, Area 7, Area 8, Area 10, and Area 25 of the NTS (see Figure 1-1). The 11 mud pit CASs are located in Area 7, Area 8, and Area 10 and are shown in Figures 2-3 through 2-13. Figure 2-14 shows the footprint of the waste dump CAS located in Area 25 of the NTS containing nonhazardous materials and construction debris associated with the MX Program. The Area 4 CAS contains the scattered lead bricks associated with atmospheric testing.
conducted at the T-4 Bunker and is shown in Figure 2-15. Figure 2-16 shows the Building 1-31.2e1 containing the header assembly and wooden boxes located in Area 1 of the NTS. The following sections provide additional information on the location and description of each CAS (Table 2-1). The description of work to be performed at each CAS is explained in detail within Section 3.0.

### Table 2-1

**CAS Coordinates**

<table>
<thead>
<tr>
<th>CAS</th>
<th>Easting (Meters)</th>
<th>Northing (Meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-09-02</td>
<td>585218.3</td>
<td>4106664</td>
</tr>
<tr>
<td>07-09-03</td>
<td>584892.4</td>
<td>4106707</td>
</tr>
<tr>
<td>07-09-04</td>
<td>586882.6</td>
<td>4103628</td>
</tr>
<tr>
<td>07-09-05</td>
<td>588617.1</td>
<td>4106090</td>
</tr>
<tr>
<td>08-09-01</td>
<td>579813.3</td>
<td>4114352</td>
</tr>
<tr>
<td>08-09-02</td>
<td>579948.9</td>
<td>4114155</td>
</tr>
<tr>
<td>08-09-03</td>
<td>579904.3</td>
<td>4114168</td>
</tr>
<tr>
<td>08-09-02</td>
<td>584200.9</td>
<td>4114411</td>
</tr>
<tr>
<td>08-09-04</td>
<td>585190.0</td>
<td>4113537</td>
</tr>
<tr>
<td>10-09-05</td>
<td>582345.4</td>
<td>4113819</td>
</tr>
<tr>
<td>10-09-06</td>
<td>581952.6</td>
<td>4114072</td>
</tr>
<tr>
<td>01-99-01</td>
<td>580584.9</td>
<td>4099452</td>
</tr>
<tr>
<td>04-26-03</td>
<td>579687.2</td>
<td>4105597</td>
</tr>
<tr>
<td>25-15-01</td>
<td>567660.9</td>
<td>4075158</td>
</tr>
</tbody>
</table>

Given in Universal Transverse Mercator coordinates: Zone 11 (North American Datum 27)

#### 2.2.1 Site Location and Description - Mud Pit - CAS 07-09-02

CAS 07-09-02, Mud Pit, is located past the Radiation Safety (RadSafe) Base Station in Area 7 of the NTS. This CAS is reached by traveling north on Mercury Highway to 7-01 Road. Turn right (northeast) on 7-01 Road and proceed for 0.4 mi to the north-south access road. Turn north on the north-south access road and proceed past the RadSafe Base Station. Turn right (east) onto a dirt road at the last dirt berm and proceed 2.35 mi. The mud pit will be on the north side of the road. See Figure 2-3 for a sketch of the site including relationship to nearby dirt access road.

This mud pit was constructed previous to, or concurrently with, the drilling operations for the exploratory hole UE-7L located about 50 ft to the east (REECo, 1991b). Exploratory hole UE-7L
Figure 2-3
CAU 357, CAS 07-09-02, Mud Pit
was drilled to a depth of 2,718 ft and a diameter of 12.25 in. (RSN, 1991). Also, approximately 1,000 ft of Halliburton’s wireline and a lead weight were left in the hole.

Today the site consists of a mud pit defined by a rectangular bermed area. The bermed, sloped areas are considered the boundaries of the mud pit which is approximately 40 ft wide by 115 ft long. The bottom of the pit is sloped from east to west. The length of the pit is running in an east-west direction. The mud within the pit is light gray in color and a reddish material that appears to be soil is also at the bottom of the pit. There is no evidence of mud or spills outside of the mud pit. Vegetation in the mud pit appears to be sparse. Visible surface debris located within the mud pit and on the berms includes wood scraps and stakes, rusted metal, and plastic bottles.

2.2.2 Site Location and Description - Mud Pit - CAS 07-09-03

CAS 07-09-03, Mud Pit, is located past the Radiation Safety (RadSafe) Base Station in Area 7 of the NTS. This CAS is reached by traveling north on Mercury Highway to the 7-01 Road. Turn right (northeast) on 7-01 Road and proceed for 2.35 mi. Turn right (east) onto a dirt road just past the dirt mounds and berm at the RadSafe Base Station. Proceed 0.15 mi, the mud pit/disposal area is located on the left (north) side of the road.

The CAS was first identified on September 2, 1993. The FFACO (1996) describes the site as being a mud pit. However, as a result of an Shaw field visit on January 9, 2002, it was determined that the CAS site is most likely a mud disposal and/or haul truck washout “pit” area. Because the site is divided by an abandoned, or infrequently used dirt road, the areas in this mud pit disposal area will be referred to in this report as mud pit A and mud pit B. It does not appear that mud pit A or B underwent any construction efforts, aside from the actual road emplacements; but rather, they were used as disposal/washout areas due to their proximity to the dirt roads and the area’s localized natural topographic relief, which promotes liquid containment. The terrain slopes gently down from the east into the mud pit areas, where the natural drainage trends north. Undisturbed native soil has been covered in many places by mud. The west side is bounded by an 8- to 15-ft high natural berm (terrace or channel bank). See Figure 2-4 for a sketch of the site.

More specifically, mud pit A is located south of the abandoned dirt road and north of the dirt access road. It is elongated in a north-south trend, irregular in shape, and has no defined berm on the north
Figure 2-4
CAU 357, CAS 07-09-03, Mud Pit
side. The dimensions are approximately 720 ft long and 230 ft wide at the southern end, but tapers to 40 ft wide at the north end. There is up to 10 in. of mud in the bottom of this mud pit. Vegetation is sparse on the bottom of this pit and completely absent in the center area where the mud is the thickest. A thin layer of light gray mud is present on the southwestern side of this mud pit.

Mud pit B is located northwest of mud pit A. The southeast berm of mud pit B makes up the northwestern berm of mud pit A and is also delineated by an abandoned, or infrequently used, dirt road. The dimensions of mud pit B are approximately 200 ft long by 120 ft wide with approximately 1 ft of mud at the bottom. Vegetation is sparse, especially where mud exists at the bottom of the pit.

The terrain slopes down into the mud pit/disposal areas, undisturbed native soil has been covered in many places by mud, and only in areas where there is mud has vegetation been disturbed. Animal burrows exist throughout the berms in both pits. Surface debris at the site consists of a wooden spool and wire (IT, 2002).

2.2.3 Site Location and Description - Mud Pit - CAS 07-09-04

CAS 07-09-04, Mud Pit, is located 150 ft from and on the left (west) side of the 3-05 Road in Area 7 of the NTS, approximately 2 mi north of the Area 3 Mud Plant. This CAS is reached by traveling north on Mercury Highway to 3-03 Road. Turn right (east) onto 3-03 Road and proceed for 1.2 mi to the 3-05 Road. Turn left (north) on the 3-05 Road and proceed approximately 2.0 mi to the mud pit, which is located on the west side of the dirt road across from the dirt road on the east side of 3-05 Road.

This site appears to be a mud staging area and not a traditional mud pit. It is assumed to have supported multiple drilling activities within Area 7 and surrounding areas. Berms define the boundaries of the mud pit, which measured 160 by 343 ft. The surface of the mud pit is approximately 4 ft below the top of the berm. A partially buried sign reads, “Buried Cable” and “Danger High Voltage”; however, the exact cable location cannot be determined. See Figure 2-5 for a sketch of the estimated site boundaries and footprint as identified during site visits and by aerial photographs. This figure includes relationships to nearby 3-05 Road, the earthen pit’s berm, and Area 3 Mud Plant.
Figure 2-5
CAU 357, CAS 07-09-04, Mud Pit
Two parallel metal pipes (33 ft apart) extend through and from the southern berm. The western pipe extends 4 ft into the mud pit, then terminates 40 ft to the south. It is an open-ended pipe used for a possible load-out zone, or overflow area; although no defined spill area has been noted. The eastern metal pipe (8 in. diameter) extends 5 ft into the mud pit and leads from the mud pit (both above and below ground), to the Area 3 Mud Plant, which is approximately 2 mi to the south (IT, 2002). Vegetation is sparse, and both the north and the south ends of the pit are covered with tumbleweeds. A wooden stand is lying near the center of the mud pit’s east berm. This stand is assumed to have rested atop the berm of the mud pit and may have held auxiliary equipment that was used to agitate the mud and/or pump mud (load) from the pit into haul trucks.

2.2.4 Site Location and Description - Mud Pit - CAS 07-09-05

CAS 07-09-05, Mud Pit, is located southeast of the left (north) fork in the dirt road off of RSM 7 G 6 Road in Area 7 of the NTS, approximately 0.5 mi northeast of the RSM 7 G 6 Road. This CAS is reached by traveling north on Mercury Highway to 3-03 Road. Turn right (east) on 3-03 Road and proceed to a fork in the road. Turn right (east) at the fork and proceed for approximately 0.2 mi to another fork in the road. Turn left (north) and proceed for approximately 0.3 mi. The mud pit is on the south side of the road. Figure 2-6 provides a sketch of the site including relationships to the nearby dirt access road, sloped berm area, and unused well (UE7ns).

The mud pit is suspected to have supported activities associated with the Bourbon test, sponsored by LLNL and conducted on January 20, 1967 (DOE/NV, 2000c). Historical record review indicates that this mud pit may have supported two drilling operations: (1) An emplacement hole (U-7n), completed February 24, 1966 (Fenix & Scisson, 1966), and drilled to a total depth of 600 ft, with a bit diameter of 86 in. (RSN, 1991); and (2) An exploratory hole (UE-7n) that was suspended on April 14, 1976 (Fenix & Scisson, 1976), having achieved a 75-ft depth using a 36-in. bit (RSN, 1991).

Shaw personnel conducted a site reconnaissance visit on January 9, 2002. It was determined that the site covers an area with dimensions of 229 by 73 ft. Multiple berms do not define the boundaries of this mud pit. The mud surface within the pit was described as light gray in color with a reddish-brown stain at the center. Both of these areas were sampled. Vegetation within the mud pit is sparse; however, there is some vegetation and small scrub trees on the southern flank of the eastern
Figure 2-6
CAU 357, CAS 07-09-05, Mud Pit
corner, near some small piping debris on the ground. There are also some tumbleweeds collecting within the mud pit. Surface debris found includes rusted metal pipes and various wood scraps.

2.2.5 Site Location and Description - Mud Pit - CAS 08-09-01

CAS 08-09-01 is located 370 ft due west of the U-8d crater in Area 8 of the NTS. This CAS is reached by traveling north on Mercury Highway to Rainier Mesa Road. Turn left (northeast) on Rainier Mesa Road and proceed to 2-07 Road. Turn right (east) onto 2-07 Road and proceed less than 0.2 mi to a dirt road on the north side of 2-07 Road. Proceed on the dirt road approximately 0.35 mi to the former Area 8 trailer park. Proceed on the dirt road that heads north out of the trailer park for approximately 0.4 mi to the U-8d crater. Proceed around the right side of the crater and the mud pit is approximately 370 ft west of the crater.

Shaw personnel conducted an in-depth reconnaissance site visit on January 11, 2002, and concluded the site correctly consists of only the mud pit area and the three surrounding berms and does not include the borrow pit area to the southeast. Three surrounding berms define the mud pit area of 75 by 50 ft. A gray mud covers the mud pit, which is approximately 11 ft below the base berm’s top. All sides of the mud pit are partially excavated and vegetation is sparse at the bottom. See Figure 2-7 for a sketch of the site including relationship to nearby crater, levelled fill area, and borrow pit. The fill dirt and graded areas are on the south side of the mud pit, labeled “Leveled Work Pad Region” in Figure 2-7. Surface debris includes two rusted 55-gallon drums (whose contents are unknown), rusted paint cans, various metal and wood scraps.

The exploratory drill hole (UE-8h), which is associated with this mud pit, was drilled to a total depth of 1,610 ft with a diameter of 9 7/8-in. (RSN, 1991) and was completed on April 23, 1971 (Fenix & Scisson, 1971a). This exploratory drill hole supported activities associated with the Cyathus test that occurred March 6, 1970, and was sponsored by LLNL (DOE/NV, 2000b).

2.2.6 Site Location and Description - Mud Pit - CAS 08-09-02

CAS 08-09-02, Mud Pit, is located 96 ft southwest of the U-8d crater in Area 8 of the NTS. This CAS is reached by traveling north on Mercury Highway to Rainier Mesa Road. Turn left (northwest) on Rainier Mesa Road and proceed to 2-07 Road. Turn right (east) onto 2-07 Road and proceed less
Figure 2-7
CAU 357, CAS 08-09-01, Mud Pit
than 0.2 mi to a dirt road on the north side of 2-07 Road. Turn left (north) onto the dirt road and proceed approximately 0.35 mi to the former Area 8 trailer park. Proceed on the dirt road that heads north out of the trailer park for approximately 0.4 mi to the U-8d crater. The mud pit is approximately 96 ft southwest of U-8d.

Figure 2-8 provides a sketch of the estimated site boundaries and footprint as identified in site visits and aerial photographs, including relationships to the nearby U-8d crater, weather station, trench, dirt mound, and other mud pits. The site consists of a mud pit whose boundary is defined by a surrounding, east to west trending berm, and covers an area with dimensions of 114 by 54 ft. Depth from the top of the berm to the pit bottom ranges from 12 ft on the north side to 6 ft on the east side. Surface debris includes various wood scraps, and a light-brown mud covers the pit. Vegetation within the mud pit area is sparse. It is believed that the mud pit supported post-test activities associated with the December 18, 1970, Baneberry test (DOE/NV, 2000c). The Baneberry test vented and released radioactive fallout. The post-test drill hole (U-8d PS #2A) was drilled to a depth of 898 ft using a 9 7/8-in. diameter bit (RSN, 1991).

2.2.7 Site Location and Description - Mud Pit - CAS 08-09-03

CAS 08-09-03, Mud Pit, is a series of mud pits located approximately 80 ft southwest of the U-8d crater in Area 8 of the NTS. Figure 2-9 provides a sketch of the estimated site boundaries and footprint as identified in site visits and aerial photographs, including relationships to the nearby U-8d crater, weather station, trench, dirt mound, and other nearby mud pit CASs. This CAS is reached by traveling north on Mercury Highway to Rainier Mesa Road. Turn left (northwest) on Rainier Mesa Road and proceed to 2-07 Road. Turn right (east) onto 2-07 Road and proceed 0.2 mi to a dirt road on the north side of 2-07 Road at RSM2L13. Turn left (north) onto the dirt road and proceed approximately 0.35 mi to the former Area 8 trailer park. Proceed on the dirt road that heads north out of the trailer park for approximately 0.4 mi to the south side of U-8d crater.

The site consists of a two-mud pit system whose boundaries are defined by surrounding berms, where the central berm is shared. It is unclear from documentation which mud pit is the return pit and which is the suction pit. Mud pit A (north) covers an area with dimensions of 53 by 24 ft. Mud pit B (south) covers an area with dimensions of 51 by 18 ft. Depth of the pits range from ground level to 6 ft bgs in the pit centers. A light-brown mud covers both mud pit floors, where vegetation was noted as sparse.
Figure 2-8
CAU 357, CAS 08-09-02, Mud Pit

Explanations:
- - - - - CAS 08-09-02 Footprint
- - - - Bermed Area and Slope Direction
* * * Proposed Biased Sample Location
** Site Marker
x x x Crater Fence Line

Scale:
0 20 40 Meters
0 80 160 Feet

Source: IT, 2002
Figure 2-9
CAU 357, CAS 08-09-03, Mud Pit
The post-test drill hole named U-8d PS #3A is associated with this mud pit and was completed on April 26, 1971 (Fenix & Scisson, 1972b), to a depth of 868 ft using a bit diameter of 9 7/8-in. Surface debris within mud pit A includes a rusted pipe and various wood scraps, and within mud pit B includes rusted metal objects, a 55-gallon drum, and a 5-gallon bucket (whose possible contents are unknown [assume empty]), two empty paint cans, some short 8-in. pipes, rope/cable, and assorted metal scraps and wood debris.

### 2.2.8 Site Location and Description - Mud Pit - CAS 10-09-02

CAS 10-09-02, Mud Pit, is located approximately 100 ft due west of the U-10as crater in Area 10 of the NTS. Figure 2-10 provides a sketch of the site including relationships to nearby U-10as crater and dirt mounds. This CAS is reached by traveling north on Mercury Highway to 2-07 Road. Turn right (east) onto 2-07 Road and proceed to Circle Road. Turn left (north) at the Circle Road intersection. Turn right (east) onto the 10-01 Road and continue for 0.4 mi. Turn left (north) just past some electrical junction boxes on the left onto an unmaintained dirt road, follow the dirt road for about 0.3 mi to the U-10as crater. The mud pit is approximately 100 ft west of U-10as crater.

The CAS consists of a two-pit mud system, with a larger suction pit A to the north and a smaller return pit B to the south. Berms carved from mud pit A form and define the boundaries of the total mud pit system. Mud pit B has been partially backfilled. A partially buried metal pipe, approximately 20 ft in length, runs between the two pits. These mud pits are believed to have supported the emplacement drill hole U-10as, which was drilled to a depth of 1,200 ft (Fenix & Scisson, Inc., 1971b). This drill activity is associated with the Pinedrops-Bayou, Pinedrops-Sloat, and Pinedrops-Tawny tests which occurred on January 10, 1974 (RSN, 1991).

It was determined that the mud pit A (suction) site covers an area with dimensions of 115 by 80 ft, berm height or depth of excavated soil is 8 ft, and depth of mud is approximately 1 ft. The volume was calculated at 9,200 cubic feet, but it was not determined if the mud pit may have been used during other drilling operations. Consequently, exact dates during which the mud pit was used were not identified. The volume of the mud pit was estimated based on visual observation at the CAS. The exact volume was not determined. A light-beige mud was noted on the bottom of the pit with no presence of staining visible. Surface debris consists of various wood scraps, a metal fence post, and partially buried, black, tarp-like material. Vegetation in the pit is sparse; however, tumbleweeds are
Figure 2-10
CAU 357, CAS 10-09-02, Mud Pit
thick along the western and northern sides. It has also been determined that the return mud pit B has been partially backfilled and currently covers an area with dimensions of 38 by 22 ft, berm height is 2 ft, and estimated depth of mud is approximately 1 ft. The volume of mud was calculated to be 836 cubic ft. Vegetation in this pit is also sparse and no mud, nor staining, is visible at the bottom of the mud pit.

2.2.9 Site Location and Description - Mud Pit - CAS 10-09-04

CAS 10-09-04, Mud Pit, is located about 1,000 ft south of 10-01 Road, and 150 degrees from the standing “bridge structure” in Area 10 of the NTS. Figure 2-11 provides a sketch of the site, including relationships to nearby drill holes. This CAS is reached by traveling north on Mercury Highway to Rainier Mesa Road. Turn left (northwest) on Rainier Mesa Road and proceed to 2-07 Road. Turn right (east) onto 2-07 Road and proceed to Circle Road. At the Circle Road intersection turn left (north). Turn right (east) onto the 10-01 Road and proceed for 1.1 mi. The mud pit is south of the road, 1,000 ft and 150 degrees from the standing bridge structure.

No drill logs were located for drill hole U-10aj-G, which is assumed (by proximity) to be associated with this mud pit. U-10aj-G is located approximately 60 ft to the west. The primary waste disposed to the mud pit is assumed to be from the pre-test drilling of the U-10ajG emplacement hole. Possible other past uses of this site were not clearly documented.

The dimensions of the berm-defined mud pit is 175 by 75 ft (trending east-west). The west, east, and south berms are approximately 3 ft high by 5 ft wide. The north berm is much larger, measuring approximately 8 ft high and 15 ft wide. The floor of the mud pit is approximately 10 ft below grade. Using an estimated mud depth of 1 ft (based on limited visual observation at the site during a previous site visit), a volume of 13,125 cubic ft of mud was calculated. The north end and northeast corner of the mud pit floor was observed to be covered with tumbleweeds and some vegetation. The remaining area in the mud pit floor was void of vegetation and was covered with a light-brown, gravelly sand. There is a large mud spill north of the north berm. The mud in the spill is dry and light gray in color. There are no signs of stains or odors. Debris at the site consists of cables and wires.
Figure 2-11
CAU 357, CAS 10-09-04, Mud Pit
2.2.10 Site Location and Description - Mud Pit - CAS 10-09-05

CAS 10-09-05, Mud Pit, is located north of both U2ey and of U10v on the west side of the dirt access road in Area 10 of the NTS. Figure 2-12 provides a sketch of the site including relationships to the nearby dirt access road and gravelly sand pile. This CAS is reached by traveling north on Mercury Highway to Rainier Mesa Road. Turn left (northwest) on Rainier Mesa Road and proceed to 2-07 Road. Turn right (east) onto 2-07 Road and proceed for 1.7 mi. Turn left (north) onto the dirt road and proceed for 0.3 mi passing around U-2ey and past U-10v. The mud pit is located on the west side of the road.

The CAS consists of a large “mud” pit that is potentially a borrow pit, and is barren of drilling mud. A small amount of light-brown mud is visible where rain waters has ponded. The majority of the soil in the pit appears to be native, fine to coarse sands and some small gravels, although it is dessication cracked in some areas at the pit floor.

It was not determined when this mud pit was constructed or what activities it might have supported. This mud pit does not appear to contain typical mud associated with other mud pits investigated. The soil in the pit appeared consistent with soil in the surrounding area. The vegetation and soil surface at the site appears to be distressed due to the construction of the pit with the vegetation being slightly more sparse at the bottom of the pit than in surrounding areas.

The walls of the pit are approximately 15 ft bgs, while the bottom of the pit is about 20 to 25 ft bgs. The pit is approximately 450 by 75 ft and oriented east west. At the west end of the pit, there is a dirt road that heads south approximately 300 ft to a large pile of gravelly sand, similar to the material from the pit. The berm on the east end of the pit is gently sloping and may have been used as a ramp for vehicles backing into the pit. Drilling-media type and dates during which the pit may have been used as a mud pit were not identified. It is believed that the pit may have been used as a borrow pit for the construction of nearby roads and not as a mud pit for drilling operations. Debris at the CAS consisted primarily of orange hurricane fencing materials.

2.2.11 Site Location and Description - Mud Pit; Stains; Material - CAS 10-09-06

CAS 10-09-06, Mud Pit; Stains; Material, is located east of the U-10am #5 potential crater in Area 10 of the NTS. Figure 2-13 provides a sketch of the site including relationships to the nearby soil pile,
Figure 2-12
CAU 357, CAS 10-09-05, Mud Pit
grout pile, cement spill, and a “palm tree” of yellow-orange insulation-coated casing (trunk) and black cables (palm leaves). This CAS is reached by traveling north on Mercury Highway to Rainier Mesa Road. Turn left (northwest) on Rainier Mesa Road and proceed to 2-07 Road. Turn right (east) onto 2-07 Road and proceed for 1.4 mi. Turn left (north) onto the dirt road at the U-110am#3 crater. Continue on the dirt road for 0.5 mi around the east side of the U-10am#3 and U-10am#4 craters to U10am#5. The mud pit is to the east of the U-10am#5 potential crater.

This mud pit is believed to have supported activities associated with the drilling of the U-10am #5 experimental hole, which was drilled to a depth of 454 ft on June 21, 1969 (RSN, 1991), to support the Tun-D test that was conducted on December 10, 1969, and was sponsored by LLNL (DOE/NV, 2000c).

The pit covers a northwest to southeast trending area with approximate dimensions of 145 by 75 ft. Elevated berms do not define the boundaries of this mud pit. The excavated soil appears to have been piled on the northeast side and the excavated wall height is 8 ft. Using an estimated mud depth of 1 ft, based on limited visual observation at the site, mud volume was calculated to be 10,875 cubic ft. It was observed that the northwest area of the pit contains a light-gray, cracked spill with the appearance of concrete or grout. Another larger, similar-type spill exists off the southwest pit corner. The vegetation and surface area at the site appears distressed, apparently due to activities during the construction of the mud pit. Soil within the mud pit, not including the mud, appears to be consistent with the surrounding native soil. Identified surface debris includes rusted metal cables and assorted scrap metal, wood scraps, polymer for cables, and the aforementioned spills of cement or grout.

2.2.12 Site Location and Description - Waste Dump - CAS 25-15-01

CAS 25-15-01, Waste Dump, is located approximately 0.3 mi north of the R-MAD Facility on the east side of the railroad tracks in Area 25. It consists of a construction waste dump surrounded by large dirt mounds (soil piles). Figure 2-14 provides a sketch of the site including relationships to nearby dirt mounds, roads, and railroad tracks. This CAS is reached by traveling west on Jackass Flats Road for approximately 20.9 mi to the Area 25 Gate (abandoned). Continue north through the gate on “C” Road. Turn right (east) on “G” Road and continue to the R-MAD Facility. At the R-MAD Facility, turn left (north) and proceed 0.3 mi to a dirt road and turn right. Continue to the
Figure 2-13
CAU 357, CAS 10-09-06, Mud Pit; Stain; Material
Figure 2-14
CAU 357, CAS 25-15-01, Waste Dump
road that runs along the railroad tracks, turn left. Follow the tracks as the road leads over the tracks to the large berms, which mark the landfill.

The northern end of the site has been backfilled, while the south end consists of an open pit containing various debris. The disturbed area of the site was measured approximately 200 by 120 ft and observed to be excavated 15 ft below grade. The open pit area at the south end is approximately 120 by 80 ft. Three large soil piles surround the zone of excavation and appear to be the excavated (soil) material from the open pit area (IT, 2002). The terrain is uneven in the dump area, and vegetation is sparse compared to vegetation in surrounding areas.

2.2.13 Site Location and Description - Lead Bricks - CAS 04-26-03

CAS 04-26-03, Lead Bricks, consists of scattered lead bricks throughout an area west of the T-4 Bunker, which is located north of the 4-04 Road in Area 4. Figure 2-15 provides a sketch of the CAS including relationships to nearby T-4 Bunker and 4-04 Road. This site is within a posted RMA which contains fused radiologically contaminated soil (i.e., trinity glass). This CAS is reached by traveling north on Mercury Highway to Rainier Mesa Road. Turn left (northwest) on Rainier Mesa Road and proceed to 4-04 Road. Turn left (west) onto the 4-04 Road for approximately 2 mi to the T-04 bunker which is on the north side of the road.

Surface debris in the scatter area includes a metal bucket, a metal gas cylinder, barbed-wire cables, various metal pieces and scraps, and poly-brick material. The contents of the metal bucket and gas cylinder have not been determined.

2.2.14 Site Location and Description - Boxes; Pipes - CAS 01-99-01

CAS 01-99-01, Boxes; Pipes, is located in Area 1 of the NTS. The CAS consists of Building 1-31.2e1, the wooden boxes and the network of metal pipes inside the building, and the proximal soils surrounding the building. The area dimensions of Building 1-31.2e1 are 28 by 22 ft and the wall is 15 ft high. Figure 2-16 provides for the estimated site boundaries and footprint as identified in site visits and aerial photographs. This CAS is reached by traveling north on Mercury Highway to Pahute Mesa Road. Turn left (west) on Pahute Mesa Road and follow to Orange Road. Turn left (south)
Figure 2-15

CAU 357, CAS 04-26-03, Lead Bricks
onto Orange Road and travel to RSM 0-30. Proceed 0.1 mi past RSM 0-30, turn left (east) onto the
dirt road and proceed for 0.9 mi to Building 1-31.2e1.

The objective for investigating CAS 01-99-01 is to identify the human health and/or environmental
hazard(s) originating from the release of materials located inside and/or from Building 1-31.2e1, also
known as the Union Carbide Building. The walls and flat roof are poured “Class 2”
structural-gypsum supported by structural-steel beams. The building is bolted to a reinforced
concrete slab (~ 2 ft thick). No drain pipes were observed on the floor area. A series of smaller
(approximately 1 1/2 in.) metal pipes appear to serve as a support structure for the main header and
distribution pipes. The smaller pipes bolt to the floor and come over the top of the main header and
distribution pipes. Directly in front of each of the six distribution pipes is one wooden box. Each of
six boxes is open on the front and back, and each box was formerly connected to an individual
distribution pipe. It is possible that a filter of some type was connected to the open front of each box,
which have either been removed or deteriorated away over time. Each distribution pipe was
connected to an individual (filter) box. Two other wooden boxes are located within the building and
do not appear to be currently associated with the aforementioned piping system. It appears that a
metal filter is still affixed to the top of one of these other two boxes (IT, 2002).

The engineering drawings indicate that the upper 3 ft of the north and south walls were originally
constructed of translucent corrugated plastic panels. At some point, these panels were replaced with
vertical wooden lath/siding. The structure has a single 3- by 7-ft doorway in the center of the west
wall. The original steel door is missing and the lower portion of the doorway has been boarded up.
The east (back) wall has a single 2.5- by 2.5-ft window framed into one of the northern gypsum
panels, which is not indicated on the original engineering drawings. The building’s interior contains
a pair of iron pipe railings and a large diameter horizontal conduit (also known as a header or
manifold) extending across the back center of the structure. A series of plywood boxes are attached
to the conduit via square metal flanges. The structure is in good condition and is listed on the NTS
historical building register (DRI, 2000).

The building was constructed as a support facility to Operation Teapot. Under Operation Teapot, the
weapons-related Apple-2 test was conducted in Area 1 on May 5, 1955 (DOE/NV, 2000c). The
“scientific hardware” within Building 1-31.2e1 may not be related to Apple-2 and most probably is
reflective of the structure’s possible reuse during the Galileo test (DRI, 2000). It is unknown specifically what this building was used for, but it appears to have been used for ventilation of some type during either the atmospheric Apple-2 and/or Galileo test(s). Note, it was documented that 30 ft northeast of the building is a fenced area 40 by 80 ft (outside the CAS boundary, and not presented in Figure 2-16), which may have been used as an aboveground storage area and/or an underground burial landfill (REECo, 1991a).

Debris at the CAS consists of wooden planks, wooden boxes, rusted (header, distribution, and ventilation) piping and metal supports, exposed and cut electrical wires, rusted and disabled fuse box, and a possible metal filter. Buried electrical lines may be located for the building, which were used for power.

### 2.3 Process Knowledge

Process knowledge for the CASs in CAU 357 has been obtained through historical document reviews, engineering drawing and map reviews, and interviews with past and present NTS employees. Some uncertainty remains regarding general knowledge of past operations for this CAU. Site-specific historical documentation pertaining to each CAS’s operation is also limited.

Additional information about each CAS has also been gained through recent site visits when samples were collected. Analytes detected, or detected at concentrations above background, may be added to the list of COPCs. Arsenic has been found in soil samples from NTS above action levels and exceeding U.S. Environmental Protection Agency (EPA) generic soil screening levels (SSL) for ingestion (Bordelois, 1998a). However, high arsenic concentrations are not unusual for the NTS and may fall within the acceptable ranges (Moore, 1999).

With the process knowledge and other information gained about the site, a conceptual site model (CSM) can be developed. Based on the process knowledge and information about the site, assumptions can be made to formulate a CSM that describes the most probable scenario for the current conditions at each CAS. Appendix A, Section A.1.2.3, provides additional information on the CSMs developed for CASs in CAU 357.
2.3.1 Process Knowledge - Mud Pits

The main constituent of drilling mud was a powdered clay mixed with water. Bentonite and sepiolite were the two types of powdered clay used at the NTS (REECo, 1994). Additives were included in the fluid mixture to enhance the properties of the clay, and subsequently enhancing the performance of the drilling equipment. Information indicates that some of these additives might contain Resource Conservation Recovery Act (RCRA) or State of Nevada-regulated contaminants (e.g., chromium often found in products such as Raykrome 400). Other COPCs that are common constituents of the drilling mud would generally be air foam (detergent), antifreeze, pipe-dope containing lead or copper, grease, and a variety of petroleum hydrocarbon products (primarily diesel fuel). However, it is unknown which additives were included in the drilling formulation for these particular operations.

The COPCs, in addition to known COCs detected from site-specific sampling, were determined for the mud pits from various sampling events at other NTS mud pits and at off-site locations (Bordelois, 1998a, b, c, d; DOE/NV, 1999a). These include total petroleum hydrocarbons (TPH)-diesel-range organics, metals (arsenic, barium, chromium, and lead in particular have been detected at some of the CASs), polychlorinated biphenyls (PCBs), various solvents (light non-aqueous phase liquids [LNAPLs] and dense non-aqueous phase liquids [DNAPLs]), and various radionuclides (Adams, 2000; LANL, 1991; Rowe, 2001; Wilkes, 2000a; Witt, 2000). Radionuclides (i.e., potassium-40, lead-212, lead-214, and thallium-208) are naturally occurring and are found in soil at measurable concentrations. Although they would be expected in drilling mud, their concentrations may vary from soil. A list of common mud additives compiled from historical sources and interviews is located in Table A.1-2 of Appendix A.

Data collected during the site characterization of CAU 417, the Central Nevada Test Area surface, by Shaw and reported in Appendix D of the CADD supports the assertion that drilling muds (which are primarily clays) are effective at containing TPH, thus preventing TPH contamination from spreading into underlying native material (DOE/NV, 1999). Characterization results of CAU 34, Area 3 Contaminated Waste Sites, also showed that the mud was effective at preventing contaminant migration from the drilling mud into the native material. Two CASs with TPH greater than the Nevada State action level were closed in place with use restrictions (NNSA/NV, 2002a). The Closure Report for CAU 356, Mud Pits and Disposal Sites, had two mud pits with TPH greater than the Nevada State action level that were closed in place (NNSA/NV, 2002a). The implementation of the
SAFER Plan for CAU 355, Area 2 Cellars/Mud Pits, closed 13 cellars and mud pits with use restrictions for the contamination left in place (NNSA/NSO, 2003).

Due to the lack of data for CAU 357 mud pits, all the CASs identified for a radiation survey also will have the soil samples collected and analyzed for the same radionuclide COPCs as CAU 355 (e.g., americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes).

### 2.3.1.1 Process Knowledge - Mud Pit - CAS 07-09-02

Circulating media used at this CAS includes 3,000 barrels of air foam; 2,640 barrels of gel mud; 3,240 barrels of lost circulation material (LCM); and 480 barrels of chemical mud (Fenix & Scisson Inc, 1983). Therefore, the drilling muds and their associated constituents will be the primary source of potential contamination.

From a soil sample collected at this CAS, the following COCs were identified: semivolatile organic compounds (SVOCs), TPH, volatile organic compounds (VOCs), acetone, arsenic, barium, chromium, lead, plutonium isotopes, strontium-90, and uranium isotopes.

### 2.3.1.2 Process Knowledge - Mud Pit - CAS 07-09-03

Site-specific information regarding exact materials used for circulating media dumped in the mud pit CAS 07-09-03 were not identified during historical review or interviews, rather they were identified through general process knowledge.

From soil samples collected at sites assumed to be similar to this CAS, the following COPCs were identified: SVOCs, TPH, VOCs, arsenic, barium, chromium, lead, americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes.

### 2.3.1.3 Process Knowledge - Mud Pit - CAS 07-09-04

Site-specific information regarding exact materials used for circulating media dumped in the mud pit, CAS 07-09-04, were not identified during historical review and interviews, rather they were identified through general process knowledge.
From a soil sample collected at this CAS, the following COPCs were identified: SVOCs, TPH, VOCs, arsenic, barium, chromium, lead, uranium isotopes, plutonium isotopes, strontium-90, cesium-137, americium-241, cobalt-60, and europium isotopes.

2.3.1.4 Process Knowledge - Mud Pit - CAS 07-09-05

Site-specific information regarding exact materials used for circulating media dumped in the mud pit, CAS 07-09-05, were not identified during historical review and interviews, rather they were identified through general process knowledge.

From soil samples collected at this CAS, the following COPCs were identified: SVOCs, TPH, VOCs, arsenic, barium, chromium, lead, uranium isotopes, plutonium isotopes, strontium-90, cesium-137, americium-241, cobalt-60, and europium isotopes.

2.3.1.5 Process Knowledge - Mud Pit - CAS 08-09-01

Air foam and Davis Mix were believed to be the circulating media for the Borehole UE-8h, the exploratory drill hole associated with this mud pit (Fenix & Scisson, 1971a).

From a soil sample collected at this CAS, the following COPCs were identified: SVOCs, TPH, VOCs, arsenic, barium, chromium, lead, uranium isotopes, plutonium isotopes, strontium-90, cesium-137, americium-241, cobalt-60, and europium isotopes.

2.3.1.6 Process Knowledge - Mud Pit - CAS 08-09-02

The post-test drill hole (U-8d PS #2A) was completed to a total drilled depth of 898 ft with a 9 7/8 in. diameter bit and used air foam and other conventional drilling media (e.g., Davis Mix) (RSN, 1991).

From soil samples collected at similar sites assumed to be similar as this CAS, the following COPCs were identified: SVOCs, TPH, VOCs, arsenic, barium, chromium, lead, americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes.
2.3.1.7 Process Knowledge - Mud Pit - CAS 08-09-03

The post-test drill hole (U-8d PS #3A), which is associated with this mud pit (Fenix & Scisson, 1972a), was completed using air foam and other conventional drilling media (e.g., Davis Mix) (RSN, 1991). However, site-specific information regarding exact materials used for drilling/circulating media dumped in the mud pit area of CAS 08-09-03 were not identified by soil sampling, historical review, or interviews. However, they were identified through general process knowledge and those potentially used within the circulating media. Yet, there remains a lack of analytical, geophysical, radiological results; therefore, current investigations have not been able to determine the exact materials, or the depth and volume of the mud pit area. Hence, a list of potentially used chemicals, based on general NTS mud pit drilling media information, is currently assumed as worst-case due to the proximity to the U-8d crater.

From soil samples collected at sites assumed to be similar to this CAS, the following COPCs were identified: SVOCs, TPH, VOCs, arsenic, barium, chromium, lead, americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes.

2.3.1.8 Process Knowledge - Mud Pit - CAS 10-09-02

Since no analytical, geophysical, or radiological surveys were identified for CAS 10-09-02, specific COPCs for this site could not be determined. The past uses of this site were not determined due to the lack of operational knowledge concerning this specific site. Although it can be assumed that pretest drilling, used for the U-10as emplacement hole, was the primary waste disposed to the mud pit. It is uncertain what, if any, other waste was disposed there. A surface sealant of undetermined chemical and physical constituents was used at the mud pits and it is unknown if the material has had any impact on the site.

Other potential COPCs that may be associated with this mud pit include TPH (primarily diesel), VOCs, and SVOCs. From soil samples collected at similar sites as this CAS, the following additional potential COPCs were identified: arsenic, barium, chromium, lead, americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes.
2.3.1.9  **Process Knowledge - Mud Pit - CAS 10-09-04**

Since no analytical or geophysical surveys were conducted, specific COPCs for CAS 10-09-04 could not be determined. The past uses of this site were not determined due to the lack of operational knowledge. This mud pit is assumed to be the primary disposal site for muds and liquids generated during the pretest drilling for the U-10aj-G emplacement hole. No drill logs were located for drill hole U-10aj-G which is assumed, by proximity, to be associated with this mud pit. Therefore, it was not determined what drilling media was used during drilling this hole. It is uncertain what, if any, other waste was disposed there or if the mud pit may have been used during other drilling operations.

Potential COPCs that may be associated with this mud pit include TPHs (primarily diesel), VOCs, and SVOCs. From soil samples collected at similar sites as this CAS, the following additional COPCs were identified: arsenic, barium, chromium, lead, americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes.

2.3.1.10  **Process Knowledge - Mud Pit - CAS 10-09-05**

Since no analytical, geophysical, or radiological surveys were conducted or identified, specific COPCs for CAS 10-09-05 could not be determined. The past uses of this site were not determined due to the lack of operational knowledge concerning this specific site. It was not determined during which drilling operation the mud pit was created. Consequently, drilling media and exact dates during which the mud pit was utilized were not identified. No historical documentation was located on this site which explained what this pit was used for. It is possible that this pit was a borrow pit for the creation of nearby roads and not as a mud pit for drilling operations.

Potential COPCs that may be associated with this mud pit include TPHs (primarily diesel), VOCs, and SVOCs. From soil samples collected at similar sites as this CAS, the following additional potential COPCs were identified: arsenic, barium, chromium, lead, americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes.

2.3.1.11  **Process Knowledge - Mud Pit; Stains; Material - CAS 10-09-06**

Since no analytical, geophysical, or radiological surveys were conducted or identified, specific COPCs for CAS 10-09-06 could not be determined. The past uses of this site were not determined
due to the lack of operational knowledge concerning this specific site. It can be assumed that the mud pit was the primary disposed area for waste mud and liquids during the pretest drilling of the U-10am #5 exploratory hole. It is uncertain what, if any, other waste was disposed there or if it supported other drilling operations.

Potential COPCs that may be associated with this mud pit include TPHs (primarily diesel), VOCs, and SVOCs. From soil samples collected at similar sites as this CAS, the following additional potential COPCs were identified: arsenic, barium, chromium, lead, americium-241, cesium-137, cobalt-60, europium isotopes, plutonium isotopes, strontium-90, and uranium isotopes.

2.3.2 Process Knowledge - Waste Dump - CAS 25-15-01

Based on historical documents and interviews, it is assumed that construction debris was the only material disposed at the site. The materials generally consisted of asphalt, roofing, wood pallets, insulation, cables, and floor tile originating primarily from the R-MAD Facility, Beetle Building, and Warehouse. Radiological surveys were conducted for all materials collected, and any materials exhibiting contamination were segregated and left at the R-MAD Facility. However, because the dump was never officially closed and was inactive and/or abandoned for a number of years, it is uncertain whether hazardous and/or radiological waste materials were introduced during other periods of activity in Area 25. It is believed that the berms are soils piles from excavation of the waste dump rather than concealing waste. One historical document (REECo, 1992) provides a worst-case scenario for sites at the NTS and focused on the identification of solid waste management units. This document identified CAS 25-15-01 as an inactive “sanitary” landfill used for disposal purposes of possibly mixed waste. Approximately 150 cubic yards of construction materials were gathered, loaded, hauled, and disposed in the waste dump.

Visual inspections of the site revealed possible contributors to COPCs including hydrocarbon waste, asphalt, and tar. Interviews indicate that wastes generated, or utilized, during the MX Program might have included asbestos, lead-based paint, hydrocarbon waste, PCBs, hydraulic fluid, lead-acid batteries, antifreeze, and lubricating oil. However, it is uncertain if the dump received any waste generated during the MX Program.
2.3.3 Process Knowledge - Lead Bricks - CAS 04-26-03

The COPC found specific to this CAS is lead. This CAS is located within a posted RMA which contains radiologically contaminated fused soil (e.g., trinity glass). Additional noted surface debris includes a metal bucket, metal gas cylinder, barbed-wire, cables, various metal pieces, miscellaneous scrap material, and non-lead (poly) brick material. The contents of the gas cylinder and metal bucket were not identified. Radionuclides associated with this CAS are not considered COPCs, but are considered part of CAU 104, South Yucca Flat Atmospheric Sites (FFACO, 1996).

2.3.4 Process Knowledge - Boxes; Pipes - CAS 01-99-01

In one document, Building 1-31.2e1 was called a chemical plant control room. The building was constructed as a support facility to Operation Teapot, the weapons-related Apple-2 atmospheric test which was conducted in Area 1 on May 5, 1955 and had a yield of 29 kt (DOE/NV, 2000c). The building appears to have been used for some type of ventilation during either the atmospheric Apple-2 test, but most probably is reflective of the structure’s possible reuse during the Galileo test (DRI, 2000). Contaminants of potential concern at this site are radionuclides originating from atmospheric testing conducted in the surrounding area.

2.4 Closure Standards

The proposed closure methods for CAU 357 CASs are no further action, close in place, and clean close. Each CAS will be evaluated and the closure method will be selected based on the following closure standards. The proposed closure standards for CAU 357 characterization and verification samples are the action levels established in the DQO process (Appendix A). Laboratory analytical results will be compared to these action levels to guide remediation and closure efforts. The extent of contamination will be bounded when a minimum of one soil sample is below the closure standards. Clean closure will be complete when verification samples of remaining soils show that contamination is no longer present at concentrations exceeding the PAL. The action levels used to evaluate analytical results for samples collected for site characterization are based on the following standards:

- EPA Region 9 risk-based preliminary remediation goals (PRGs) for industrial soils (EPA, 2002).
- TPH concentrations above the TPH limit of 100 parts per million (ppm) per the *Nevada Administrative Code* (NAC) 445A.2272 (NAC, 2000e).

- Background concentrations for metals will be evaluated when natural background exceeds the PAL (i.e., arsenic). A sediment sampling effort performed by the Nevada Bureau of Mines and Geology (1998) provides relevant analytical data for numerous metals, including the eight RCRA metals. Statistical analysis of this data indicate background concentrations (mean plus two standard deviations) applicable to soil samples collected from the NTS for investigation of CASs (Moore, 1999).

- For COPCs without established PRGs, a protocol similar to EPA Region 9 will be used in establishing an action level.

- The PALs for radiological contaminants are isotope-specific and are defined as the maximum concentration for each isotope found in environmental samples taken from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991). The US Ecology and Atlan-Tech reference is used because soil samples have not been collected from undisturbed background locations of the NTS and analyzed for their radionuclide concentrations. Therefore, data is needed on the concentration of radionuclides in soil at undisturbed background locations located in the vicinity of the NTS. Based upon the Ward Valley climatology, geology, and radionuclide concentration data, the use of *Environmental Monitoring Report for the Proposed Ward Valley California Low Level Radioactive Waste (LLRW) Facility* (US Ecology and Atlan-Tech, 1991) is appropriate for use in defining PAL concentrations based on background. The PALs are expressed in units of pCi/g for solid media or picocuries per liter (pCi/L) and are identified on Table 6-3 (see Section 6.2).

For TPH-contaminated sites that will be closed in place, the site conditions will be evaluated in accordance with the NAC 459.9973 (1) (a-k) factors to determine if any corrective action will be required (NAC, 2002f). This evaluation will be used to determine if post-closure monitoring will be required.
3.0 Field Activities and Closure Objectives

This section of the SAFER Plan provides a description of the field activities and closure objectives for CAU 357. The objectives for the field activities is to determine if contaminants exist and, if detected, their nature and extent is defined so that closure alternatives may be implemented. All sampling activities will be conducted in compliance with the Industrial Sites Quality Assurance Project Plan (QAPP) (NNSA/NV, 2002b) and other applicable, approved procedures and instructions.

Field activities will be performed in accordance with the Architecture-Engineer Contractor’s Health and Safety Plan (HASP) and an approved site-specific health and safety plan (SSHASP) prepared prior to the field effort. As required by the NNSA/NSO Integrated Safety Management System (ISMS) (DOE/NV, 1997), these documents outline the requirements for protecting the health and safety of the workers and the public, and the procedures for protecting the environment. The ISMS program requires that site personnel take every reasonable step to reduce or eliminate the possibility of injury, illness, or accidents, and protect the environment during all project activities. The following safety issues will be considered when evaluating the potential physical and chemical hazards associated with the proposed field activities.

Potential physical and chemical hazards to site personnel and the public include, but are not limited to: radionuclides, chemicals (e.g., toxic metals, VOCs, SVOCs, and TPHs), adverse and rapidly changing weather, remote location, and motor vehicle and heavy equipment operations. Associated control procedures include:

- Proper training of all site personnel to recognize and mitigate the anticipated hazards.
- Work controls to reduce or eliminate the hazards including engineering controls, substitution of less hazardous materials, and personal protective equipment (PPE).
- Occupational exposure monitoring to prevent overexposures to hazards such as radionuclides, chemicals, and physical agents (e.g., heat, cold, and high wind).
- Radiological surveying for alpha/beta and gamma emitters to minimize and/or control personnel exposures. Use of the “as-low-as-reasonably-achievable” principle when dealing with radiological hazards.
• Emergency and contingency planning and communications to include medical care and evacuation, decontamination, and spill control measures, and appropriate notification of project management.

3.1 **Contaminants of Potential Concern**

Soil samples (QC samples are the only liquid samples anticipated), initially collected for all mud pit-related CASs and the wastes dump CAS, will be analyzed in the laboratory for SVOCs, TPH, VOCs, metals, PCBs, gamma-emitting radionuclides, isotopic uranium, isotopic plutonium, and total strontium. The lead bricks in CAS 04-26-03 has lead identified as the only COPC, and CAS (01-99-01) only has radionuclides identified as COPCs. Table 3-1 presents a summary of the specific COPCs for each CAS. Table A.1-4 provides additional details on these COPCs.

As described in the DQOs (see Appendix A), if during the course of investigation (or remediation) analytical data becomes available that indicates a specific COPC is not present at a CAS, it will be eliminated from consideration.

The analytical requirements and methods for these COPCs are listed in Table 6-2. If a CAS advances to the second decision stage of investigation, the list of COCs will be revised based on analytical results, with NNSA/NSO and NDEP (identified decision makers) concurrence.

3.2 **Remediation**

The DQOs developed for CAU 357 identified data gaps that require additional data collection prior to identifying and implementing the preferred closure alternative for each CAS. A decision point approach, based on the DQOs, has been chosen to address the data collection activities. The presence of contamination, if any, is assumed to be confined to the spatial boundaries of the sites as defined in the DQO process and conceptual site model. Biased sampling will be conducted at CAU 357 according to DQO guidelines.

If COCs are located within a CAS based on the initial investigation results, that CAS will be further assessed before implementing closure activities. If COPCs are not present at concentrations exceeding PALs, the CAS will be eliminated from further consideration. It is important to note that the target population(s) to be initially investigated may be different based on the analytical results. Target populations for each decisional phase are documented in the relevant sections.
3.2.1 Determining if COCs are Present

The objective of the initial investigation strategy is to determine whether COCs are present at concentrations exceeding PALs. Laboratory analytical results will be used to confirm the presence or absence of COPCs, and if the concentrations exceed PALs.

The sampling strategy targets locations and media most likely to be contaminated. Biasing factors considered for choosing the sample locations for this investigation with available process knowledge are discussed in Section A.1.4 and Table A.1-3 of Appendix A. These biased sample locations may be modified, as determined by the Site Supervisor, based on the culmination of all the biasing data generated throughout the investigation (e.g., configuration of the mud pits and waste dump, field observations, geophysics, field-screening results). Additional samples may be collected for waste management characterization and disposal purposes.

### Table 3-1

**COPCs for CASs in CAU 357**

<table>
<thead>
<tr>
<th>CAS</th>
<th>TPH (GRO)</th>
<th>TPH (DRO)</th>
<th>Total VOCs</th>
<th>Total SVOCs</th>
<th>Total Metals</th>
<th>PCBs</th>
<th>Lead Only</th>
<th>Radionuclides</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-09-02</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>07-09-03</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>07-09-04</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>07-09-05</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>08-09-01</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>08-09-02</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>08-09-03</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>10-09-02</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>10-09-04</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>10-09-05</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>10-09-06</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>25-15-01</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>04-26-03</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>01-99-01</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>X</td>
</tr>
</tbody>
</table>

X = COPC for a given CAS
-- = Not a COPC for a given CAS
GRO = Gasoline-Range Organics (C₆ - C₁₀)
DRO = Diesel-Range Organics (C₁₀ - C₉₈)

CAS 01-99-01 will also be sampled for asbestos for health and safety purposes. Asbestos is not a COPC.

### 3.2.1 Determining if COCs are Present

The objective of the initial investigation strategy is to determine whether COCs are present at concentrations exceeding PALs. Laboratory analytical results will be used to confirm the presence or absence of COPCs, and if the concentrations exceed PALs.

The sampling strategy targets locations and media most likely to be contaminated. Biasing factors considered for choosing the sample locations for this investigation with available process knowledge are discussed in Section A.1.4 and Table A.1-3 of Appendix A. These biased sample locations may be modified, as determined by the Site Supervisor, based on the culmination of all the biasing data generated throughout the investigation (e.g., configuration of the mud pits and waste dump, field observations, geophysics, field-screening results). Additional samples may be collected for waste management characterization and disposal purposes.
Field screening may be instituted to provide additional semiquantitative screening measurements. These field-screening results (FSRs), along with other biasing factors, will help guide the selection(s) of the most appropriate sampling location for collection of laboratory samples. Potential field-screening methods, with the respective field-screening level (FSLs), are presented below:

- **TPH** - TPH screening levels are established at 100 ppm, using an appropriate field test kit. Soil will be field screened for TPH only at the mud pit and waste dump sites.

- **VOC** - VOC headspace screening levels are established at 20 ppm or 2.5 times background, whichever is greater, using a photoionization detector (PID).

- **Radionuclides** - Radiological FSLs are based on CAS-specific background measurements. The CAS specific background is defined as the mean count rate plus two standard deviations of the mean count rate.

Site preparation activities for each CAS are documented in the following text.

Site preparation activities will consist of performing a utility survey, the removal of surface debris (if necessary) from the applicable CAS areas, inspecting the surface features, conducting radiological and geophysical surveys (as appropriate) for locating sample points, and verifying the configuration of the CASs. Backfilled constituents within the Waste Dump will not be intentionally identified (uncovered) through intrusive investigation. If unanticipated features (e.g., drums) are identified in the surveys, they will be inspected for configuration/integrity and sampled in an appropriate manner. Visual inspection and/or geophysical surveys may also be conducted to investigate unknown or suspected buried utility lines and bricks that may be associated with individual CASs. Excavation using a backhoe, direct push using a drill rig, or hand augering will be the primary intrusive investigation techniques applied.

A sediment/soil sample will be collected in areas presented in Appendix A. Biased locations to be sampled include surface and the underlying soil at both the inlet and outlet ends of the mud pits. A minimum of two biased locations (four biased samples) within each identified mud pit will be sampled. These biased locations will target areas most likely to have been contaminated. These sample results will be used to determine whether the mud pit CAS requires further investigation. The exact locations within each mud pit will be selected by the Site Supervisor based upon site-specific...
conditions. Samples collected will be analyzed for the chemical and radiological parameters provided in Section 3.1.

No further action closure requirements for the mud pits are discussed in Section 3.5. If clean closure or close-in-place closure activities are recommended, the CAS closure will be based on the parameters also summarized in Section 3.5.

3.2.1.1 Mud Pit CASs (07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 07-09-03, 10-09-02, 10-09-04, 10-09-05, and 10-09-06)

Site preparation activities to be completed prior to sampling activities for the Area 7, 8, and 10 mud pit CASs include the following:

- Removing tumbleweeds from within each pit
- Inspecting the surface features of each pit for staining, debris, etc.
- Collecting debris and setting aside for housekeeping
- Conducting radiological surveys within each pit
- Conducting geophysical surveys within each pit
- Constructing access ramps into pits, where required, for backhoe/rig and personnel entrance

Geophysical surveys will be performed within the spatial boundaries of each mud pit to facilitate the selection of biased sample locations, determine the configuration of each pit (e.g., construction of base), identify debris within the pits and have it removed. The surveys may be extended several feet past the boundaries to gather data on contrasting soil characteristics. The geophysical surveys will consist of imaging methods to identify buried debris and try to locate the transition between the mud and the native soil.

All the mud pits are located in NTS areas of known fallout from atmospheric testing and cratering experiments. A radiological survey will be performed over the entire surface of each mud pit to identify any potential areas of elevated radiological readings above ambient levels.

If field conditions indicate that biasing factors are inconclusive in selecting the sample location (see Figure A.1-17 and Table A.1-3 in Appendix A), field screening for TPH may be conducted to further enhance the selection of sample areas most likely to be contaminated. A revised sampling location (selection based on geophysics, field observations, and discretion of the Site Supervisor) is where surface samples will be collected for the TPH-screening samples. The locations with the highest TPH
FSRs will be considered, along with other biasing data collected, in selecting the sample point for surface and subsurface sample collection and laboratory analysis.

With the exception of CAS 07-09-03, each mud pit will be sampled at a minimum of two biased locations within the defined spatial boundaries. Each sample location will consist of two discrete samples unless the configuration and depth of mud at a given location precludes two separate depths (i.e., less than 12 in.), in which case only one sample will be collected at that particular location. One sample will be collected at the surface (0 to 6 in.) within the mud/soil cuttings matrix, while the second sample will consist of an approximate 6-in. interval comprised of mud and native soil at or below the textural discontinuity. Collecting both mud and native soil at this discontinuity ensures that contamination, if present, will be captured whether it is bound in the mud matrix or leached into the native soil. Additional material adjacent to the initial sample location may be collected to ensure sufficient volume is submitted to satisfy analytical requirements. Figures A.1-16 and A.1-17 in Appendix A show both planar and cross-sectional views of potential sample locations based on the conceptual model for the mud pits. Random sample locations are included in the investigation of CAS 07-09-03 and are shown in Figure A.1-21. Exact sample locations will be determined in the field by the Site Supervisor. Locations will be selected in areas most likely to be contaminated based on the conceptual model and other biasing factors outlined in Step 3 of the DQO process (e.g., field screening, geophysics).

The mud spill of CAS 10-09-04 will be sampled during Decision I activities. The mud characteristics at this location can be considered consistent with the results of the mud pit associated with this CAS. Therefore, the analytical results from this mud pit will be used to determine if any further characterization strategies (i.e., sampling the spill) are necessary at this location during the Decision II efforts. The two drums within Mud Pit 08-09-01 are part of CAU 346, CAS 08-22-04; therefore, they will not be addressed in this SAFER Plan.

3.2.1.2 Waste Dump CAS 25-15-01

The initial sampling strategy consists of biased sampling. Surface cover material will not be sampled. Site preparation activities to be completed prior to sampling activities for the Area 25 waste dump CAS include the following:
• Removing tumbleweeds, as required from within the dump’s excavated pit

• Inspecting the surface features of the dump pit for staining, debris, etc.

• Collecting debris and staging debris within the CAS boundaries for future housekeeping activities

• Conducting radiological surveys within the dump pit, backfilled areas, and around soil piles

• Conducting geophysical surveys within the dump pit, backfilled areas, and around soil piles

• Ensuring backhoe/rig and personnel entry access into the dump pit and backfill areas

Geophysical surveys will be performed within the spatial boundaries of the waste dump, which is the disturbed area located in between the surrounding three soils piles. The objective of the geophysical survey is to facilitate the selection of biased sample locations, determine/verify the configuration waste dump, and identify the absence/presence of buried construction debris within the soil piles. Any associated surface debris observed will be collected and set aside for housekeeping removal. The surveys may be extended several feet (10 to 15 ft) past the defined spacial boundary to gather information data on contrasting (fill/native) soil characteristics. The geophysical surveys will consist of imaging methods applicable to identify buried debris and attempt location of the transition horizon between the backfill/cover soils and the undisturbed/native soil.

The waste dump will be sampled at a minimum of four biased locations within the defined spatial boundaries. Each sample location will consist of collecting two discrete soil samples from each particular location. One sample location will be within the dump pit at approximately the toe of the backfilled zone, which most likely will also correspond with the lowest topographic point within the open pit.

The scope of investigation for this CAS does not include characterization of debris contained within the dump itself; therefore, boreholes in the rear areas of the dump will be used to investigate if contaminates are being released by the waste materials in the dump. As a result, the three remaining proposed sample locations are to be located in areas near to the backfilled zone. These locations will be used to determine if contaminants have been released from the waste dump.
Each soil pile will be probed or hand-augered for sample collection, if the geophysical survey identifies anomalies. It is anticipated from historical records that these piles (collectively) contain only backfilling soils of native soil.

Although radionuclides are not assumed to be COCs, it cannot be confirmed from historical record review that radiological wastes associated with other activities were not placed in the waste dump. The CAS is also located in the NTS, Area 25, which has received radioactive fallout. Therefore, a radiological survey will be performed over the entire surface of this CAS.

If other biasing factors are inconclusive in selecting the sample locations, field screening for TPH may be conducted to further enhance the selection of sample areas most likely to be contaminated. Sample locations are presented in Appendix A and may be changed based on field conditions at the discretion of the Site Supervisor.

Figure A.1-31 in Appendix A shows a planar view of the CAS area and indicates the four proposed potential sample locations based on the CSM for the waste dump. Exact sample locations will be determined in the field by the Site Supervisor. Locations will be selected in areas most likely to be contaminated based on the CSM and other biasing factors outlined in Step 3 of the DQO process (e.g., field-screening, geophysics).

**3.2.1.3 Lead Bricks CAS 04-26-03**

Activities at this CAS will consist of removing the scattered lead bricks, collection of a soil sample, and subsequent analysis to verify the absence of lead. Surface soil samples will be collected to determine the lead concentrations on, or within, the near-contact soil material adjacent to the bricks, resulting from the brick’s potential oxidation and degradation from over four decades of exposed time.

Site preparation activities are minimal at this CAS and should consist primarily of health and safety precautions for accessing the area, which is within an RMA with radiologically contaminated fused soil (i.e., trinity glass). For the Area 4 lead bricks CAS, some preliminary investigation actions that need be completed prior to sampling activities include the following:
• Ensuring a radiological work permit (RWP) is attained and appropriate radiation safety training is provided for all field personnel

• Inspecting the scatter area surface for anomalous stains, etc., and removing non-brick debris

• Removing visible lead bricks from the surface and marking their location with pin-flags

• Conducting a geophysical survey to identify any buried bricks and confirming the scatter boundary

After all the bricks visible on the surface are removed, a geophysical survey will be performed within the scatter area to confirm the spatial boundaries of the lead bricks CAS and determine the location (identify/presence) of buried lead bricks. If necessary, associated surface debris will be collected and set aside for housekeeping removal, along with the retrieved lead bricks. The survey may be extended several feet (10 to 15 ft) past the defined spacial boundary (initially observed scatter area) to gather information data on possible contrasting soil characteristics. Radionuclides identified at this site are COCs for CAU 104, South Yucca Flat Atmospheric Sites (FFACO, 1996).

All observable lead bricks, and those buried and identified by geophysics, will be retrieved from the scatter area and placed in an approved container for disposal and/or recycling. The bricks will be screened for radiological contamination. The bricks will be segregated for disposal purposes and/or recycling, if required. Each former brick location will be marked with a pin flag concurrently with the brick’s collection (in lieu of having to identify each brick location with a global positioning system). Each location of a former brick will be revisited and sampled. The sample results will be used for characterization and potential disposal of the soil. Verification of the remediation will be conducted in accordance with Section 3.3.

Figure A.1-32 in Appendix A shows a planar view of the scatter area and indicates the proposed sample locations, based on the CSM for the Lead Bricks CAS. Exact sample locations will be determined in the field by the Site Supervisor. Locations will be selected in areas most likely to be contaminated based on the CSM and other biasing factors outlined in DQO Step 3 (e.g., geophysics, visible soil staining).
3.2.1.4  **Boxes; Pipes CAS 01-99-01**

Initial activities at this CAS will be somewhat limited to the outside of Building 1-31.2e1, which houses the boxes and pipes for which the CAS was named. Activities at this CAS will be planned and executed as to protect and maintain the building’s historical significance. A minimum of two sample locations will be selected outside the building. The flooring material of the building is a 2-ft thick concrete slab foundation; therefore, impractical to sample soils beneath the slab. However, a visual inspection for possible contamination, as evidenced by staining, and a survey of the interior of the building will be conducted with a PID and appropriate radiological instruments. Samples will be taken where the PID exceeds FSLs for organic vapors, and swipes will be collected if radiological contamination is detected above FSLs.

Site preparation activities at this CAS should consist primarily of health and safety precautions for accessing the area, which is within a known Nuclear Testing Area, and for entering the building that may have asbestos and hantavirus concerns. For the boxes; pipes CAS 01-99-01, some preliminary investigation actions that need be completed prior to sampling activities include the following:

- Ensuring appropriate radiation safety training is provided for all field personnel and an RWP is approved in the event radiation dose rates or contamination is detected at levels exceeding the *NV/YMP Radiological Control Manual* (DOE/NV, 2000a)

- Conducting a geophysical survey to identify buried utilities that may have serviced the building

- Ensuring that all those working in the building have asbestos awareness training

- Determining whether decontamination for hantavirus will be necessary in the building

Figure A.1-33 in Appendix A shows a planar view of the area and illustrates, based on the CSM and other biasing factors outlined in the DQO Step 3, the two proposed sample locations. These locations are nearest to identified release pathways from the building that contaminants (generated or concentrated within the building) could use to exit the building and potentially impact the surrounding environment. Exact sample locations will be determined in the field by the Site Supervisor. Radionuclides associated with testing activities conducted at, around, and within this building are the primary COCs identified for this investigation. If the PID detects organic vapors or if
staining is visible in the building, then the list of COPCs will expand to include VOCs, SVOCs, PCBs, and metals.

The sampling strategy for CAS 01-99-01 consists of identifying and sampling two biased surface soil locations around the proximal area of the building. One sample will be collected from near the front doorway, and the other will be collected from an area near the back window. These locations will be sampled for COC analysis from the native soil interface, assumed to be 0 to 6 in. In addition to these samples outside the building, the inside of the building will be surveyed with radiological instruments and swipes will be taken if radiological contamination is detected above FSL. Where the PID survey detects organic vapors, samples will be taken for VOCs if there is sufficient media to sample. Where there is visual staining, samples will be collected for SVOCs, PCBs, and metals if there is sufficient media to sample.

3.2.2 Determining the Extent of Contamination

Unless specifically noted, determining the extent of contamination will consist of further characterizing sites where COCs were confirmed to be present during the initial field investigation. Laboratory analytical results from this effort will be used to determine the extent of contamination at concentrations exceeding PALs. The data collected from this activity will be used to determine if the preferred corrective action is closure-in-place or clean closure.

Environmental soil samples may be field screened to guide sample collection activities, to assist in waste management decisions, and to provide health and safety information provided that the COCs identified have an appropriate screening method. Field-screening methods and FSLs will be documented prior to the start of sampling activities.

Lateral and vertical extent of contamination will be bounded by analytical results that show concentrations of COCs below PALs. If results indicate the extent of contamination extends beyond 50 ft of the spatial boundaries and/or an increasing trend in contaminant concentrations, the CSM has failed and the investigation may need to be evaluated.
3.2.2.1 **Mud Pit CASs 07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 07-09-03, 10-09-02, 10-09-04, 10-09-05, 10-09-06**

As required, activities to investigate the vertical and lateral extent of contamination at these CASs will commence. These activities will include collecting subsurface samples at locations below the textural discontinuity (vertical) and adjacent to those locations (lateral) at depths and step-out locations selected by the Site Supervisor (up to approximately 15 ft beyond the outer boundary of the initial sample locations). Each sample will be submitted for analysis for only the COCs identified in the initial investigation.

3.2.2.2 **Waste Dump CAS 25-15-01**

The lateral extent of contamination will be initially conducted simultaneously with the initial investigation activities. Geographic access limitations and unknown debris within the backfilled area hampers direct push or backhoe techniques to determine lateral extent within the excavated walls of the waste dump. Therefore, initial investigation activities include three sampling locations beyond the excavated parameter. Every attempt will be made to collect these samples from below the textural discontinuity horizon at each determined location to define and/or confirm vertical extent is adequately defined. The lateral and vertical extent of contamination will be bounded by laboratory analytical results that show concentrations of COCs below PALs. If any of the original “step-out” analytical results indicate COCs are present above PALs, additional “step-out” sample locations will be implemented until it can be demonstrated that COC concentrations below PALs have been achieved.

3.2.2.3 **Lead Bricks CAS 04-26-03**

If initial analytical results indicate COCs above PALs, increased depth and step-out sampling will be collected. Lead may have oxidized and fallen off the parent brick. Lead (a rather large, heavy, basically immobile metallic molecule in dry soils) is anticipated to have accumulated in the near-contact soil surrounding each brick location. Sampling will consist of collecting and drumming a soil sample from each of the pin-flagged locations. This will be performed to define vertical extent and four additional samples will be collected from locations around and outside the known scatter area toward the CAS boundary. This information, combined with analytical results from the in-between former brick locations in the scatter area, compared to the drummed soil results, should
provide confirmatory abatement evidence as required for a clean closure corrective action. Additional soil samples will be analyzed for radiological constituents for waste management purposes. All flags will be retrieved for waste management upon this sampling’s completion.

### 3.2.2.4 Boxes; Pipes CAS 01-99-01

For locations where COC concentrations exceed PALs, the step-out sampling locations selected will be up to approximately 15 ft from initial sample locations. Each sample will be submitted to the laboratory for analysis for only the COCs initially identified, and the depth/step-out locations will be determined by the Site Supervisor based on site conditions.

### 3.3 Verification

Verification sampling of subsurface soil will be required at CASs where soil excavation and removal are part of the closure decision (e.g., close-in-place or clean closure alternative). The number and location of verification samples will be determined in the field. Consistent with the *Sected Clean-up Work Plan for Housekeeping Category Waste Sites* (DOE/NV, 2000b), a minimum of one sample is needed for each distinct stained area where less than 3 cubic yards (yd³) of soil are removed. This sample will be collected from the approximate center of the bottom of the excavation below the stained area. The final locations and numbers of verification samples to be collected will be determined in the field based on site conditions and the professional judgement of the Site Supervisor.

Each sample collected will be submitted for laboratory analysis for the COPCs identified in Table 3-1. If analytical results are above closure standards, additional soil excavation and verification sampling will be conducted until the closure criteria are met. If more than one round of excavation and verification sampling is required, COPCs may be eliminated from subsequent rounds based on validated analytical data and professional judgement of the Site Supervisor. Additional samples may be collected for waste management purposes.

Soil samples must be collected at the lead bricks to show either: (1) that lead has not oxidized or leached from the bricks; or (2) if lead spalling or “leakage” has occurred, that soil remaining after remediation (drummed spade fulls) from the impacted (contact soil) areas is below closure standards.
At a minimum, one soil sample will be collected from the base of a below-brick excavation horizon at each end of the scatter area and compared to the background between-brick location results. If the drum’s contents are determined to have toxicity characteristic leaching procedure (TCLP) lead results exceeding PALs, the drums containing lead will be disposed of as hazardous waste. If verification samples of the final composite remediation will be collected and analyzed for the appropriate COCs (lead) and for site characterization purposes.

### 3.4 Data Quality Objectives

The DQOs are qualitative and quantitative statements that specify the quality of the data required to support potential closure alternatives for CAU 357. The DQOs were developed to clearly define the purposes for which environmental data will be used and to design a data collection program that will satisfy these purposes. The formulation of a CSM is an aid to the development of DQOs for the site. The NDEP was briefed on the DQOs on February 5, 2003.

Details of the DQO process are presented in Appendix A. During the DQO discussions for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented. Criteria for data collection and analysis were defined and agreed upon, and the appropriate QA/QC required for particular data collection activities were assigned. The analytical methods and reporting limits prescribed through the DQO process, as well as the data quality indicators (DQI) for laboratory analysis (e.g., precision and accuracy requirements) are provided in more detail in Section 6.0 of this SAFER Plan. At the end of the investigation, resulting laboratory data will be evaluated to confirm or revise the conceptual site model and determine if the DQOs were met by using the DQIs of precision, accuracy, representativeness, completeness, and comparability. Other DQIs, such as sensitivity, may be used.

### 3.5 Closure

The following activities, at a minimum, have been identified for closure of these CASs. The decision logic behind the activities is provided in Figure 1-2:

- If no contaminants are detected above PALs, the CAS will be closed with no further action.
• Sufficient data will be collected and analyzed to determine the nature and extent of contamination above the PALs, so that the appropriate closure may be selected and implemented.

• If closure-in-place is the preferred corrective action alternative, the appropriate use restrictions will be implemented and documented in the SAFER Closure Report (CR).

• If clean closure is the preferred corrective action alternative, the material to be remediated will be removed and disposed as waste, and verification samples will be collected in remaining soil. Verification analytical results will be documented in the SAFER CR.

• All documentation required for CAS 01-99-01 as a registered historical building will be completed.

• Closure activities for the lead bricks will include removing all identifiable lead bricks from the CAS, remediation of the area (scooping soil from beneath each brick location), and composite sampling the soil drum contents for characterization and waste determination.

• Housekeeping waste will be accumulated at the CAS, as necessary, and may be photodocumented. Soil verification sampling will be conducted for appropriate COCs.

• All completed activities in support of the closure of CAU 357 will be documented in a SAFER CR.

• Specific closure activities for each CAS are summarized in Table 3-2.

3.6 Duration

After submittal of the Final SAFER Plan for CAU 357 to NDEP (FFACO milestone deadline of June 30, 2003), the following is a tentative schedule of activities (in calendar days):

• Day 0: Preparation for field investigation will begin.

• Day 60: The field investigation, including sampling, will commence. Samples will be shipped to meet applicable holding times.

• Day 150: The field investigation will be completed. Laboratory analytical data will be submitted.

• Day 215: The quality-assured, analytical data will be available for NDEP review.

Field work is not scheduled to commence until Fiscal Year 2004.
### Table 3-2
Summary of CASs Conceptual Site Model and Expected Closure

<table>
<thead>
<tr>
<th>CAS</th>
<th>Potential Release Mechanisms of COCs</th>
<th>Conceptual Site Model: Release Pathways of COCs</th>
<th>Expected Closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud Pits - 07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 08-09-03, 10-09-02, 10-09-04, 10-09-05</td>
<td>Potential COPCs, liquid or solid, released from mud pit to native soils below</td>
<td>Limited vertical movement of contaminants on the surface to shallow subsurface soils</td>
<td>Close in place with use restriction</td>
</tr>
<tr>
<td>10-09-06, Mud Pit; Stains; Materials</td>
<td>Potential COPCs, liquid or solid, released from mud pit to native soils below</td>
<td>Limited vertical movement of contaminants on the surface to shallow subsurface soils</td>
<td>Close in place with use restriction</td>
</tr>
<tr>
<td>25-15-01, Waste Dump</td>
<td>Potential COPCs, liquid or solid, released from waste dump to native soils below</td>
<td>Limited vertical movement of contaminants near the surface to shallow subsurface soils</td>
<td>Close in place with use restriction</td>
</tr>
<tr>
<td>04-26-03, Lead Bricks</td>
<td>Lead from lead bricks to nearby soils</td>
<td>Limited vertical movement</td>
<td>N/A</td>
</tr>
<tr>
<td>01-99-01, Boxes; Pipes</td>
<td>Potential COPCs, liquid or solid, released from inside the building to soils outside</td>
<td>Limited horizontal movement of contaminants to surface soils and then vertically to shallow subsurface soils</td>
<td>Closure in place</td>
</tr>
</tbody>
</table>

N/A = Not applicable, this is a housekeeping corrective action.
4.0 Reports and Records Availability

During field activities, a daily report will be prepared summarizing all field activities conducted that day. The report will include the project accomplishments, problems encountered, and personnel and equipment utilized. The report will be submitted to the NNSA/NSO Environmental Restoration Division (ERD) Task Manager for submittal to NDEP.

Upon completion of the field activities, a closure report will be prepared to include the following:

- Introduction (Purpose and Scope)
- Closure Activities (Description of Field Activities)
- Waste Disposition
- Conclusions (Data Quality Assessment)

This document is available in the DOE public reading rooms located in Las Vegas and Carson City, Nevada, or by contacting the DOE Project Manager. The NDEP maintains the official Administrative Record for all activities conducted under the auspices of the FFACO.
5.0 Investigation/Remediation Waste Management

Management of investigation-derived waste (IDW) and remediation waste will be based on regulatory requirements, field observations, process knowledge, and the results of laboratory analysis of CAU 357 SAFER investigation samples.

Disposable sampling equipment, pin flags, 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, direct samples of IDW may be taken to support waste characterization.

Generally, remediation waste will be characterized prior to generation. Once a waste stream is characterized, a disposal path will be selected. The waste will be packaged based on the waste acceptance criteria specified by the disposal location, transportation requirements, and logistics.

Sanitary, hazardous, radioactive, and/or mixed IDW or remediation waste, if generated, will be managed and disposed of in accordance with DOE Orders, U.S. Department of Transportation (DOT) regulations, state and federal waste regulations, and agreements and permits between DOE and NDEP.

5.1 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 (such as 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 in order to limit unnecessary generation of hazardous or mixed waste. Administrative controls, including decontamination procedures and waste characterization strategies, will minimize waste generated during investigations.
5.2 Potential Waste Forms

The on-site management and ultimate disposition of IDW may 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. Table 4-2 of the NV/YMP Radiological Control Manual (DOE/NV, 2000a) shall be used to determine if such materials may be declared nonradioactive. On-site IDW management requirements by waste type are detailed in the following sections. Applicable waste management regulations and requirements are listed in Table 5-1.

Waste generated during the investigation and remediation activities will include the following potential waste forms:

- PPE and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls)
- Decontamination rinsate
- Environmental media (e.g., soil)
- Surface debris in investigation area
- Field-screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminated by field-screening activities)
- Remediation waste

Each waste form generated will be reviewed and segregated at the point of generation.

5.2.1 Sanitary Waste

Office trash and lunch waste will placed in the dumpster to be transported to the sanitary landfill for disposal. Sanitary IDW generated at each CAS will 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 a roll-off box located in Mercury, Nevada, or other approved container and 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 (FADL). These logs will provide
<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Federal Regulation</th>
<th>Additional Requirements</th>
</tr>
</thead>
</table>
| Solid (nonhazardous)             | NA                 | NRS 444.440 - 444.620\(^a\)  
                               |                    | NAC 444.570 - 444.7499\(^b\)  
                               |                    | NTS Landfill Permit SW13.097.04\(^c\)  
                               |                    | NTS Landfill Permit SW13.097.03\(^d\) |
| Liquid/Rinsate (nonhazardous)    | NA                 | Water Pollution Control General Permit  
                               |                    | GNEV93001, Rev. 3ii\(^e\) |
| Hazardous                        | RCRA\(^f\)        | NRS 459.400 - 459.600\(^g\)  
                               |                    | NAC 444.850 - 444.8746\(^h\)  
                               |                    | POC\(^i\) |
| Low-Level Radioactive            | NA                 | DOE Orders and NTSWAC\(^j\) |
| Mixed                            | RCRA\(^f\)        | NTSWAC\(^j\)  
                               |                    | POC\(^i\) |
| Hydrocarbon                      | NA                 | NAC 445A.2272\(^k\)  
                               |                    | NTS Landfill Permit SW13.097.02\(^l\) |
| Polychlorinated Biphenyls        | TSCA\(^m\)        | NRS 459.400 - 459.600\(^n\)  
                               |                    | NAC 444.940 - 444.9555\(^p\) |
| Asbestos                         | TSCA\(^n\)        | NRS 618.750-618.801\(^q\)  
                               |                    | NAC 444.965-444.976\(^r\) |

\(^{a}\)Nevada Revised Statutes (1999a)  
\(^{b}\)Nevada Administrative Code (2002a)  
\(^{c}\)Area 23 (NDEP, 1997a)  
\(^{d}\)U10c crater located in Area 9 (NDEP, 1997c)  
\(^{e}\)Nevada Test Site Sewage Lagoons (NDEP, 1999)  
\(^{f}\)Resource Conservation and Recovery Act (CFR, 2002a)  
\(^{g}\)Nevada Revised Statutes (1999b)  
\(^{h}\)Nevada Administrative Code (2002b)  
\(^{i}\)Performance Objective for the Certification of Nonradioactive Hazardous Waste (BN, 1995)  
\(^{j}\)Nevada Test Site Waste Acceptance Criteria, Revision 4 (NNSA/NV, 2002d)  
\(^{k}\)Nevada Administrative Code (2002e)  
\(^{l}\)Area 6 Hydrocarbon Landfill (NDEP, 1997b)  
\(^{m}\)Toxic Substance Control Act (CFR, 2002e)  
\(^{n}\)Toxic Substance Control Act (CFR, 2002d)  
\(^{o}\)Nevada Administrative Code (2002c)  
\(^{p}\)Nevada Revised Statutes (1999c)  
\(^{q}\)Nevada Administrative Code (2002d)  

NA = Not applicable  
TSCA = Toxic Substance Control Act
necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill or other approved landfill.

### 5.2.1.1 Special Sanitary

Hydrocarbon waste is defined as waste containing more than 100 milligram per kilogram (mg/kg) of TPH contamination (NAC, 2002e). Hydrocarbon waste 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, 1997b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with Nevada regulations.

Regulated asbestos-containing materials that may be encountered or generated during this investigation will be managed and disposed of in accordance with appropriate federal (CFR, 2002d) and State of Nevada (NAC, 2002d) regulations.

Materials that are thought to potentially contain the hantavirus will be managed and disposed in accordance with appropriate health and safety procedures.

### 5.2.2 Hazardous Waste

CAU 357 will have waste accumulation areas established according to the needs of the project. Satellite accumulation areas (SAAs) and hazardous waste accumulation areas (HWAAAs) will be managed consistent with the requirements of federal (CFR, 2002a) and state regulation (NAC, 2002b). HWAAAs will be properly controlled for access and equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers. All containerized waste in HWAAAs will be handled, inspected, and managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 265, Subpart I. These provisions include managing the waste in containers compatible with the waste type, and segregating incompatible waste types so that in the event of a spill, leak, or release, incompatible wastes shall not contact one another.

The HWAAAs will be covered under a site-specific emergency response and contingency action plan until such time that the waste is determined to be nonhazardous or all containers of hazardous waste have been removed from the storage area. Hazardous wastes will be characterized in accordance with
the requirements of Title 40 CFR 261. *Resource Conservation and Recovery Act* “listed” waste has not been identified at CAU 357. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT requirements to a permitted treatment, storage, and disposal facility (CFR, 2002f).

**Management of Personal Protective Equipment** - PPE and disposable sampling equipment will be visually inspected for stains, discoloration, and gross contamination as the waste is generated. Any IDW that meets this description will be segregated and managed as potentially “characteristic” hazardous waste. This segregated population of waste will either be: (1) assigned the characterization of the soil/sludge that was sampled, (2) sampled directly, or (3) undergo further evaluation using the soil/sludge sample results to determine how much soil/sludge would need to be present in the waste to exceed regulatory levels. Waste that is determined to be hazardous will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. The PPE/equipment that is not visibly stained, discolored, or grossly contaminated will be managed as nonhazardous sanitary waste.

**Management of Decontamination Rinsate** - Rinsate at this CAU will not be considered hazardous waste unless there is evidence that the rinsate would display a RCRA characteristic. Evidence may include the presence of a visible sheen, high or low pH, or association with equipment/materials used to respond to a release/spill of a hazardous waste/substance. Decontamination rinsate that is potentially hazardous (using associated sample results and/or process knowledge) will be managed as “characteristic” hazardous waste (CFR, 2002a). The regulatory status of the potentially hazardous rinsate will be determined through the application of associated sample results or through direct sampling. If determined to be hazardous, the rinsate will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. If the associated samples do not indicate the presence of hazardous constituents, the rinsate will be considered to be nonhazardous.

The disposal of nonhazardous rinsate will be consistent with guidance established in current NNSA/NSO Fluid Management Plans (NNSA/NV, 2002c) for the NTS as follows:
- Rinsate that is determined to be nonhazardous and contaminated to less than 5x the Safe Drinking Water Standards (SDWS) is not restricted as to disposal. Nonhazardous rinsate which is contaminated at 5 to 10x the SDWS will be disposed of in an established infiltration basin or solidified and disposed of as sanitary waste or low-level waste in accordance with the respective sections of this document.

- Nonhazardous rinsate which is contaminated at greater than 10x the SDWS will be disposed of in a lined basin, or solidified and disposed of as sanitary waste or low-level waste in accordance with the respective sections of this document.

**Management of Soil** - This waste form consists of soil produced during soil sampling, excavation, and/or drilling. This waste form is considered to have the same COPCs as the material remaining in the ground. The preferred method for managing this waste form is to place the material back into the borehole/excavation in the same approximate location from which it originated. If this cannot be accomplished, the material will either be managed on site by berming and covering next to the excavation, or by placement in a container(s). The disposal of soil may be deferred until implementation of corrective action at the site.

**Management of Debris** - This waste form can vary depending on site conditions. Debris that requires removal for investigation activities (e.g., soil sampling, excavation, and/or drilling) must be characterized for proper management and disposition. Historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring/screening results, radiological survey/swipe results and/or the analytical results of samples either directly or indirectly associated with the waste will be used to characterize the debris. Debris will be visually inspected for stains, discoloration, and gross contamination. Debris may be deemed reusable, recyclable, sanitary waste, hazardous waste, PCB waste, or low-level waste. Waste that is not sanitary will be entered into an approved waste management system, where it will be managed and dispositioned according to federal, state requirements, and agreements between NNSA/NSO and the State of Nevada. The debris will either be managed on site by berming and covering next to the excavation, by placement in a container(s), or left on the footprint of the CAS and its disposition deferred until implementation of corrective action at the site. The lead bricks as CAS 04-26-03 will be screened for radiological contamination. The intact bricks that meet free-release criteria will be segregated for possible reuse or recycling. Contaminated or broken bricks will be properly containerized for disposal. Documentation of disposal will be included in the closure report.
**Field Screening Waste** - The use of field test kits and/or instruments may result in the generation of small quantities of hazardous wastes. If hazardous waste is produced by field screening, it will be segregated from other IDW and managed in accordance with the hazardous waste regulations (CFR, 2002a). On radiological sites, this may increase the potential to generate mixed waste; however, the generation of a mixed waste will be minimized as much as practicable. In the event a mixed waste is generated, the waste will be managed in accordance with the mixed waste section of this document.

**Remediation Waste** - Remediation waste may be comprised of any or all of the above five types of waste forms. Once a waste form is characterized, a disposal path will be selected. Multiple waste forms may be packaged together, depending on the characterization, waste acceptance criteria specified by the disposal location, transportation requirements, and logistics.

### 5.2.3 Polychlorinated Biphenyls

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) (USC, 1976) and its implementing regulations at 40 CFR 761 (CFR, 2002e). Polychlorinated biphenyls contamination may be found as a sole contaminant or in combination with any of the types of waste discussed in this document. For example, PCBs may be a co-contaminant in soil that contains a RCRA “characteristic” waste (PCB/hazardous waste), or in soil that contains radioactive wastes (PCB/radioactive waste), or even in mixed waste (PCB/radioactive/hazardous waste). The IDW will initially be evaluated using analytical results for media samples from the investigation. If any type of PCB waste is generated, it will be managed according to 40 CFR 761 (CFR, 2002e) as well as State of Nevada requirements (NAC, 2002c) and agreements with NNSA/NSO.

### 5.2.4 Low-Level Waste

Radiological swipe surveys and/or direct-scan surveys may be conducted on reusable sampling equipment and the PPE and disposable sampling equipment waste forms exiting a radiologically controlled area. This allows for the immediate segregation of radioactive waste from waste that may be unrestricted regarding radiological release. Contamination limits, as defined in Table 4-2 of the current version of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000a), will be used to determine if 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 if a particular waste unit (e.g., drum of soil) contains low-level radioactive waste, as necessary. Waste that does not meet the criteria of radioactive waste will not be managed as potential radioactive waste but will be managed in accordance with the appropriate section of this document. Wastes that exceed the criteria listed in Table 4-2 of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000a), the criteria listed in Section C of the Performance Objective for Certification (BN, 1995), and the Area 23 Solid Waste Landfill Permit, Area 6 Hydrocarbon Landfill Permit, and U10e Crater Permit values will be managed as potential radioactive waste, in accordance with this section, and any other applicable sections of this document.

Low-level radioactive waste (LLW), if generated, will be managed in accordance with 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/NV, 2002d). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated RMA or radiologically controlled area (RCA) when full or at the end of an investigation phase. The waste drums will remain at the RMA pending certification and disposal under NTSWAC requirements (NNSA/NV, 2002d).

### 5.2.5 Mixed Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA (CFR, 2002a) or subject to agreements between NNSA/NSO and the State of Nevada, as well as 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 constituents below Land Disposal Restrictions may be disposed of at the NTS Area 5 Radioactive Waste Management Site (RWMS), if the waste meets the requirements of the NTSWAC (DOE/NV, 2002b), the NTS’s *Nevada Division of Environmental Protection Permit for a Hazardous Waste Management Facility, NEV HW0009* (NDEP, 2000), and the *RCRA Part B Permit Application for Waste Management*
Activities at the Nevada Test Site (DOE/NV, 1999b). Mixed waste not meeting 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).
6.0 Quality Assurance/Quality Control

The overall objective of the closure activities described in this SAFER Plan is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each CAS in CAU 357. The following two sections discuss the collection of required QC samples in the field and QA requirements for laboratory/analytical data to achieve closure. Unless otherwise stated in this SAFER Plan or required by the results of the DQO process (see Appendix A), this investigation will adhere to the Industrial Sites QAPP (NNSA/NV, 2002b).

6.1 Quality Control Field Sampling Activities

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

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per lot of source material that contacts sampled media)
- 5 Field duplicates (1 per 20 environmental samples for the 11 mud pit CASs and 1 per CAS for the other 3 CASs: waste dump, lead bricks, and boxes; pipes)
- Field blanks (1 per 20 environmental samples)
- Matrix spike/matrix spike duplicate (MS/MSD) (1 per 20 environmental samples for the mud pit CASs and, if the sample media is significantly different than the mud pit CASs, 1 per CAS for the other 3 CASs: waste dump, lead bricks, and boxes; pipes; otherwise, include all CASs together in the 1 per 20 environmental samples.)

Additional QC samples may be submitted based on site conditions at the discretion of the Site Supervisor. Field quality control samples shall be analyzed using the same analytical procedures implemented for environmental samples. The results of the QC sample analyses will be included in
the analytical report. Additional details regarding field QC samples are available in the Industrial Sites QAPP (NNSA/NV, 2002b).

6.2 Laboratory/Analytical Quality Assurance

Criteria for Decision I, Decision II, and, if necessary, clean closure (as stated in the DQOs, Appendix A) require laboratory analysis be conducted for samples used in decision making to provide a quantitative measurement of any COCs present. Rigorous QA/QC will be implemented for all laboratory samples and includes documentation, data verification, and validation of analytical results, and meeting the requirements of DQI as they relate to laboratory analysis.

The sample volume requirements, data verification and validation will be performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002b) and this SAFER Plan. All laboratory data from samples collected and analyzed will be evaluated for data quality according to *EPA Functional Guidelines* (EPA, 1994a and 1999). The data will be reviewed to ensure that all critical samples were appropriately collected and analyzed, and the results passed data validation criteria. Validated data, whether estimated (i.e., J-qualified) or not, will be assessed to determine if they meet the DQOs of the investigation and the performance criteria for the DQIs. The results of this assessment will be documented in the closure report. If the DQOs were not met, corrective actions will be evaluated, selected, and implemented (e.g., refine conceptual site model or resample to fill data gaps).

Data quality indicators are qualitative and quantitative statements that specify the data requirements for a project and include precision, accuracy, representativeness, completeness, and comparability. In addition, sensitivity has been included as a DQI for laboratory analysis. The performance criteria for each indicator has been selected based on the intended use of the data, current field and analytical procedures, and instrumentation. Precision and accuracy goals have been standardized for both organic and inorganic analytes for analytical laboratories under the EPA Contract Laboratory Program (CLP) (EPA, 1988a and b). Laboratory quality control samples used to measure precision and accuracy of analytical procedures shall be analyzed using the same analytical procedures implemented for environmental samples. Additional details regarding DQIs and laboratory QC samples are available in the Industrial Sites QAPP (NNSA/NV, 2002b).
Table 6-1 provides the established performance criteria for each of the DQIs and the impacts to the decision if the criteria are not met. The Industrial Sites QAPP (NNSA/NV, 2002b) documents the actions to be taken to correct conditions that adversely affect data quality both in the field and the laboratory. Any deficiencies noted during the investigation that render the data quality unacceptable will be documented in the closure report.

**Table 6-1**

**Laboratory/Analytical Data Quality Indicators**

<table>
<thead>
<tr>
<th>Data Quality Indicator</th>
<th>Performance Criteria</th>
<th>Impact on Decision if Performance Criteria Not Met</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Precision</strong></td>
<td>Variations between duplicates (field, lab, and MS/MSD) and the original sample should not exceed analytical method-specific criteria listed in Tables 6-2 and 6-3.</td>
<td>Estimated data within the sample delivery group (SDG) will be evaluated for its usability. If data is determined not usable, then data will not be used in decision and completeness criteria will not be met.</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>Laboratory control sample results and matrix spike results should be within analytical method-specific criteria listed in Tables 6-2 and 6-3.</td>
<td>Estimated data within SDG will be evaluated for its usability. If estimated data is biased high or conservative, the data may be used in decision. If estimated data is biased low and below the decision threshold, the data may not be used in the decision and completeness criteria may not be met.</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>Detection limits of laboratory instruments must be less than the action level for COC.</td>
<td>Cannot determine if COCs are present at levels of concern; thereby, investigation objectives cannot be met.</td>
</tr>
<tr>
<td><strong>Decision I Completeness</strong></td>
<td>100% of samples submitted to laboratory 100% of requested analyses conducted 100% of critical analytes to be valid a 80% of noncritical analytes to be valid</td>
<td>Cannot make decision on whether COCs are present with high confidence.</td>
</tr>
<tr>
<td><strong>Decision II Completeness</strong></td>
<td>100% of samples submitted to laboratory 100% of requested analyses conducted 100% of critical analytes to be valid a 80% of noncritical analytes to be valid</td>
<td>Decision of whether or not extent of contamination has been bounded cannot be determined.</td>
</tr>
<tr>
<td><strong>Clean Closure Completeness</strong></td>
<td>100% of samples submitted to laboratory 100% of requested analyses conducted 100% of critical analytes to be valid a 80% of noncritical analytes to be valid</td>
<td>Decision of whether or not COCs remain in soil cannot be determined.</td>
</tr>
<tr>
<td><strong>Comparability</strong></td>
<td>Equivalent samples analyzed using same analytical methods, the same units of measurement and detection limits must be used for like analyses.</td>
<td>Inability to use data compiled in previous phases.</td>
</tr>
<tr>
<td><strong>Representativeness</strong></td>
<td>Correct analytical method performed for appropriate COPC; valid data reflects the appropriate target population.</td>
<td>Cannot identify COC or estimate the concentration of COC; therefore, cannot make decision(s) on target population.</td>
</tr>
</tbody>
</table>

aCritical analytes are those analytes most likely present in the target population at concentrations of concern and have been identified through process knowledge of similar sites and historical documentation. Critical analytes for mud pit and waste dump samples are petroleum hydrocarbons, PCBs, radionuclides, and metals. The critical analyte for the lead brick CAS samples is lead. Critical analytes for the box and pipe samples are radionuclides. Decision II critical samples will be determined based on Decision I analytical results.
# Table 6-2
## Analytical Requirements for CAU 357
### (Page 1 of 3)

<table>
<thead>
<tr>
<th>Parameter/Analyte</th>
<th>Medium or Matrix</th>
<th>Analytical Method</th>
<th>Minimum Reporting Limit</th>
<th>RCRA Hazardous Waste Regulatory Limit</th>
<th>Laboratory Precision</th>
<th>Percent Recovery (%R)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ORGANICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Volatile Organic Compounds (VOCs)</td>
<td>Water</td>
<td>8260B</td>
<td>Parameter-specific estimated quantitation limits</td>
<td>Not Applicable (NA)</td>
<td>Lab-specific</td>
<td>Lab-specific</td>
</tr>
<tr>
<td>Total Volatile Organic Compounds (VOCs)</td>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toxicity Characteristic Leaching Procedure (TCLP) VOCs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>Aqueous</td>
<td>1311/8260B</td>
<td>0.050 mg/L</td>
<td>0.5 mg/L</td>
<td>Lab-specific</td>
<td>Lab-specific</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>0.5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>100 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloroform</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>6 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>0.5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>0.7 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>200 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetrachloroethene</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>0.7 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichloroethene</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>0.5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td></td>
<td></td>
<td>0.050 mg/L</td>
<td>0.2 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Semivolatile Organic Compounds (SVOCs)</td>
<td>Water</td>
<td>8270C</td>
<td>Parameter-specific estimated quantitation limits</td>
<td>NA</td>
<td>Lab-specific</td>
<td>Lab-specific</td>
</tr>
<tr>
<td>Total Semivolatile Organic Compounds (SVOCs)</td>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCLP SVOCs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o-Cresol</td>
<td>Aqueous</td>
<td>1311/8270C</td>
<td>0.10 mg/L</td>
<td>200 mg/L</td>
<td>Lab-specific</td>
<td>Lab-specific</td>
</tr>
<tr>
<td>m-Cresol</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>200 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-Cresol</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>200 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cresol (total)</td>
<td></td>
<td></td>
<td>0.30 mg/L</td>
<td>200 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,4-Dichlorobenzene</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>7.5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-Dinitrotoluene</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>13 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>0.13 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexachlorobutadiene</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>0.5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexachloroethane</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>3 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrobenzene</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>2 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td></td>
<td></td>
<td>0.50 mg/L</td>
<td>100 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyridine</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4,5-Trichlorophenol</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>400 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4,6-Trichlorophenol</td>
<td></td>
<td></td>
<td>0.10 mg/L</td>
<td>2 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polychlorinated Biphenyls (PCBs)</td>
<td>Water</td>
<td>8082</td>
<td>Parameter-specific (CRL)</td>
<td>NA</td>
<td>Lab-specific</td>
<td>Lab-specific</td>
</tr>
<tr>
<td>Polychlorinated Biphenyls (PCBs)</td>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Petroleum Hydrocarbons (TPH)</td>
<td>Water Gasoline</td>
<td>8015B</td>
<td>0.1 mg/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Petroleum Hydrocarbons (TPH)</td>
<td>Soil Gasoline</td>
<td>8015B modified</td>
<td>0.5 mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Petroleum Hydrocarbons (TPH)</td>
<td>Water Diesel</td>
<td>8015B modified</td>
<td>0.5 mg/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Petroleum Hydrocarbons (TPH)</td>
<td>Soil Diesel</td>
<td></td>
<td>25 mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>Water</td>
<td>8015B modified</td>
<td>1,000 µg/L</td>
<td>NA</td>
<td>Lab-specific</td>
<td>Lab-specific</td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Pesticides</td>
<td>Water</td>
<td>8081A</td>
<td>Parameter-specific estimated quantitation limits</td>
<td>NA</td>
<td>Lab-specific</td>
<td>Lab-specific</td>
</tr>
<tr>
<td>Total Pesticides</td>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 6-2
Analytical Requirements for CAU 357
(Page 2 of 3)

<table>
<thead>
<tr>
<th>Parameter/Analyte</th>
<th>Medium or Matrix</th>
<th>Analytical Method</th>
<th>Minimum Reporting Limit</th>
<th>RCRA Hazardous Waste Regulatory Limit</th>
<th>Laboratory Precision a</th>
<th>Percent Recovery (%R) b</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TCLP Pesticides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpha Chlordane</td>
<td>Aqueous</td>
<td>1311/8081A c</td>
<td>0.0005 mg/L g</td>
<td>0.03 mg/L f</td>
<td>Lab-specific e</td>
<td>Lab-specific e</td>
</tr>
<tr>
<td>Gamma Chlordane</td>
<td>Aqueous</td>
<td>0.0005 mg/L g</td>
<td>0.03 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endrin</td>
<td></td>
<td>0.001 mg/L L</td>
<td>0.02 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heptachlor</td>
<td></td>
<td>0.0005 mg/L L</td>
<td>0.008 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heptachlor Epoxide</td>
<td></td>
<td>0.0005 mg/L L</td>
<td>0.008 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lindane (Gamma-BCH)</td>
<td></td>
<td>0.0005 mg/L L</td>
<td>0.4 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methoxychlor</td>
<td></td>
<td>0.005 mg/L L</td>
<td>10.0 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toxaphene</td>
<td></td>
<td>0.05 mg/L L</td>
<td>0.5 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Herbicides</td>
<td>Water</td>
<td>8151A e</td>
<td>Parameter-specific</td>
<td>NA</td>
<td>Lab-specific e</td>
<td>Lab-specific e</td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td></td>
<td>estimated quantitation limits d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TCLP Herbicides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4,5-T</td>
<td>Aqueous</td>
<td>1311/8151A e</td>
<td>4.0 mg/L k</td>
<td>400.0 mg/L</td>
<td>Lab-specific e</td>
<td>Lab-specific e</td>
</tr>
<tr>
<td>2,4,5-TP (Silvex)</td>
<td>Aqueous</td>
<td>0.01 mg/L k</td>
<td>1.0 mg/L f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4-D</td>
<td>Water</td>
<td>8330 i</td>
<td>Parameter-specific</td>
<td>NA</td>
<td>Lab-specific e</td>
<td>Lab-specific e</td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td></td>
<td>estimated quantitation limits d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Explosives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INORGANICS**

<table>
<thead>
<tr>
<th>Parameter/Analyte</th>
<th>Medium or Matrix</th>
<th>Analytical Method</th>
<th>Minimum Reporting Limit</th>
<th>RCRA Hazardous Waste Regulatory Limit</th>
<th>Laboratory Precision a</th>
<th>Percent Recovery (%R) b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>Water 6010B i</td>
<td>0.060 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>6 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>Water 6010B i</td>
<td>0.01 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>1 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Barium</td>
<td>Water 6010B i</td>
<td>0.20 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>20 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>Water 6010B i</td>
<td>0.005 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>0.5 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>Water 6010B i</td>
<td>0.005 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>0.5 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>Water 6010B i</td>
<td>0.01 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>0.5 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>Water 6010B i</td>
<td>0.003 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>0.5 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>Water 7470A i</td>
<td>0.0002 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 7471A i</td>
<td>0.1 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>Water 6010B i</td>
<td>0.04 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>4 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td>Water 6010B i</td>
<td>0.005 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>0.5 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td>Water 6010B i</td>
<td>0.01 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>1 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>Water 6010B i</td>
<td>0.02 mg/L h, i</td>
<td>NA</td>
<td></td>
<td>20 i</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 6010B i</td>
<td>2 mg/kg h, i</td>
<td>NA</td>
<td></td>
<td>35 i</td>
<td></td>
</tr>
</tbody>
</table>
**Analytical Requirements for CAU 357**

<table>
<thead>
<tr>
<th>Parameter/Analyte</th>
<th>Medium or Matrix</th>
<th>Analytical Method</th>
<th>Minimum Reporting Limit</th>
<th>RCRA Hazardous Waste Regulatory Limit</th>
<th>Laboratory Precision</th>
<th>Percent Recovery (%R)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TCLP RCRA Metals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>Aqueous</td>
<td>1311/6010B</td>
<td>0.10 mg/L</td>
<td>5 mg/L</td>
<td>20'</td>
<td>Matrix Spike Recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1311/7470A</td>
<td>2 mg/L</td>
<td>100 mg/L</td>
<td></td>
<td>75-125</td>
</tr>
<tr>
<td>Barium</td>
<td></td>
<td></td>
<td>0.05 mg/L</td>
<td>1 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td></td>
<td></td>
<td>0.1 mg/L</td>
<td>5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td></td>
<td></td>
<td>0.03 mg/L</td>
<td>5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
<td>0.002 mg/L</td>
<td>0.2 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td></td>
<td>0.05 mg/L</td>
<td>1 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selenium</td>
<td></td>
<td></td>
<td>0.1 mg/L</td>
<td>5 mg/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Relative percent difference (RPD) is used to calculate precision. Precision is estimated from the RPD of the concentrations measured for the matrix spike and matrix spike duplicate or of laboratory, or field duplicates of unspiked samples. It is calculated by: \( RPD = 100 \times \left( \frac{|A_1 - A_2|}{(A_1 + A_2)/2} \right) \), where \( A_1 \) = Concentration of the parameter in the initial sample aliquot, \( A_2 \) = Concentration of the parameter in the duplicate sample aliquot.

* The %R is used to calculate accuracy. Accuracy is assessed from the recovery of parameters spiked into a blank or sample matrix of interest, or from the recovery of surrogate compounds spiked into each sample. The recovery of each spiked parameter is calculated by: \( \%R = 100 \times \left( \frac{A_s - A_u}{A_n} \right) \), where \( A_s \) = Concentration of the parameter in the spiked sample, \( A_u \) = Concentration of the parameter in the unspiked sample, \( A_n \) = Concentration increase that should result from spiking the sample.


* Estimated Quantitation Limit as given in SW-846 (EPA, 1996).

* In-House Generated RPD and %R Performance Criteria. It is necessary for laboratories to develop in-house performance criteria and compare them to those in the methods. The laboratory begins by analyzing 15 to 20 samples of each matrix and calculating the mean %R for each parameter. The standard deviation (SD) of each %R is then calculated, and the warning and control limits for each parameter are established at \( \pm 2 \) SD and \( \pm 3 \) SD from the mean, respectively. If the warning limit is exceeded during the analysis of any sample delivery group (SDG), the laboratory institutes corrective action to bring the analytical system back into control. If the control limit is exceeded, the sample results for that SDG are considered unacceptable. These limits are reviewed after every quarter and are updated when necessary. The laboratory tracks trends in both performance and control limits by the use of control charts. The laboratory’s compliance with these requirements is confirmed as part of an annual laboratory audit. Similar procedures are followed in order to generate acceptance criteria for precision measurements.


* EPA Contract Laboratory Program (CLP) Statement of Work for Organic Analysis (EPA, 1988b; 1991; and 1994c)

* Industrial Sites Quality Assurance Project Plan (NNSA/NV, 2002b)

* EPA Contract Laboratory Program Statement of Work for Inorganic Analysis (EPA, 1988a; 1994b; and 1995)

* The MRL was established at 1/10 the PAL.

* The MRL was established at 1/100 of the Regulatory Limit.

**Definitions:**
- mg/L = Milligrams per liter
- µg/kg = Micrograms per kilogram
- mg/kg = Milligrams per kilogram
- µg/L = Micrograms per liter
- CRQL = Contract-required quantitation limits
# Table 6-3
Analytical Requirements for Radionuclides for CAU 357

<table>
<thead>
<tr>
<th>Parameter/Analyte</th>
<th>Matrix</th>
<th>Analytical Method</th>
<th>MDC</th>
<th>PAL</th>
<th>MRL</th>
<th>Laboratory Precision</th>
<th>Percent Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gamma Spectrometry</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Americium-241</td>
<td>Water</td>
<td>EPA 901.1(^a)</td>
<td>50 pCi/L</td>
<td>50 pCi/L</td>
<td>50 pCi/L</td>
<td>Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2&lt;ND&lt;2</td>
<td>Laboratory Control Sample Recovery 80-120 (^%) Recovery</td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>HASL-300(^b)</td>
<td>2.0 pCi/g</td>
<td>2.0 pCi/g</td>
<td>2.0 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cesium-137</td>
<td>Water</td>
<td>EPA 901.1(^a)</td>
<td>10 pCi/L</td>
<td>10 pCi/L</td>
<td>10 pCi/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>HASL-300(^b)</td>
<td>0.5 pCi/g</td>
<td>7.0 pCi/g</td>
<td>2.5 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-60</td>
<td>Water</td>
<td>EPA 901.1(^a)</td>
<td>10 pCi/L</td>
<td>10 pCi/L</td>
<td>10 pCi/L</td>
<td>Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2&lt;ND&lt;2</td>
<td>Laboratory Control Sample Recovery 80-120 (^%) Recovery</td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>HASL-300(^b)</td>
<td>1.35 pCi/g</td>
<td>0.1 pCi/g</td>
<td>2.5 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eu-155</td>
<td>Water</td>
<td>EPA 901.1(^a)</td>
<td>1.0 pCi/L</td>
<td>20 pCi/L</td>
<td>1.0 pCi/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>HASL-300(^b)</td>
<td>20 pCi/g</td>
<td>1.35 pCi/g</td>
<td>20 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Radionuclides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plutonium-238</td>
<td>Water</td>
<td>ASTM D3885-02(^c)</td>
<td>0.1 pCi/L</td>
<td>0.16 pCi/L</td>
<td>0.1 pCi/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>ASTM C1001-00(^c)</td>
<td>0.05 pCi/g</td>
<td>0.05 pCi/g</td>
<td>0.05 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plutonium-239/240</td>
<td>Water</td>
<td>ASTM D3885-02(^c)</td>
<td>0.1 pCi/L</td>
<td>9.0 pCi/L</td>
<td>0.5 pCi/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>ASTM C1001-00(^c)</td>
<td>0.05 pCi/g</td>
<td>0.106 pCi/g</td>
<td>0.05 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strontium-90</td>
<td>Water</td>
<td>ASTM D2811-09(^c)</td>
<td>1.0 pCi/L</td>
<td>1.0 pCi/L</td>
<td>1.0 pCi/L</td>
<td>Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2&lt;ND&lt;2</td>
<td>Laboratory Control Sample Recovery 80-120 (^%) Recovery</td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>HASL-300(^b)</td>
<td>0.5 pCi/g</td>
<td>1.17 pCi/g</td>
<td>0.5 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uranium-234</td>
<td>Water</td>
<td>ASTM D3972-02(^c)</td>
<td>0.1 pCi/L</td>
<td>8.92 pCi/L</td>
<td>0.5 pCi/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>C1000-02(^d)</td>
<td>0.05 pCi/g</td>
<td>3.47 pCi/g</td>
<td>0.25 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uranium-235</td>
<td>Water</td>
<td>ASTM D3972-02(^c)</td>
<td>0.1 pCi/L</td>
<td>0.36 pCi/L</td>
<td>0.1 pCi/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>C1000-02(^d)</td>
<td>0.05 pCi/g</td>
<td>0.07 pCi/g</td>
<td>0.05 pCi/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uranium-238</td>
<td>Water</td>
<td>ASTM D3972-02(^c)</td>
<td>0.1 pCi/L</td>
<td>9.39 pCi/L</td>
<td>0.5 pCi/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil</td>
<td>C1000-02(^d)</td>
<td>0.05 pCi/g</td>
<td>3.47 pCi/g</td>
<td>0.25 pCi/g</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) The MDC is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.
\(^b\) The PALs for soil (with the exception of Am-241) are isotope-specific and defined as the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991).
\(^c\) The PALs for Am-241 in soil are set equal to the MDC.
\(^d\) The PALs for liquids are set equal to the MDC.
\(^e\) The MRL is set equal to 5 times the MDC, or if 5 times the MDC is greater than the PAL, the MRL is set equal to the MDC.
\(^f\) Prescribed Procedures for Measurements of Radioactivity in Drinking Water, EPA-600/4-80-032 (EPA, 1980)
\(^g\) MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.
\(^h\) Environmental Measurements Laboratory Procedures Manual, HASL-300 (DOE, 1997)
\(^i\) ND is not RPD, 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)
\(^j\) EPA Contract Laboratory Program Statement of Work for Inorganic Analysis (EPA, 1998a; 1994b; and 1995)
\(^k\) Standard Test Method for Plutonium in Water (ASTM, 2002b)
\(^l\) General Radiochemistry and Routine Analytical Services Protocol (GRASP) (EG&G Rocky Flats, 1991). The chemical yield only applies to plutonium, uranium, and strontium.
\(^m\) Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy (ASTM, 2000a)
\(^n\) Standard Test Method for Isotopic Uranium in Water by Radiochemistry (ASTM, 2002a)
\(^o\) Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry (ASTM, 2002c)

ASTM = American Society for Testing and Materials  
MDC = Minimum detectable concentration  
PAL = Preliminary action level  
MRL = Minimum reporting limit  
PCi/g = Picocuries per gram  
PCi/L = Picocuries per liter

The MDC is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.  
The PALs for soil (with the exception of Am-241) are isotope-specific and defined as the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991).  
The PALs for Am-241 in soil are set equal to the MDC.  
The PALs for liquids are set equal to the MDC.  
The MRL is set equal to 5 times the MDC, or if 5 times the MDC is greater than the PAL, the MRL is set equal to the MDC.  
Prescribed Procedures for Measurements of Radioactivity in Drinking Water, EPA-600/4-80-032 (EPA, 1980)  
MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.  
Environmental Measurements Laboratory Procedures Manual, HASL-300 (DOE, 1997)  
ND is not RPD, 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)  
EPA Contract Laboratory Program Statement of Work for Inorganic Analysis (EPA, 1998a; 1994b; and 1995)  
Standard Test Method for Plutonium in Water (ASTM, 2002b)  
General Radiochemistry and Routine Analytical Services Protocol (GRASP) (EG&G Rocky Flats, 1991). The chemical yield only applies to plutonium, uranium, and strontium.  
Standard Test Method for Isotopic Uranium in Water by Radiochemistry (ASTM, 2002a)  
Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry (ASTM, 2002c)  
7.0 References

ASTM, see American Society for Testing and Materials.


BN, see Bechtel Nevada.


Butler, M., Lawrence Livermore National Laboratory. 2000. Record of Telecon with B. Bailey (IT) concerning the mud pits on the NTS, 2 November. Las Vegas, NV.

Center for Land Use Interpretation. 1996. The Nevada Test Site, A Guide to America’s Nuclear Proving Ground. Las Vegas, NV.

CFR, see Code of Federal Regulations.


DOE, see U.S. Department of Energy.


DRI, see Desert Research Institute.

Desert Research Institute. 1985. Additional Intensity Duration Analyses and Design Hectograph Parameters for Various Precipitation Stations on the Nevada Test Site, Nevada, August. Las Vegas, NV.


EPA, see U.S. Environmental Protection Agency.


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


Fenix & Scisson, Inc. 1971b. “Hole History Data for U-10as,” 16 December. Las Vegas, NV.


IT, see IT Corporation.


LANL, see Los Alamos National Laboratory.


LLNL, see Lawrence Livermore National Laboratory.


NAC, see Nevada Administrative Code.

NBMG, see Nevada Bureau of Mines and Geology.

NDEP, see Nevada Division of Environmental Protection.


Nevada Division of Environmental Protection. 1997a. *Class II Solid Waste Disposal Site for Municipal and Industrial Solid Waste, Area 23 of the NTS,* Permit SW 13 097 04. Carson City, NV.

Nevada Division of Environmental Protection. 1997b (as amended in August 2000). *Class III Solid Waste Disposal Site for Hydrocarbon Burdened Soils, Area 6 of the NTS,* Permit SW 13 097 02. Carson City, NV.

Nevada Division of Environmental Protection. 1997c (as amended in August 2000). *Class III Solid Waste Disposal Site; U10C, Area 9 of the NTS,* Permit SW 13 097 03. Carson City, NV.
Nevada Division of Environmental Protection. 1999. *State of Nevada Water Pollution Control General Permit*, Permit No. GNEV93001. Carson City, NV.


*Nevada Revised Statutes*. 1999c. NRS 618.750 - 618.801, “Control of Asbestos.” Carson City, NV.

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


NRS, see *Nevada Revised Statutes*.


REECo, see Reynolds Electrical & Engineering Co., Inc.

Reynolds Electrical and Engineering Co., Inc. 1991a. *Inventory of Inactive and Abandoned Facilities and Waste Sites Areas 1-4*, Volume 1 of 5, April. Las Vegas, NV.

Reynolds Electrical and Engineering Co., Inc. 1991b. *Inventory of Inactive and Abandoned Facilities and Waste Sites Areas 5-10*, Volume 2 of 5, April. Las Vegas, NV.


Rowe, P., Stone and Webster Incorporated. 2001. Record of Telecon with Beatriz Bordeloi (SAIC) concerning mud pits and cellars/sumps, 22 January. Las Vegas, NV.
RSN, see Raytheon Services Nevada.

USC, see *United States Code*.


USGS, see U.S. Geological Survey.


Wilkes, M., Bechtel Nevada. 2000a. Record of meeting with B. Bailey (IT) regarding mud pits at the NTS, 3 November. Las Vegas, NV.

Wilkes, M., Bechtel Nevada. 2000b. Record of meeting with B. Bailey (IT) regarding mud pits at the NTS, 9 November. Las Vegas, NV.


Appendix A
Data Quality Objectives Worksheets
A.1.0 Data Quality Objectives (DQO) Process

The DQO process described in this appendix is a seven-step strategic planning approach based on the scientific method used to plan site characterization data collection activities. These activities will be performed in accordance with the EPA guidance and information the State of Nevada provided within the FFACO (1996) for CAU 357: Mud Pits and Disposal Sites, Nevada Test Site, Nevada (EPA, 2000). The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend necessary corrective actions (i.e., no further action, closure in place, or clean closure). Information adequacy about the nature and extent of contamination, gained from process knowledge acquired through Preliminary Assessments (PA) performed and review of historic documentation from similar CAS locations, may be sufficient to recommend a closure alternative. Because available process knowledge is limited, a SAFER Plan investigation will be conducted (FFACO, 1996). This SAFER Plan will be used to verify and evaluate existing knowledge, identify and select decision points (developed in cooperation with NNSA/NSO and NDEP prior to beginning the next decision of work), and select and/or affirm a recommended potential corrective actions and closure.

The investigation will be based on the DQOs presented in this appendix as developed with concurrence from representatives of the NDEP and the NNSA/NSO. The DQO participants are identified in Table A.1-1. The seven steps of the DQO process identified in Sections A.1.2 through A.1.8 were developed based on the CAS-specific information presented in Section A.1.1.1.

A.1.1 CAS-Specific Information

Figure A.1-1 illustrates the locations of the 14 CASs that comprise CAU 357. There are 11 Mud Pit CASs: four are located within Area 7, three are within Area 8, and four are located in Area 10. The three remaining CASs identified by the FFACO are Boxes/Pipes, Lead Bricks, and Waste Dump, which are located in Areas 1, 4, and 25, respectively.
## Table A.1-1
DQO Participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Affiliation</th>
<th>Department/Project Team Member’s Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabine Curtis</td>
<td>NNSA/NSO</td>
<td>Task Manager</td>
</tr>
<tr>
<td>Clem Goewert</td>
<td>NDEP</td>
<td>Project Coordinator</td>
</tr>
<tr>
<td>C. Carlos Gonzales</td>
<td>BN</td>
<td>Hazardous Waste Operations</td>
</tr>
<tr>
<td>David M. Nacht</td>
<td>BN</td>
<td>Environmental Regulations</td>
</tr>
<tr>
<td>Glenn Richardson</td>
<td>BN</td>
<td>Task Manager</td>
</tr>
<tr>
<td>Stacy Alderson</td>
<td>Shaw</td>
<td>Rad Physics, Task Manager</td>
</tr>
<tr>
<td>Wolf Exner</td>
<td>Shaw</td>
<td>Health &amp; Safety</td>
</tr>
<tr>
<td>Peter Ferron</td>
<td>SAIC</td>
<td>Technical Support Staff</td>
</tr>
<tr>
<td>John Fowler</td>
<td>Shaw</td>
<td>Regulatory Support Manager</td>
</tr>
<tr>
<td>Sylvan Hersh</td>
<td>Shaw</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>Joe Hutchinson</td>
<td>SAIC</td>
<td>Radiation Analytical</td>
</tr>
<tr>
<td>Robert Irwin</td>
<td>GRAM</td>
<td>CAU 357 Lead</td>
</tr>
<tr>
<td>Bridget Iverson</td>
<td>GeoTrans</td>
<td>Preliminary Assessment</td>
</tr>
<tr>
<td>Lynn Kidman</td>
<td>Shaw</td>
<td>Project Manager</td>
</tr>
<tr>
<td>William Nicosia</td>
<td>SAIC</td>
<td>Radiation Physics, CAU Lead</td>
</tr>
<tr>
<td>Joe Peters</td>
<td>SAIC</td>
<td>Chemical Analytical</td>
</tr>
<tr>
<td>Gary Romano</td>
<td>Shaw</td>
<td>FFACO</td>
</tr>
<tr>
<td>David Schrock</td>
<td>SAIC</td>
<td>Environmental Control and Waste Management</td>
</tr>
<tr>
<td>Jeanne Wightman</td>
<td>Shaw</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>Lowell Wille</td>
<td>Shaw</td>
<td>Task Lead</td>
</tr>
</tbody>
</table>

**Abbreviations:**
- BN = Bechtel Nevada
- FFACO = Federal Facility Agreement and Consent Order
- GeoTrans = GeoTrans, Inc.
- GRAM = GRAM, Inc.
- NNSA/NSO = U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
- SAIC = Science Applications International Corporation
- Shaw = Shaw Environmental, Inc.
As they are presented, the 14 CASs comprising CAU 357 with their corresponding site sketch are:

- 07-09-02, Mud Pit  
- 07-09-03, Mud Pit  
- 07-09-04, Mud Pit  
- 07-09-05, Mud Pit  
- 08-09-01, Mud Pit  
- 08-09-02, Mud Pit  
- 08-09-03, Mud Pit  
- 10-09-02, Mud Pit  
- 10-09-04, Mud Pit  
- 10-09-05, Mud Pit  
- 10-09-06, Mud Pit; Stains; Material  
- 25-15-01, Waste Dump  
- 04-26-03, Lead Bricks  
- 01-99-01, Boxes; Pipes

The COPCs specific to each CAS are described in the following text. The COPCs are defined as those contaminants that are known or suspected to be present within a CAS.

If a COPC is detected in any sample at a concentration above a PAL, the COPC will be identified as a COC. If a COC is identified, the CAS containing that COC will be further investigated to determine the extent of the COC. The DQOs and conceptual model may be modified if results identify an unanticipated COPC. If COPCs are present above PALs, the extent of contamination to support a closure will be determined.

**A.1.1.1 CAS-Specific Background Information**

Individual CAS information, summarized below, was identified for all 14 CASs in CAU 357 during the PA. **Figure A.1-1** is a sketch of the NTS identifying the individual CAS locations. There were three additional mud pit CASs (07-09-01, 10-09-01, and 10-09-03) identified during the PA which have been transferred from CAU 357 to CAU 544 because they are located in potential or subsided crater areas. Therefore, they are not addressed further in this document.
Figure A.1-1
CAU 357, CAS Location Map

Explanation
- Nevada Test Site Boundary
- Area Boundary
- County Boundary
- Paved Road
- Unpaved Road
- CAS Location

Scale
0 8 16 Miles
0 12 24 Kilometers

Source: Modified from DOE/NV, 1996
A.1.1.1 Mud Pit, CAS 07-09-02

Physical Setting and Operational History - CAS 07-09-02, Mud Pit, is located past the RadSafe Base Station in Area 7. The mud pit is rectangular (approximately 115 by 40 ft), slopes from east to west, and is defined by a berm. Figure A.1-2 shows a sketch of the CAS.

The CAS was first identified in the December 12, 1991, Environmental Compliance Inventory (REECo, 1991b). This mud pit is believed to have supported activities associated with the Rudder test sponsored by LLNL that occurred December 28, 1976 (DOE/NV, 2000b). The exploratory drill hole UE-7L, associated with this mud pit, was drilled to 2,718 ft with a diameter of 12.25 in. (RSN, 1991). Reports conflict as to the actual period of drilling. Drilling was completed on either May 29, 1986 (RSN, 1991) or September 4, 1981 (Fenix & Scisson Inc., 1983). The site is currently listed in the FFACO as inactive and abandoned (FFACO, 1996). Surface debris visible within the mud pit and on the berms includes scrap crates, wood stakes, rusted metal, and plastic bottles. The mud within the pit is light gray, with a reddish cement stain in the northwest corner of the pit. There is no evidence of mud outside of the mud pit (IT, 2002).

Sources of Potential Concern - The Fenix & Scisson (1983) report identifies that the circulating media for the hole used included 3,000 barrels of air foam; 2,640 barrels of gel mud; 3,240 barrels of LCM mud; and 480 barrels of chemical mud. Therefore, the drilling muds and their associated constituents will be the primary source of potential contamination.

Previous Investigation Results - One soil sample was collected from a cement-stained area within the mud pit on August 21, 1997, and analyzed for RCRA metals, VOCs, SVOCs, and TPH (Bordelois, 1998a). Acetone, arsenic, barium, chromium, and lead were the only parameters reported above detection limits (Coleman, 1998). Two additional soil samples were collected for a preliminary radiological survey on August 21, 1997. One discrete soil sample was collected from the bottom of the mud pit for the radiological analysis. Gross alpha, gross beta, and potassium-40 were reported at concentrations above detection limits (Bordelois, 1998a). The second sample was collected from the northwest corner of the mud pit and all radiological parameters were less than detection limits (IT, 1998).
Figure A.1-2
CAU 357, CAS 07-09-02, Mud Pit

Explanation:
- Bermed Area and Slope Direction
- CAS 07-09-02 Footprint
- Stained Area
- bgs = Below Ground Surface
- Site Marker

Source: IT, 2002
Contaminants of Potential Concern - Previous investigations of similar CASs, at CAU 356 and CAU 34, show that the primary COPC for mud pits is TPH diesel-range organics. The specific drilling fluids used in association with the various mud pits are unknown. COPCs identified at this CAS include acetone, arsenic, barium, chromium, lead, and radionuclides (e.g., gross alpha, gross beta, and potassium-40). Arsenic was the only COPC identified above action levels and exceeding EPA generic SSL for ingestion (Bordelois, 1998a). However, the arsenic concentration level detected is representative of ambient conditions for this area of the NTS (Moore, 1999).

A.1.1.1.2 Mud Pit, CAS 07-09-03

Physical Setting and Operational History - The CAS 07-09-03, Mud Pit, is located 0.15 mi past the RadSafe Base Station on the left (north) side of the road in Area 7. The CAS was first identified on September 2, 1993, and a preliminary investigation was performed on January 9, 2002. It is believed that this CAS was used for drilling media and/or drill cuttings disposal, or a mud haul-truck washout pit. The CAS is currently listed in the FFACO (1996) as inactive and the site is abandoned.

Figure A.1-3 shows the CAS, which consists of two areas (Mud Pit A and Mud Pit B) defined by 8- to 15-ft high natural berms (terrace or channel bank), dirt roads, and natural slopes. It does not appear that this mud pit/disposal area (pits A and B) was constructed, but rather was used as a dumping/washout zone/area due to its proximity between the junction of two dirt access roads (one active and the other inactive). The terrain slopes gently down from the east into the mud pit/disposal areas, where natural drainage trends north. Undisturbed native soil has been covered in many places by mud. Vegetation has been disturbed only in areas where there is mud (IT, 2002).

Mud Pit A is located north of the dirt access road. It is elongated in a north/ south trend and irregular in shape. Dimensions are approximately 720 ft long by 230 ft wide at the southern end, and tapers north to 40 ft wide. No defined berms exist, rather an abandoned or infrequently-traveled dirt road crossing divides the two areas, and the western flank is “bermed” by a natural channel bank that ranges from 8 to 15 ft high. Animal burrows exist throughout the berms. Vegetation within the mud pit/disposal area is sparse, and completely absent in the center of the area, where maximum thickness of the mud is estimated to be approximately 10 in. A thin deposit of light-gray mud is present on the southwest side of the area.
Figure A.1-3
CAU 357, CAS 07-09-03, Mud Pit
Mud Pit B is located northwest of washout/mud pit/disposal Area A. It is also elongated in a north/south trend and is irregular in shape. Dimensions are approximately 200 ft long by 120 ft wide. The southeast berm of Mud Pit B makes up the northwestern berm of Area A and has been utilized infrequently as a road. Vegetation is sparse and mud exists at the bottom of this pit, where maximum thickness of the mud is estimated to be approximately 1 ft or less. Because of the irregular dimensions of the disposal area, the exact depths and volumes are unknown.

Surface debris at the site consists of wire, a wooden spool, and miscellaneous scrap. Site-specific information regarding the materials in the mud pit/disposal area(s) of CAS 07-09-03 were not identified during historical review and interviews. General process knowledge and information was used to estimate what may have been included within the circulating media.

**Sources of Potential Concern** - The sources of potential concern include the constituents found within the drilling mud media, the cleanout/wash-down media, and petroleum hydrocarbons washed/released from the trucks, tanker trailers, and mobile mud pits.

**Previous Investigation Results** - A radiological survey was conducted on the south side of the Mud Pit A which produced measurements within the range of background (IT, 1998). No other chemical or geophysical data collection has been conducted at this CAS. The exact materials and the depth of the mud pits/disposal areas are not well defined.

**Contaminants of Potential Concern** - The COPCs applicable to all mud pit CASs are based on general NTS mud pit drilling-media information. Table A.1-2 provides a comprehensive list of chemicals potentially used during the drilling efforts at the NTS. This list does not identify the chemicals used at specific CASs. Previous investigations of similar CASs, such as those in CAU 356 and CAU 34, show that the primary COPC for the mud pits is TPH-diesel/motor oil range organics. Other COPCs might include VOCs, SVOCs, and various radionuclides (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]). The quantity of diesel fuel dumped or washed out into the disposal area(s) is not known, nor is the specific fluid(s) used at a drilling location. Because no analytical results are available for this CAS, the list of potential chemicals is assumed as a worst-case scenario. These constituents, potentially added to the muds, are considered the primary COPCs for all mud pit CASs.
**Table A.1-2**

Constituents Used in Drilling Mud

<table>
<thead>
<tr>
<th>Product</th>
<th>Company</th>
<th>Chemical Material</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>My-Lo-Gel</td>
<td>Dresser Industries</td>
<td>Pregelatanized starch</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>M-I Gel (Bentonite)</td>
<td>M-I Drilling Fluids Co.</td>
<td>Unknown</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Bentonite/Polyacrylamide</td>
<td>Unknown</td>
<td>REECo, 1994</td>
<td></td>
</tr>
<tr>
<td>Bentonite, Swell Gel</td>
<td>Redmond Clay and Salt</td>
<td>Unknown</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Sepiolite Clay</td>
<td>IMV Div. of Floridan Co.</td>
<td>Mg$_4$Si$<em>6$O$</em>{15}$(OH)$_2$+6H$_2$O</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>EZ Mud-DP</td>
<td>Baroid Drilling Fluids, Inc.</td>
<td>Polymer</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Soda Ash</td>
<td>Texas Gulf, Inc.</td>
<td>Theophylline, ethylenediamine, carbonic acid, disodium salt</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Potash</td>
<td>Texas Gulf Chemicals Co.</td>
<td>97% KCl</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Surfactant TF Foamer</td>
<td>Thatcher Chemical Co.</td>
<td>Isopropanol</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Guar Gum G-150</td>
<td>Rantee Corp.</td>
<td>Unknown</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Lithium Hypochlorite</td>
<td>FMC Corp.</td>
<td>LiClO</td>
<td>REECo, 1994; Chemfinder.com, 2001b</td>
</tr>
<tr>
<td>Rapid Mud</td>
<td>Dresser Industries</td>
<td>Liquid anionic polyelectrolyte (organic)</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Cydrl 4000 Flocculant</td>
<td>American Cyanamid Co.</td>
<td>Anionic polyacrylamide</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Sodium Acid Pyrophosphate</td>
<td>Nusource Chemical Corp.</td>
<td>Na$_2$H$_2$P$_2$O$_7$</td>
<td>REECo, 1994; Chemfinder.com, 2001c</td>
</tr>
<tr>
<td>Lithium Bromide</td>
<td>Lithium Corp. of America</td>
<td>LiBr</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Magco Foam Check</td>
<td></td>
<td>Proprietary mixture</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Cypan</td>
<td></td>
<td>Sodium polyacrylate (polymer)</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Caustic Soda Flake</td>
<td></td>
<td>NaOH</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Magcocide</td>
<td></td>
<td>91% Paraformaldehyde (EPA Hazardous Chemical)</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>My-Lo-Gel Preservative</td>
<td></td>
<td>95% Paraformaldehyde (EPA Hazardous Chemical)</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Thermogel</td>
<td>Unknown</td>
<td>Sepiolite</td>
<td>LANL, 1991</td>
</tr>
<tr>
<td>Pela Caustic Soda Beads</td>
<td>Dyce Chemical Co.</td>
<td>NaOH</td>
<td>REECo, 1994; Chemfinder.com, 2001a</td>
</tr>
<tr>
<td>Sodium Polyacrylate - Spar</td>
<td>Dixie Chemical Co.</td>
<td>Unknown</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Guar Gum</td>
<td>Polychem International</td>
<td>Galacto-mannans (C$<em>6$H$</em>{10}$O$_3$)$_a$</td>
<td>REECo, 1994; LANL, 1991</td>
</tr>
<tr>
<td>Nalco ASP-715</td>
<td>Nalco Chemical Co.</td>
<td>Unknown</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Stepantan 29N Foaming Agent</td>
<td>Stepan Chemicals</td>
<td>Unknown</td>
<td>REECo, 1994</td>
</tr>
<tr>
<td>Magconol</td>
<td>Magcobar</td>
<td>Alcohol</td>
<td>LANL, 1991</td>
</tr>
<tr>
<td>Raykrome 400</td>
<td>Unknown</td>
<td>Chrome lignosulfonate, contains 4% Cr</td>
<td>LANL, 1991</td>
</tr>
<tr>
<td>Polysal</td>
<td>Unknown</td>
<td>Modified starch</td>
<td>LANL, 1991</td>
</tr>
<tr>
<td>Hydrogel, Big Horn, or Envirogel</td>
<td>Unknown</td>
<td>Sodium montmorillonite, Western Bentonite</td>
<td>LANL, 1991</td>
</tr>
</tbody>
</table>
A.1.1.3 Mud Pit, CAS 07-09-04

Physical Setting and Operational History - CAS 07-09-04, Mud Pit, is located 150 ft west of the 3-05 Road in Area 7 of the NTS approximately 2 mi north of the Area 3 Mud Plant. The mud pit was first identified on September 2, 1993. The site is currently listed in the FFACO (1996) as inactive and abandoned. This CAS appears to be a mud staging area and not a traditional mud pit. It is believed to have supported multiple drilling activities within Area 7.

Berms define the boundaries of the mud pit, measured 160 by 343 ft, and the surface of the mud pit is approximately 4 ft below the top of the berm, as shown in Figure A.1-4. Two parallel metal pipes (33 ft apart) extend from the southern end of the pit. The western pipe extends on one end 4 ft into the mud pit, then beyond the berm. The other end of the pipe terminates 40 ft to the south. It is an open-ended, 6- or 8-in. pipe (unspecified in field notes) used for a possible load-out zone or overflow area, although no defined spill area is noted outside the berm. The 8-in. diameter eastern metal pipe extends 5 ft into the pit, through the berm, and runs both above and below the ground to the Area 3 Mud Plant approximately 2 mi to the south (IT, 2002). Vegetation is sparse; however, both the north and the south ends of the pit are covered with tumbleweeds. A wooden stand is near the northeast side of the pit. This stand is assumed to have rested atop the east berm of the mud pit, and may have held auxiliary equipment that was used to agitate the mud (IT, 2002). Also, a buried cable sign was noted to read: “Buried Cable” and “Danger High Voltage.” The exact cable location is unknown.

Sources of Potential Contamination - The drilling mud media and the constituents that comprise it will be the primary source of potential contamination.

Previous Investigation Results - On August 21, 1997, one biased mud sample was collected from the floor of the mud pit near the pipe inlets and analyzed for RCRA metals, VOCs, SVOCs, TPHs, and radionuclides. COPCs identified above detection limits include VOCs, SVOCs, RCRA metals (e.g., arsenic, barium, chromium, lead), gross beta-emitters, and radionuclides (i.e., potassium-40, lead-212, lead-214, thallium-208). A second area (northeast corner) field screened for radionuclides showed no readings above background (IT, 2002).

Contaminants of Potential Concern - Previous investigations of similar CASs, such as those in CAU 356 and CAU 34, show that the primary COPC for mud pits is TPH-diesel/motor oil range
Figure A.1-4
CAU 357, CAS 07-09-04, Mud Pit
organics. The specific drilling fluids used at this location are unknown. COPCs identified at this CAS include arsenic, barium, chromium, lead, and radionuclides (i.e., gross beta-emitters, potassium-40, lead-212, lead-214, and thallium-208). Other COPCs include VOCs, SVOCs, and various radionuclides (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]). Arsenic was the only COPC identified above action levels and exceeding the EPA generic SSL for ingestion (Bordelois, 1998b). However, the arsenic concentration level is representative of ambient conditions for this area of the NTS (Moore, 1999).

A.1.1.1.4 Mud Pit, CAS 07-09-05

Physical Setting and Operational History - The CAS 07-09-05, Mud Pit, is located southeast of the north fork in the dirt road off of RSM 7 G 6 in Area 7 approximately 0.5 mi northeast of the RSM 7 G 6 Road (Figure A.1-5). The CAS was first identified on September 1, 1993, and is currently listed in the FFACO (1996) as inactive and abandoned. Shaw personnel conducted a site reconnaissance effort visit on January 9, 2002. It was determined that the site covers an area with dimensions of 229 by 73 ft. The mud surface within the pit was described as generally light gray with a reddish-brown stain area off-east center of the pit. Berms do not define the boundaries of this mud pit. The mud pit is suspected to have supported activities associated with the Bourbon test sponsored by LLNL and conducted on January 20, 1967 (DOE/NV, 2000b).

Historical record review indicates that this mud pit may have supported two drilling operations: (1) An emplacement hole U-7n, completed February 24, 1966 (Fenix & Scisson, 1966) and drilled to a total depth of 600 ft with a bit diameter of 86 in. (RSN, 1991), and (2) an exploratory hole (UE-7n) that was suspended on April 14, 1976 (Fenix & Scisson, 1976), having achieved 75 ft total depth using a 36-in. bit (RSN, 1991).

Surface debris includes rusted metal pipes and various wood scraps. Vegetation within the mud pit is sparse; however, there is some vegetation and small scrub trees on the southern flank of the eastern corner, near some small piping debris on the ground. There are also some tumbleweeds collecting within the mud pit.
Figure A.1-5
CAU 357, CAS 07-09-05, Mud Pit
Sources of Potential Contamination - The drilling mud and the constituents that comprise it will be the primary source of potential contamination.

Previous Investigation Results - Two biased solid mud/soil samples were collected from the pit on August 21, 1997. Both samples were analyzed for total RCRA metals, VOCs, SVOCs, TPH, and radionuclides (Bordelois, 1998c). The detected COPCs identified in both samples at concentration levels above detection limits included arsenic, barium, chromium, lead, and various radionuclides (i.e., gross beta-emitters and potassium-40) (Bordelois, 1998c; IT, 2002). A third area (northeast corner) was field screened for radionuclides, producing readings within the range of background (IT, 2002). The variant mud pit bottom zones of color identified in the visit on January 9, 2002, have not been investigated.

Contaminants of Potential Concern - Previous investigations of similar CASs, such as those in CAU 356 and CAU 34, show that the primary COPC for mud pits is TPH-diesel/motor oil range organics. The specific drilling fluids used at this location are unknown. COPCs identified at this CAS include arsenic, barium, chromium, lead, and radionuclides (i.e., gross beta-emitters and potassium-40). Other COPCs may include VOCs, SVOCs, and various radionuclides (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 (NCRP, 1999). Arsenic was the only COPC detected above action levels and exceeding the EPA generic SSL for ingestion (Bordelois, 1998c). However, the arsenic concentration level detected is representative of ambient conditions for this area of the NTS (Moore, 1999).

A.1.1.1.5 Mud Pit, CAS 08-09-01

Physical Setting and Operational History - CAS 08-09-01, Mud Pit, is located 370 ft west of the U-8d crater in Area 8. The CAS was first identified on September 2, 1993, and is currently listed in the FFACO (1996) as inactive and abandoned. The CAS includes three berms, which surrounds the mud pit in an area approximately 75 by 50 ft. A borrow pit area (approximately 170 by 25 ft) is approximately 50 ft southeast of the mud pit. A more in-depth reconnaissance site visit was conducted on January 11, 2002, and concluded the CAS consists of the mud pit area only, excluding the borrow pit area from the CAS. A gray mud covers the mud pit, which is approximately 11 ft below the berm tops. All sides of the mud pit are partially excavated and vegetation is sparse at the
bottom. Potential fill and graded areas are on the south side of the mud pit, labeled “Leveled Work Pad Region” on the Figure A.1-6 sketch of the site (IT, 2002). Surface debris identified includes two rusted 55-gallon drums, whose integrity condition and potential contents are unknown; rusted paint cans; and various metal and wood scraps.

This mud pit is suspected to have supported activities associated with the Cyathus test that occurred on March 6, 1970, and was sponsored by LLNL (DOE/NV, 2000b). The UE-8h Exploratory Drill Hole is associated with this mud pit was drilled to 1,610 ft with a diameter of 9 7/8-in. (RSN, 1991). The drilling was completed on April 23, 1971 (Fenix & Scisson, 1971a).

**Sources of Potential Contamination** - Air foam and Davis Mix was believed to be the circulating media for the hole (Fenix & Scisson, 1971a), and drilling mud media is considered a primary source of COPCs. Also, the two rusted 55-gallon drums and the rusted paint cans may also have released contaminants to the environment.

**Previous Investigation Results** - One biased soil sample was collected from darker soil in the northeast corner of the mud pit on August 28, 1997. It was analyzed for RCRA metals, VOCs, SVOCs, and TPH (Bordelois, 1998d). Several RCRA metal analytes were identified at concentrations above detection limits including arsenic, barium, chromium, and lead. The same sampling location was used to collect soil from the bottom of the mud pit for the analysis of radionuclides. Analytes reported at concentrations above detection limits include gross alpha- and beta-emitters, cesium-137, lead-212, and potassium-40 (Bordelois, 1998d).

**Contaminants of Potential Concern** - Previous investigations of similar CASs, such as those in CAU 356 and CAU 34, show that the primary COPC for mud pits is TPH-diesel/motor oil range organics. Unknown for this specific mud pit includes the specific drilling fluids used. COPCs identified at this CAS include arsenic, barium, chromium, lead, and radionuclides (i.e., gross alpha- and beta-emitters, cesium-137, lead-212, and potassium-40). Other COPCs might include VOCs, SVOCs, and various radionuclides (i.e., americium-241, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]). Arsenic was the only COPC detected above action levels and exceeding the EPA generic SSL for ingestion (Bordelois, 1998d). However, the arsenic concentrations level detected is representative of ambient conditions for this area of the NTS.
Figure A.1-6
CAU 357, CAS 08-09-01, Mud Pit
Also, there are the two rusted 55-gallon drums and rusted paint cans, whose condition and potential contents are unknown. The assumption, based on process knowledge, is that they are empty and related to drilling. If it appears leakage and/or staining has occurred in the areas they currently lay, soil samples will be collected and analyzed for the COPCs listed above. If contents of original material are found in any of the containers, characterization will be directed to waste management.

A.1.1.6 Mud Pit, CAS 08-09-02

Physical Setting and Operational History - The CAS 08-09-02, Mud Pit, is located 96 ft southwest of the U-8d crater in Area 8. The CAS consists of a mud pit defined by an east to west-trending berm, and covers a 114- by 54-ft area. Depth from the top of the berm to the pit bottom ranges from 12 ft on the north side to 6 ft on the east side. Vegetation within the mud pit area is sparse. Figure A.1-7 shows a sketch of the CAS. The CAS is currently listed in the FFACO (1996) as inactive and abandoned (IT, 2002).

The site was first identified during field activities for the FFACO on August 31, 1993. It is believed that the mud pit supported post-test activities associated with the December 18, 1970, Baneberry test (DOE/NV, 2000b). The Baneberry test vented and released radioactive fallout. On March 1, 1971, the post-test drill hole associated with this mud pit (U-8d PS #2A) was drilled (Fenix & Scisson, 1972b). This hole was completed to a depth of 898 ft using a bit diameter of 9 7/8-in. (RSN, 1991).

Sources of Potential Contamination - Air foam and other conventional circulation media (e.g., Davis Mix) are believed to have been used when U-8d PS #2A was drilled (Fenix & Scisson, 1972b) and drilling mud media is considered a primary source of COPCs. Surface debris includes various wood scraps. A light-brown mud coats the pit.

Previous Investigation Results - A site reconnaissance visit was conducted on January 9, 2002. However, no preliminary soil samples were collected. No previous geophysical, chemical, or radiological sampling were identified.

Contaminants of Potential Concern - Because no analytical results are available for this CAS, a list of potential chemicals used, based on the general NTS mud pit drilling-media information, is
Figure A.1-7
CAU 357, CAS 08-09-02, Mud Pit
assumed as a worst-case scenario. These constituents and TPH-diesel/motor oil range organics are considered the primary COPCs. Other COPCs might include VOCs and SVOCs. Due to the proximity to the U-8d crater, radiological COPCs may also be a concern (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]). Other unknowns include diesel fuel that may have been dumped or washed into the mud pit.

A.1.1.1.7 Mud Pit, CAS 08-09-03

Physical Setting and Operational History - CAS 08-09-03, Mud Pit, is a series of two mud pits (return and suction) located approximately 80 ft southwest of the U-8d crater in Area 8. It is unclear from documentation which mud pit is the return pit and which is the suction pit. The CAS is defined by a grade-level berm (excavated soil was stockpiled) where the central berm is shared (shown as the divide between the mud pits). Mud Pit A (north) is 53 by 24 ft. Mud Pit B (south) is 51 by 18 ft, and is located approximately 80 ft north-northwest of CAS 08-09-02s mud pit. Depth of the pits range from grade level to 6 ft bgs in the centers. A light-brown mud covers both mud pit floors. Figure A.1-8 shows a sketch of the CAS. Surface debris within Mud Pit A includes a rusted pipe and various wood scraps, and debris within Mud Pit B includes wood debris and rusted metal objects (e.g., 55-gallon drum, 5-gallon bucket [whose integrity and possible contents are unknown]), two empty paint cans, 8-in. pipes, rope/cable, and metal scraps.

The CAS was first identified for the FFACO (1996) on August 31, 1993. It is suspected that the mud pits (return and suction) supported post-test activities associated with the December 18, 1970, Baneberry test (DOE/NV, 2000b). On April 26, 1971, the 9 7/8-in. post-test drill hole, identified as U-8d PS #3A and associated with these mud pits, was completed (Fenix & Scisson, 1972a) to a depth of 868 ft (RSN, 1991). The CAS is currently listed in the FFACO (1996) as inactive and abandoned (IT, 2002).

Sources of Potential Contamination - Air foam and other conventional circulation media (e.g., Davis Mix) are believed to have been used when U-8d PS #3A was drilled (RSN, 1991), and drilling mud media is considered a primary source of COPCs. Surface debris of concern includes a 55-gallon drum and a 5-gallon bucket located within Mud Pit B. The integrity and possible contents of the debris are unknown.
Figure A.1-8
CAU 357, CAS 08-09-03, Mud Pit
Previous Investigation Results - A site reconnaissance visit was performed on January 9, 2002. However, no preliminary soil samples were collected. No previous geophysical, chemical, or radiological sampling was identified.

Contaminants of Potential Concern - Since no analytical results are available for this CAS, a list of potential chemicals used, based on the general NTS mud pit drilling-media information, is assumed as a worst-case scenario. These constituents and TPH-diesel/motor oil range organics are considered the primary COPCs. Other COPCs include VOCs and SVOCs. Due to the proximity to the U-8d crater, radiological COPCs are also a concern (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]). Other COPCs include diesel fuel that may have been dumped or washed into the mud pit.

A.1.1.1.8 Mud Pit, CAS 10-09-02

Physical Setting and Operational History - The CAS 10-09-02, Mud Pit, is located approximately 100 ft due west of the U-10as crater in Area 10. The site consists of a two mud pit system, with a larger (suction) Pit A to the north and a smaller (return) Pit B to the south. Berms carved from Mud Pit A form and define the boundaries of the total mud pit system. Mud Pit B has been partially backfilled. A partially buried metal pipe approximately 20 ft in length runs between the two pits. Figure A.1-9 shows a sketch of the CAS. The CAS is currently listed in the FFACO as inactive and abandoned (REECo, 1991b; FFACO, 1996).

The site was first identified during the original ECI survey conducted in 1990 when it was designated as an open pre-emplacement mud pit(s) west of the potential crater at U-10as (REECo, 1991b). These mud pits are assumed to have supported the emplacement drill hole U-10as, which was drilled using air and water with Surfseal (as a drilling mud additive) to a depth of 1,200 ft and completed on July 24, 1971 (Fenix & Scisson, Inc., 1971b). This drill rig activity is assumed associated with the Pinedrops-Bayou, Pinedrops-Sloat, and Pinedrops-Tawny tests, which occurred on January 10, 1974 (RSN, 1991). The mud pit was most likely created to support drilling operations at U-10as; however, it may have been used during other drilling operations. Consequently, exact dates during which the mud pit was used were not identified, and the chemical and physical constituents used at the mud pits are unknown.
Sources of Potential Contamination - The drilling media used was air and water with Surfseal (Fenix & Scisson, Inc., 1971b). The past uses of this CAS were not clearly determined due to the lack of operational knowledge concerning this specific site. Although it can be assumed that pre-test drill cuttings, derived from the U-10as emplacement hole, were the primary waste in the mud pit. It is uncertain if other waste was disposed there. Based on the limited information available, the potential COPCs that may be associated with this mud pit include TPH diesel-range organics, VOCs, SVOCs, metals, and various radionuclides.

Previous Investigation Results - A site reconnaissance effort occurred on a visit on January 9, 2002. It was determined that Mud Pit A (suction) is 115 by 80 ft, berm height or depth of excavated soil is 8 ft, and depth of mud is approximately 1 ft. The volume was calculated to be approximately 9,200 cubic feet. A light-beige mud was noted on the bottom of the pit, with no presence of staining visible. Vegetation in the pit is sparse; however, tumbleweeds are thick along the western and northern sides. It was also determined that Mud Pit B (return) has been partially backfilled and is 38 by 22 ft, the berm height is 2 ft, and the estimated depth of mud is approximately 1 ft. Volume of the mud pit was estimated to be 836 cubic feet based on visual observation at the site. Surface debris consists of various wood scraps, a metal fence post, and partially buried black tarp-like material (IT, 2002).

Contaminants of Potential Concern - Because no analytical results are available for this CAS, a list of potential contaminants was generated based on the general NTS mud pit drilling-media information. This list is assumed as a worst-case scenario. These constituents and TPH-diesel/motor oil range organics are considered the primary COPCs. Other COPCs include VOCs and SVOCs. Due to the proximity to nearby craters in Area 10, radiological COPCs are also a concern (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]). Other unknowns include diesel fuel that may have been dumped or washed into the mud pit(s).
A.1.1.9 Mud Pit, CAS 10-09-04

Physical Setting and Operational History - CAS 10-09-04, Mud Pit is located south of 10-01 Road, 1,000 ft southeast from the standing bridge structure in Area 10. Figure A.1-10 shows a sketch of the CAS.

The CAS was identified in the January 1990 document titled, Environment, Safety, and Health Compliance Assessment of the Nevada Test Site (DOE, 1990).

By proximity, this mud pit is associated with drill hole U-10aj-G located approximately 60 ft to the west. It was not determined what drilling media was used for drilling this hole or when the drilling occurred. The past uses of this site were not clearly documented. It has been assumed that pretest drill cuttings from the U-10ajG emplacement hole were the primary waste disposed to the mud pit. It is uncertain if any other waste was disposed there.

On August 23, 1999, a reconnaissance effort was conducted for this CAS. The berm dimensions of the mud pit are 175 by 75 ft (trending east-west). The west, east, and south berms are approximately 3 ft high by 5 ft wide. The north berm is much larger and measures approximately 8 ft high and 15 ft wide. The floor of the mud pit is approximately 10 ft below grade. An estimated mud depth of 1 ft yielded a volume of approximately 13,200 cubic feet. The north end and northeast corner of the mud pit floor was noted to be covered with vegetation and tumbleweeds. The remaining area in the mud pit floor was observed void of vegetation and was covered with a light brown gravelly sand. A large mud spill area was also noted north of the berm. Debris at the site consists of cables and wires (IT, 1999).

Sources of Potential Contamination - Drill cuttings were the primary waste disposed to the mud pit. It was not determined what drilling media was used for this hole. Mud in these pits may be radioactively contaminated. A list of potentially used chemicals, based on the general NTS mud pit drilling-media information, was established to provide a potential contaminant list for mud pit CASs where no previous analytical results are available. This list is considered the primary COPCs for this CAS. Due to the proximity to the U-10ajA, U-10ajG, and U-10ajF craters, radiological COPCs are also a concern. Other unknowns include diesel fuel that may have been dumped or washed out into the mud pit.
Figure A.1-10
CAU 357, CAS 10-09-04, Mud Pit
Previous Investigation Results - A second site visit was attempted on January 9, 2002. High dose rate measurements due to the emission of gamma photons from nearby CAS 10-09-03 prevented a close inspection walkaround of the CAS (IT, 2002). The CAS 10-09-03 was transferred from CAU 357 to CAU 544 because of its location within the U-10Ess crater area. Therefore, no preliminary soil samples were collected. No previous geophysical, chemical, or radiological sampling were identified.

Contaminants of Potential Concern - It can be assumed that pretest drilling mud, used for the U-10ajG emplacement hole, was the primary waste disposed to the mud pit. Since no analytical or geophysical surveys were conducted, and only elevated radiation levels were identified for CAS 10-09-03, specific COPCs for this CAS could not be determined. A list of potential contaminants was established based on the general NTS mud pit drilling-media information. This list is assumed as a worst-case scenario. The constituents on this list and TPH-diesel/motor oil range organics are considered the primary COPCs. Other COPCs may include VOCs and SVOCs. Due to the proximity to nearby craters in Area 10, radiological COPCs are also a concern (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]); therefore, a RWP may be required. Another COPC included is diesel fuel that may have been dumped or washed into the mud pit(s).

A.1.1.1.10 Mud Pit, CAS 10-09-05

Physical Setting and Operational History - CAS 10-09-05, Mud Pit, is located near U2ey and north of U10v on the west side of the dirt road in Area 10 (IT, 2002). The CAS consists of a large bermed pit that contains a small amount of light-brown mud at the bottom. The rest of the soil appears to be native. At the west end of the pit, there is a dirt road that heads south approximately 300 ft to a large pile of gravelly sand, similar to the material in the pit. The east berm of the pit is gently sloping and may suggest a ramp that vehicles used to access the pit. Debris at the CAS consisted primarily of orange hurricane fencing materials, which is consistent with construction operations. It is possible that this pit was used as a borrow pit for nearby roads (IT, 2002). Figure A.1-11 shows a sketch of the CAS.
Figure A.1-11

CAU 357, CAS 10-09-05, Mud Pit
This CAS was first identified on August 24, 1993, during the environmental sites inventory (REECo, 1991b). It is not known from historical documentation when this pit was constructed, what its past uses were, which drilling operation (if any) was involved, or which test it might have supported. Consequently, drilling-media type and exact dates of use were not identified. It is possible that this pit was a “borrow pit” for nearby roads, and not a mud pit for drilling operations.

**Sources of Potential Contamination** - The “mud” (gravely sand) in this pit may be drilling-related and radioactively contaminated. Therefore, residual drill cuttings, unknown drilling-mud media, and various radionuclides (due to nearby Area 10 testing) are considered the primary sources of potential contamination for this CAS.

**Previous Investigation Results** - On January 9, 2002, it was observed that the mud pit did not appear to contain a mud bottom that is similar, or typical, to other mud pits previously investigated. The soil in the pit appeared consistent with native soil in the surrounding area. The vegetation and surface area at the site are distressed due to the construction of the pit, and was slightly more sparse at the bottom of the pit than in surrounding areas. The bottom of the borrow/mud pit is described as being 20 to 25 ft bgs; other dimensions of the pit were not provided.

**Contaminants of Potential Concern** - Since no analytical, geophysical, or radiological surveys were conducted or identified, specific COPCs for this site could not be determined. A list of drilling fluids (and their chemical components) potentially used during site operation was developed based on the general NTS mud pit drilling-media information. Because no analytical results are available for this CAS, this list and TPH-diesel/motor oil range organics are considered the primary COPCs. Other COPCs that may be associated with this mud/borrow pit may include VOCs, SVOCs, and various radionuclides (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, and uranium-238 [NCRP, 1999]).

**A.1.1.11 Mud Pit; Stains; Material, CAS 10-09-06**

**Physical Setting and Operational History** - The CAS 10-09-06, Mud Pit; Stains; Material, is located east of the U-10am #5 potential crater in Area 10. Berms do not define the boundaries of this mud pit, which was excavated and the excess soil piled on the northeast side of the mud pit. The site
covers an area of 145 by 75 ft (trending north to south). The excavated wall height is 8 ft with an estimated mud depth of 1 ft, which yields a calculated volume of 10,875 cubic ft of mud. Figure A.1-12 shows a sketch of the CAS. Surface debris found includes rusted cables and assorted scrap metals, wood scraps, polymer for cables, and spills of cement or grout (IT, 2002).

The site was not part of the original environmental sites inventory. The CAS was first identified for the FFACO (1996) on October 12, 1993, and is currently listed as inactive and abandoned (IT, 2002). This mud pit is suspected to have supported activities associated with the drilling of the U-10am #5 experimental hole, which completed drilling to a depth of 454 ft on June 21, 1969 (RSN, 1991). The emplacement hole which supported the Tun-D test conducted on December 10, 1969, was sponsored by LLNL (DOE/NV, 2000b). It is unknown if the mud pit was used during other subsequent drilling operations. Consequently, exact dates during which the mud pit was used are unknown.

Sources of Potential Contamination - Pre-test drill cuttings and fluids from the U-10am #5 exploratory hole are considered to be the primary waste disposed to the mud pit. However, it is uncertain what, if any, other waste was disposed there.

Previous Investigation Results - A site reconnaissance effort was performed January 9, 2002. It was observed that the northwest side of the pit contains a light-gray, cracked, mud. There is a thin, dry, cracked, and broken spill of concrete (or grout) in the northwest side of the mud pit. There is another larger pile of cement or grout outside the mud pit’s southwest corner. The vegetation and surface area at the CAS are distressed due to the construction of the mud pit. Soil within the mud pit appeared to be consistent with the surrounding native soil (IT, 2002).

Contaminants of Potential Concern - Since no analytical, geophysical, or radiological surveys were conducted or identified, specific COPCs for this CAS could not be determined. A list of drilling fluids (and their chemical components) potentially used during site operation was developed based on the general NTS mud pit drilling-media information. Because no analytical results are available for this CAS, this list and TPH-diesel/motor oil range organics are considered the primary COPCs. Other COPCs that may be associated with this mud/borrow pit may include VOCs, SVOCs, and various radionuclides (i.e., americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, plutonium-238 plutonium-239/240, strontium-90, uranium-234, uranium-235, and
"Palm Tree" of Yellow-Orange
Casing (Trunk) Rising Vertically
from U-10 am #5 with Black Cables
(Palm Leaves)

Cement Spill
Excess Soil Pile

Mud Pit

Site Marker:
CAS 10-09-06

Large Pile of Grout (Grey)

Figure A.1-12
CAU 357, CAS 10-09-06, Mud Pit; Stains; Material
uranium-238 [NCRP, 1999]). Other unknowns include diesel fuel dumped or washed into the mud pit.

**A.1.1.1.12 Waste Dump, CAS 25-15-01**

**Physical Setting and Operational History** - The CAS 25-15-01, Waste Dump, is located approximately 0.3 mi north of the R-MAD Facility on the east side of the railroad tracks in Area 25. The CAS consists of a waste dump surrounded by large dirt mounds (term used interchangeably with soil piles). The northern end of the site has been backfilled, while the south end consists of an open pit containing various types of visible debris. The CAS dimensions of total disturbed (excavated) area was estimated to be approximately 200 x 120 x 15 ft below grade. An un-backfilled space, estimated to be approximately 120 x 80 x 15 ft, was located at the south end of the area. An earthen access ramp extends from the south wall of the pit down into the un-backfilled area. The terrain is uneven in the dump’s backfilled area, and vegetation is sparse compared to vegetation in surrounding areas. Three large (assumed) soil piles surround the zone of excavation and appear capable of filling the excavated area that remains (IT, 2002).

**Figure A.1-13** shows a sketch of the CAS. The site was originally designated as a sanitary landfill during the 1990 REECo survey. It was later determined that the site location was incorrectly described in that document (REECo, 1991b), and the more correct terms are construction/debris/rubble landfill or waste dump (IT, 2002).

Based on the information obtained from nonintrusive site investigations (IT, 2002), personal interviews (conducted August 1998, and August to November 1999), and historical documentation, there is a high degree of confidence that the waste dump was constructed after 1976 and prior to 1981. The period of operation is unknown.

**Sources of Potential Contamination** - Construction debris is assumed to be the primary material disposed at the site. The materials generally consisted of asphalt, roofing, wood pallets, insulation, cables, and floor tile originating primarily from the R-MAD Facility, Beetle Building, and Warehouse.
Figure A.1-13
CAU 357, CAS 25-15-01, Waste Dump
**Previous Investigation Results** - Interviewees (chronologically summarized below) provided information relating sometimes conflicting dates of operation and objects put into the waste dump:

- K. Garey, August 1998 (PEER Consultants): The dump was created in the 1980s in conjunction with the MX Program. Cables were cut up and buried here, as well as other construction material (Garey, 1998).

- G. Martin, August 1999 (Bechtel Nevada [BN]): Did not believe radiological concerns were generated during the MX Program, that the only hazardous constituents associated with these operations were possibly toxic gases emitted by the rockets during launches (Martin, 1999).

- R. Hunter, August 1999 (BN): Did not know of any landfills receiving waste from the MX Program; suggests materials may be from construction of the MX Towers (Hunter, 1999).

- A. Fowkes, August 1999 (Professional Analysis, Inc. [PAI]): Landfill was used to dispose of construction materials associated with the MX Program; was not sure of time of operation; commented that landfill might have contained asphalt, concrete, cabling, plastics, wood, lead-based paint, hydrocarbon waste, and possibly transformers (containing PCBs). However, transformers typically were not disposed of in landfills (Fowkes, 1999).

- W. Jacobs, August 1999 (Science Applications International Corporation [SAIC]): Commented that gas generators were used in the MX experiments; however, the system used was a cold launch system and that any wastes would have been in the form of gas vapors. Other MX-related hazardous constituents might have included hydraulic fluid, lead-acid batteries, antifreeze, and lubricating oil. He felt the landfill was constructed prior to MX, and did not recall ever having construction material disposed of in the landfill (Jacobs, 1999).

- J. Tinney, August 1999 (SAIC): Mentioned that D. Wheeler (DOE/NV) had taken radiation equipment out to the site, but that Wheeler had relayed to him that contaminated materials were not buried at the site (Tinney, 1999).

- D. Wheeler, August 1999 (DOE/NV): Conducted a walkover survey of CAS 25-15-01 in 1998 to determine whether it should be posted as a radiation contamination area. He did not see any signs of surficial contamination during the survey, but noted that it was not a full radiological survey. He felt that the site had been used to dispose of uncontaminated materials. He commented that the site was not posted, but the walkover survey was not sufficient to definitively say there was no buried contamination. He mentioned that the CAU 143 waste dump had been used to dispose of contaminated materials from the R-MAD Facility (not necessarily from the MX Program operations) (Wheeler, 1999).

- P. Robinson, October 1999 (BN): A former REECO employee in 1981, working under the Westinghouse Electric Corporation Contract for the MX Program (which operated from 1978 to 1983) (The Center for Land Use Interpretation, 1996), was identified during the preliminary assessment as a primary source of information regarding the site and MX
Program history during the period of dump operation. Mr. Robinson stated that he had used the dump prior to the MX Program as a disposal site for objects that were disassembled to clear the location for the MX Tower construction. The MX Program was conducted at the R-MAD Facility in the early 1980s. He had a high degree of confidence that construction debris was the only material disposed at the site. The materials generally consisted of roofing, wood pallets, and tile from floors (perhaps containing asbestos) originating from the R-MAD Facility, Beetle Building, and Warehouse. He did not recall dumping any aerosol cans or other hazardous materials. He stated radiological surveys were conducted for all materials collected and any materials exhibiting contamination were segregated and left at the R-MAD Facility. He had a moderate degree of confidence that the three soil piles were from excavation of the waste dump (landfill) rather than concealing waste. The interview further revealed that construction materials were dumped eight hours a day, five days a week, for two weeks. He estimated that approximately 15 truck loads (or approximately 150 yd³) of material was dumped into CAS 25-15-01 during that two-week period. Mr. Robinson recalled transporting and placing concrete monuments at the site. These monuments are routinely placed at a closed landfill or dump, but he was unsure why they were never emplaced or posted at the dump, which was never officially closed. However, because the dump was exposed for a number of years, it is uncertain whether hazardous or radiological waste materials were introduced during other periods of activity. He could not confirm that the only period of activity was associated with the MX Program (Robinson, 1999).

- P. Jacobson, November 1999 (Silver Mountain Trucking): He stated approximately 10 yd³ were contained within one load of a standard end-dump truck load. The information was used to estimate the amount of waste that might have been dumped during the 1981 use of the landfill (Jacobson, 1999).

One historical document reviewed (REECo, 1992) provided a worst-case scenario for sites at NTS, and focused on the identification of solid waste management units. This document identified CAS 25-15-01 as an inactive “sanitary” landfill used for disposal purposes of possibly mixed waste.

**Contaminants of Potential Concern** - Possible contributors to COPCs include insulation, floor tiles (possibly containing asbestos), hydrocarbon waste, asphalt, roofing materials, and tar. Wastes generated or utilized during the MX Program might have included lead-based paint, hydrocarbon waste, PCBs, hydraulic fluid, asbestos materials, lead-acid batteries, antifreeze, and lubricating oil. Debris identified include wood, scrap metal, cables hoses, pieces of concrete, plastic, and cable spools. However, not all constituents (i.e., radiological material) potentially placed in the dump are known and it is uncertain if the dump received any such waste generated during the MX Program, or if there were any other periods of activity following deactivation of the MX Program.
A.1.1.1.13  Lead Bricks, CAS 04-26-03

Physical Setting and Operational History - The CAS 04-26-03, Lead Bricks, consists of lead bricks, which are the remains of a radiation protection wall scattered throughout a delineated area west of the T-4 Bunker, and located north of the 4-04 Road in Area 4. The CAS was first identified by REECo on October 23, 1990 (REECo, 1991a). Figure A.1-14 shows a sketch of the CAS.

The lead bricks are believed to have been deposited in situ by activities associated with the Fox, Nancy, Apple-1, and Kepler tests, which occurred between 1952 through 1957 (DOE/NV, 2000b).

Sources of Potential Contamination - Lead (from the lead bricks) is considered the only source of potential contamination within CAS 04-26-03. The surface contains with fused radiologically contaminated soil (i.e., trinity glass). Additional noted surface debris includes a metal bucket, metal gas cylinder, barbed-wire, cables, various metal pieces, miscellaneous scrap material, and nonlead (poly) brick material. The gas cylinder and metal bucket are not part of CAU 357 and their contents are not known.

Previous Investigation Results - A reconnaissance site visit was conducted on January 19, 2002. An estimated 50 lead bricks were observed scattered over the ground surface of an area approximately 320 by 200 ft. It has not been determined if additional lead bricks are buried beneath the ground surface at the CAS.

Contaminants of Potential Concern - Lead is the primary COPC specific to this CAS. The CAS is also located within a posted radiological area. Therefore, radionuclides may be associated with this CAS. However, no extended radionuclide assessments will be performed. Radionuclides associated with this CAS are part of CAU 104, South Yucca Flat Atmospheric Sites, and are not considered COPCs for this CAS (FFACO, 1996).

A.1.1.1.14  Boxes; Pipes, CAS 01-99-01

Physical Setting and Operational History - The CAS 01-99-01, Boxes; Pipes, is located in Area 1 of the NTS. The site was first identified during the original environmental inventory survey (REECo, 1991a). It is presumed that CAS 01-99-01 identifies the environmental hazard(s) resulting from the contents (source material) located inside Building 1-31.2e1 (i.e., the Union Carbide
Figure A.1-14
CAU 357, CAS 04-26-03, Lead Bricks
Building), which consists of a network of metal pipes and header system (manifold) and wooden boxes. The boxes are believed to have been used to support a filtering system. Building 1-31.2e1 is a rectangular, one-room structure measuring 26 by 22 ft, with a wall height of 10.5 ft. Figure A.1-15 shows a sketch of the site. The smaller 1.5-in. support pipes are not included in Figure A.1-15.

Designed by the Engineering Department of Union Carbide, this building was erected for Project 31.2 (Damage to Commercial and Industrial Buildings Exposed to Nuclear Effects) as a blast-resistant control room. The walls and flat roof are poured “Class 2” structural gypsum supported by structural steel beams. The building is bolted to a reinforced concrete slab (~ 2 ft thick). The engineering drawings indicate that the upper 3 ft of the north and south walls were originally constructed of translucent, corrugated, plastic panels. At some point, these panels were replaced with vertical wooden lath/siding. The structure has a single 3- by 7-ft doorway in the center of the west wall. The original steel door is missing and the lower portion of the doorway has been boarded up. The east wall has a single 2.5- by 2.5-ft window framed into one of the gypsum panels, which is not indicated on the original engineering drawings. The building’s interior contains a pair of iron pipe railings and a large-diameter, horizontal conduit (e.g., header or manifold) extending across the center of the structure. A series of plywood boxes are attached to the conduit via square metal flanges. The structure is in good condition and is listed on the NTS historical building register (DRI, 2000). The building was constructed as a support facility to Operation Teapot, the weapons-related Apple-2 test was conducted in Area 1 on May 5, 1955, which had a yield of 29 kt (DOE/NV, 2000b). The “scientific hardware” within Building 1-31.2e1 may not be related to Apple-2 and is most reflective of the structure’s reuse during the Galileo test (DRI, 2000). The building appears to have been used for ventilation of some type during either the Apple-2 test or Galileo test. Of note, it was documented that 30 ft northeast of the building is a 40 by 80 ft fenced area (outside the CAS boundary, and not presented in Figure A.1-15), which may have been used as an aboveground storage area and/or an underground burial landfill (REECo, 1991a).

**Sources of Potential Contamination** - Radionuclides (originating from testing conducted in the surrounding area) are considered the primary sources of potential contamination within CAS 01-99-01.
Figure A.1-15
CAU 357, CAS 01-99-01, Boxes; Pipes - “Building 1-31.2e1”
Previous Investigation Results - A reconnaissance site visit was performed on February 19, 2002. This location description of Building 1-31.2e1’s contents were verified. No drain pipes were observed on the floor area. A series of smaller, approximately 1-1/2 in. metal pipes appear to serve as a support structure for the main header and distribution pipes. The smaller pipes bolt to the floor, and come over the top of the main header and distribution pipes. Directly in front of each of the six distribution pipes is one wooden box. Each of six boxes is open on the front and back, and each box was formerly connected to an individual distribution pipe. It is possible that a filter of some type was connected to the open front of each box. Each distribution pipe was connected to an individual (filter) box. Two other wooden boxes are located within the building and do not appear to be currently associated with the aforementioned piping system. It appears that a metal filter is still affixed to the top of one of these other two boxes (IT, 2002).

Contaminants of Potential Concern - Radionuclides, originating from testing conducted in the surrounding area, are the primary COPCs specific to this CAS. The laboratory analytes to be tested for are presented in Table A.1-4, found in Section A.1.4.3.5. Debris within the building consists of wooden planks, wooden boxes (listed above), rusted piping (header, distribution, and ventilation) and metal supports (listed above), exposed and cut electrical wires, rusted and disabled fuse box, a possible metal filter (listed above), and Building 1-31.2e1. Possible buried electrical lines may be located near the building, which may have been used to power the building.

A.1.2 Step 1, State the Problem

This initial step of the seven-step DQO process for CAU 357 identifies the planning team participants, describes the problem that has initiated the CAU 357 SAFER investigation, and develops the Conceptual Site Models.

A.1.2.1 DQO Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NSO, Shaw, and BN. The primary decision-makers include NDEP and NNSA/NSO representatives. Decision-makers will receive notifications as work progresses and when decision points are reached within the SAFER process. Table A.1-1 lists the representatives from each organization in attendance for the DQO presentation held February 5, 2003.
A.1.2.2 Describe the Problem

Corrective Action Unit 357 is being investigated because some data gaps exist concerning the nature and extent of potential contamination and this data is necessary to evaluate and recommend with certainty corrective action alternatives for the individual CASs.

As a result of activities for the previously described CASs, potentially known but uncontrolled, or at least undocumented release of waste(s) of hazardous and/or radioactive constituents may be present at concentrations that could potentially pose a threat to human health and the environment. In addition, contamination may be present at concentrations and locations without appropriate controls (i.e., use restrictions). Although the CASs are inactive and abandoned, past activities are not well documented and may not comply with the requirement of the future land uses.

A.1.2.3 Develop Conceptual Site Models

The CSM describes the most probable current conditions at each CAS and defines the assumptions that are the basis for identifying appropriate CAS-specific sampling strategies and data collection methods. The CSMs set the stage for assessing how contaminants could reach receptors both in the present and future by addressing contaminant nature and extent, transport mechanisms and pathways, potential receptors, and potential exposures to receptors. Accurate CSMs are important because they serve as the basis for all subsequent inputs and decisions throughout the DQO process.

An important concept is that CSMs are based on identifying the release mechanism migration pathways that may influence sampling of an affected media. CSMs are not chemical constituent, geographic location, nor CAS dependent.

An important element of a CSM is the expected Fate and Transport of contaminants, which infer how contaminants move (transport mechanism) through site media and where they can be expected (location of contaminants) in the environment (affected media). The expected fate and transport is based on distinguishing physical characteristics of the contaminants and media; whereby, characteristics of contaminants include solubility, density, and particle size; and media include permeability, saturation, sorting, chemical composition, and adsorption coefficients.
Contaminants migrating to regional aquifers are not considered a likely scenario at CAU 357 based on low annual average precipitation rates, high potential evaporation, and low mobility of expected COPCs (e.g., SVOCs, PCBs, petroleum hydrocarbons, and metals).

Currently, the potential for exposure to contamination at the CAU 357 CASs is limited to industrial site workers, construction/remediation workers, and military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soils and/or debris (e.g., equipment, concrete) due to inadvertent disturbance of these materials or irradiation by radioactive material. The future land-use scenarios identified in Nevada Test Site Resource Management Plan (DOE/NV, 1998) limit future uses of the CASs to various nonresidential (e.g., industrial) uses. Nonresidential uses include defense and nondefense research, development, testing activities, and commercial-use capabilities.

For CAU 357, two CSMs have been developed: one CSM for the 11 Mud Pit(s) CASs; the Waste Dump (construction disposal landfill) CAS; and Lead Bricks CAS. The other CSM model is for the remaining CAS identified as Boxes/Pipes.

The historical background information provided in Sections A.1.1.1.1 through A.1.1.1.14 and reviewed in the February 5, 2003, DQO Presentation and the SAFER Plan’s main document (Section 2.0) were used to develop the two CSMs identified for CAU 357. The following is a list of elements and characteristics common to all 14 CASs that are essential to the development and understanding of an effective CSM:

- **Exposure Scenario**: Site workers may be exposed to COCs through oral ingestion, inhalation, external exposure to radiation, or dermal contact (by absorption) of COCs absorbed onto the soils. Exposure is due to inadvertent disturbance of the contaminated soils and/or contaminated structures.

- **Affected Media**: This is typically the surface soil, shallow subsurface soil, and potentially perched (shallow) groundwater, which is not identified in these CAS areas. The lack of groundwater impact is due primarily to: (1) low precipitation, (2) high evapotranspiration rate, (3) soils often are clay-rich (common to the NTS), and (4) depth to groundwater (DOE/NV, 1997b). There is no downward driving force with limited precipitation. The arid environment and extreme summer temperatures ensures shallow moisture is baked out of the near subsurface, creating a dry sponge-like effect, whereby precipitation that does occur has limited infiltration. Clays exhibit a high surface area (increased porosity potential), which promotes COC absorption and inhibits migration. They are deposited in an overlapping
manner in a relatively homogeneous lateral distribution (natural bedding); and their small particle size fills pore space, blocking pathways within the soil-media (reduced permeability). Hence, clays greatly inhibit vertical migration of aqueous-based contaminants downward. Also, the depth to groundwater is hundreds of feet below ground surface. Thus, deep subsurface contamination is most likely not a concern.

- **Location of Contamination/Release Points:** The native soil interface below and adjacent to the disposed waste is the most likely location for soil contamination. Any contaminants migrating from CASs, regardless of physical or chemical characteristics, are expected to be in soil adjacent to disposal features lateral and vertical native-soil interfaces.

- **Transport Mechanisms:** In general, contaminants with low solubility, high density, and/or high affinity can be expected to be found relatively close to release points. Contaminants with small particle size, high solubility, low density, and/or low affinity can be expected to be found further from release points, or in low areas where settling may occur and evaporation of ponding will concentrate dissolved constituents. COPCs can impact various media (air, soil, water) dependent on the transport mechanism. COPCs that can volatilize may impact the air, and COPCs contained in a liquid media or are “dusts” dissolved by rainwater may infiltrate the subsoil and potentially impact groundwater. COPCs that volatilize (VOCs) are not an anticipated concern at these CASs because of the duration they have experienced inactivity; whereby, if they were present at some past date, they would be depleted during volatization over time. Infiltration of any COPC, beyond shallow substrate, is not a concern at these sites, as discussed in the groundwater impacts section.

- **Preferential Pathways:** Due to the nature of the COPCs, the preferential pathways at the CASs are typically limited to vertical migration due to gravity and minor lateral migration due to localized porosity and permeability increases/changes within the substrate, or confining (impermeable) layers redirecting flow direction, which is always gravity driven, to low points.

- **Lateral and Vertical Extent of Contamination:** Contamination, if present, is expected to be contiguous. Concentrations are expected to decrease with distance and depth from the source. Based on the depth to groundwater, which varies for each CAS, groundwater contamination is not considered a likely scenario. Surface migration may occur as a result of a spill, or as runoff of precipitation. Surface migration is a biasing factor considered in the selection of sampling points.

- **Groundwater impacts:** Groundwater is not expected to be impacted in Areas 1, 4, 7, 8, 10, and 25 of the NTS for the following reasons. Percolation of precipitation through subsurface media serves as the major driving force for migration of contaminants. However, due to the arid environment of the NTS, percolation of precipitation is very small and migration of contaminants has been shown to be very limited. Evaporation potentials significantly exceed precipitation. The average annual precipitation across the CAU 357 sites ranges from 6 to 8 in. per year (DOE/NV, 1997b).
- Depth to groundwater in Area 1 wells (Boxes & Pipes CAS) generally ranges from approximately 543 to 1,630 ft bgs.

- Depth to groundwater in Area 4 wells (Lead Bricks CAS) generally ranges from approximately 366 to 1,732 ft bgs.

- Depth to groundwater in Area 7 wells (4 Mud Pit CASs) generally ranges from approximately 1,067 to 1,976 ft bgs.

- Depth to groundwater in Area 8 wells (3 Mud Pit CASs) generally ranges from approximately 2,052 to 2,164 ft bgs.

- Depth to groundwater in Area 10 wells (4 Mud Pit CASs) generally ranges from approximately 1,067 to 2,066 ft bgs.

- Depth to groundwater in Area 25 wells (Waste Dump CAS) generally ranges from approximately 924 to 1,040 ft bgs.

- **Future Land Use:** Areas 7, 8, and 10 are located within the Nuclear Test Zone, Areas 1 and 4 are located within the Nuclear and High Explosive Zone, and Area 25 is located within the Yucca Mountain Site Characterization Zone under Alternative 3 (DOE/NV, 1998). These zones include compatible defense and nondefense research, development, and testing projects and activities. These land-use scenarios limit future uses to industrial activities; therefore, future residential uses are not considered.

**A.1.2.3.1 CSM #1 for Mud Pits, Waste Dump, and Lead Bricks CASs**

The basis for developing this CSM was process knowledge and historical records, which revealed a commonality to each of the CASs it represents. This CSM is different from the Boxes; Pipes CSM based on one or more of the following: (1) release (transport) mechanism, (2) potential migration pathways, and (3) things that would influence sampling strategies. The difference between the CSM CAS grouping is not dependent on: (1) types of contaminant(s), (2) geographic systems, or (3) being part of an engineered system. Figure A.1-16 illustrates the CSM for the combined mud pit, waste dump, and lead bricks CASs. This diagram shows known and suspected locations of contaminants and potential pathways for physical transport. The following descriptions relate to Figure A.1-16 illustrating mud pits, potential spill areas, waste dump features, and lead bricks within a defined scatter area.

- **Exposure Scenario:** Site workers may be exposed to COCs through oral ingestion, inhalation, or dermal contact (by absorption) of COCs absorbed onto the soils.
**Affected Media:** This is typically the surface soil and shallow subsurface soil.

**Location of Contamination/Release Points:** The native soil interface below and adjacent to the disposed waste is the most likely location for soil contamination. Any contaminants migrating from CASs are expected to be in soil adjacent to vertically encountered native-soil interfaces.

**Transport Mechanisms:** Contaminants can be expected to be found relatively close to release points or in low areas where settling may occur and evaporation of ponding will concentrate dissolved constituents. COPCs that volatize (VOCs) are not an anticipated concern. COPC infiltration beyond shallow substrate is not a concern at these CAS sites.

**Preferential Pathways:** The preferential pathway at these CASs is limited to vertical migration of COPCs due to gravity.
• **Lateral and Vertical Extent of Contamination:** Contamination, if present, is expected to be contiguous. Concentrations are expected to decrease with distance and depth from the source. Surface migration is a biasing factor considered in the selection of sampling points.

• **Groundwater Impacts:** The groundwater is expected to be impacted in Areas 4, 7, 8, 10, and 25. Due to the arid environment of the NTS, percolation of precipitation is very small and migration of contaminants has been shown to be very limited. Evaporation potentials significantly exceed precipitation. The annual precipitation across the CAU 357 sites ranges from 6 to 8 in. per year.

• **Future Land Use:** The land-use scenarios (previously discussed) limit future uses to industrial activities; therefore, future residential uses are not considered.

The mud pit specific items for this CSM include:

• The COPCs, if present, are associated with the (1) disposal of used drilling fluid and wastewater in the mud pits, and (2) potential effluent discharge from truck dumping activities. Surface and shallow subsurface soils are the affected media within each mud pit. The volume of particular contaminant(s) in the drilling fluid effluent is unknown.

• 1997 sample results at four of the mud pit CASs (i.e., 07-09-02, 07-09-04, 07-09-05, 08-09-01) indicated detections of VOCs, SVOCs, RCRA metals, TPH, and radionuclides. None of the results exceeded action levels or background, except for arsenic which was above action levels but within NTS background levels (Bordelois, 1998a, b, and c; Forsgren, 1998).

• Recirculation processes within the mud pits enhance volatilization of VOCs, thereby reducing the potential concentrations of any VOCs that may be present.

Potential contaminants listed below are associated with the discharged effluent in mud pits:

• Additives (e.g., polymers, chelating agents, diesel) used during drilling activities (LANL, 1991; Wuellner, 1994; Rowe, 2001). Whereby diesel within drilling muds is expected to be the primary COPC (TPH-diesel range organics) with the greatest potential for concentrations above action levels based on interviews (Wilkes, 2000; Witt, 2000) and process knowledge gained from similar investigations of the mud pits (e.g., CNTA) (DOE/NV, 1999a and b). Other fuels, grease, motor oil, antifreeze, and hydraulic fluids are compounds that may have leaked from trucks and also discharged into the mud pit effluent stream (Wilkes, 2000; Witt, 2000). Random dumping/spillage of constituents was not a common practice; therefore, it is considered minimal.

• Radionuclide contamination is not expected to be a major concern at these CASs based on historical information; however, the potential still exists based on process knowledge of the atmospheric testing activities conducted in Areas 7, 8, and 10 of the NTS. The primary radioisotopes expected, if present, based on previous sampling data and historical records are

While contaminants within a mud system may be present at locations throughout the system, they will tend to be present in higher concentrations at particular locations within the system based on distinguishing chemical and physical characteristics. For example, petroleum-based fuels in the mud slurry would tend to be found in higher concentrations near the surface (because they are less dense than water-based fluids and float) and lower concentrations near the bottom of the mud pits (DOE/NV, 1997a). Other distinguishing characteristics of contaminants such as high or low solubility, high or low density, and large or small particle size can also be used to draw inferences on the locations within the mud pit system where they could be expected to be present at higher concentrations. Sampling in these preferential locations will increase the probability of detecting contamination if it is present anywhere within the system.

The following four areas (A-D) represent the preferential sample locations within the mud pit system, as illustrated in cross-sectional view across a mud pit (Figure A.1-17):

- **A**: Near the surface and near the influent (recharge) location, generally located on the mud pit topographic high spot, being synonymous with the top of the drill cuttings pile. It is the highest point because drilled cuttings of coarse grade drop out as the mud’s lofting turbulence ceases upon entering the placid liquid media within the pit, and mound there; while fines remaining in suspension drift off to quieter areas to settle out. It is important to keep in mind, sampling the cuttings mound represents observing a reverse stratigraphy (e.g., a hole would have its “deepest drilled” cuttings on the top of the pile and “closest to the surface” cuttings at the bottom of the pile). Also, LNAPLs and VOCs and other light contaminant constituents, being less dense than water, float and migrate up.

- **B**: At the bottom of the pit (pit/native soil interface) near the influent location, generally located beneath sample point A is where COCs of dense, nonaqueous phase liquids (DNAPLs) that might be present would sink downward and accumulate at the bottom of the drill cuttings pile.

- **C**: Near the surface at the lowest surface elevation, generally the lowest topographic elevation which held the last evaporation pond, is where the suspended COC constituents would be concentrated.

- **D**: At the lowest elevation of the original pit bottom (pit/native soil interface), generally assumed to be located beneath Sample Point C, which may or may not be true. Geophysics can identify a drum buried in a mud pit, but it may or may not be able to contrast the native
soil/mud pit base interface. Therefore, geophysics may not be able to identify the lowest point within best economic means. Expensive geophysics may not be necessary due to the knowledge that the reverse stratigraphy processes extend across the entirety of the pit. Fines in suspension seek low calm areas to settle in; whereby, a progressive and contiguous layering of deposited fines developed across the mud pit as the well is drilled deeper. This makes the assumption valid in that fine sediments and fine contaminated sediments are relatively evenly distributed across the mud pit’s floor. Therefore, sampling beneath the Sample C location for Sample D will provide a reliable and repeatable representation of the type of contaminants located across the floor of the pit. This can be conducted without the inflated cost of performing expensive high-definition geophysics to contour map the pit bottom prior to collecting Sample D.

Infiltration of COPCs are assumed to be limited to less than 10 ft vertically and 5 ft laterally based on past investigations of several mud pits (DOE/NV, 1999a and b).

- It is assumed that the mud pits (and the construction disposal landfill) are not lined. In the absence of a physical barrier below the mud, downward vertical migration will be predominant over lateral migration. However, bentonite clay (native to NTS soils) has a low
hydraulic conductivity and a high adsorption capacity which binds constituents, inhibiting migration into subsurface soils. According to historical documentation and process knowledge, clay was commonly used as a pond liner to prevent infiltration of water into underlying units. Vertical migration is limited because the mud pits are dry and potential evaporation exceeds precipitation.

- The densely welded volcanic tuff units that underlie a mud pit may tend to be highly fractured with increased transmissivity (USGS, 1970), dependent on proximity closeness to a given crater. The underground nuclear tests (i.e., Cyathus, Baneberry - Area 8, and Pinedrops-Bayou, Pinedrops-Sloat, and Pinedrops-Tawny - Area 10) conducted at U-8d and U-10as, respectively, probably induced additional vertical fracturing of these tuff units when the surface crater formed. These densely welded tuffs can provide preferential pathways to groundwater. However, the preferential pathway factors are far out weighted by factors that inhibit the migration of any COCs present in the mud. The highly adsorptive nature of mud (i.e., bentonite) binds the contaminant and inhibits the migration of constituents as previously discussed in this CSM. In addition, bentonite would create seals within fractures underlying the mud limiting infiltration of precipitation. Four of the mud pit CASs (08-09-01, 08-09-02, 08-09-03, and 10-09-02) are located within 500 ft of a surface crater rim, but are not in the collapse zone; therefore, they are not anticipated to have experienced significant transmissivity inflation.

- Contamination, if present, is primarily confined laterally by the slope of the land surface to the historical and physical boundaries of each site such as the berms of each mud pit. Unsaturated conditions due to arid climate limit the potential for lateral migration into surrounding soils, and promotes vertical migration (i.e., the lateral contamination of the mud spill at CAS 10-09-06) is not expected to extend past the edge of the visible mud layer.

The waste dump specific items for the first CSM include:

- The possibly affected media is soil/sediment within the excavated dump area (measuring 200 by 120 ft), and surface and subsurface soils in proximity of what are assumed to be soil piles from the excavation itself. However, discarded debris is not expected to be concealed within the soil piles; this will be confirmed with geophysical investigation. The following are descriptions of the sources and types of possible contributors to COPCs into the landfill system’s generated effluent:

  - It is assumed that only rubble from construction debris generally consisting of roofing materials (e.g., asphalt shingles and tar), wood pallets, and possibly asbestos-laden insulation and flooring tiles originating from the R-MAD Facility, Beetle Building, and Warehouse were deposited in the dump.

  - Other possible contributors of wastes that were generated, or utilized, during the MX Program might have included lead-based paint, hydrocarbon waste, PCBs, hydraulic fluid,
lead-acid batteries, antifreeze, and lubricating oil. However, it is uncertain if the dump received any waste generated during the MX Program.

- The waste dump was constructed between 1976 and 1981, but the exact date is unknown. The period of operation is unknown. Because the dump was exposed for a number of years, it is uncertain whether hazardous or radiological waste materials were introduced during other periods of activity. No historical data was identified to indicate that materials were placed in the dump.

- Radionuclide contamination is not expected at this CAS based on historical information. However, a radiological survey will be performed at this CAS because of its proximity to other nearby radioactively contaminated areas.

- No previous sampling, geophysics, or radiological surveys have been identified.

The lead bricks site-specific items for the first CSM include:

- The possibly affected media in the Lead Bricks CAS is the soil/sediment in direct contact with the bricks.

- Identification of the location of buried bricks will be confirmed with a geophysical survey.

- The sources and type of possible contributors to COPCs from this CAS identifies lead as the only COPC. Sources include fragments of the bricks and oxidized remnants of lead within the soils and trinity glass.

- The CAS is located within a posted RMA; so radionuclides, being regionally distributed, may also be associated, but they are not identified as COPCs for this investigation.

- Other surface debris that may be possible contributors of contamination that were identified in the PA are a metal bucket and a metal gas cylinder; however, their contents are unknown.

A.1.2.3.2 CSM #2 for Boxes; Pipes CAS

As noted in the previous section, the basis for developing this CSM was process knowledge and historical records. Figure A.1-18 shows a generalized representation of the CSM constructed for the Boxes; Pipes CAS. This diagram shows known and suspected locations of contaminants and potential pathways for physical transport.

The CAS was named Boxes and Pipes for a network of metal pipes (manifold/header system, with six lateral pipe ports and six wooden [filter] boxes). The building’s construction materials are not
considered part of the CAS, nor COPCs, but can be sampled for characterization per the direction of waste management. Observed through the main header conduit pipe, it was revealed the pipes often contain some very thin, evaporated, crusty, and dust-covered residues of unknown chemical nature (IT, 2002). These residues are immobile and confined to pipe interiors; therefore, they are not considered to be a COPC to the environment and are eliminated from this CAS investigation. However, all items (except the immobile residue in the pipe interiors found within Building 1-31.2e1) may be COPC sources for contaminant release to the environment of remnant radionuclides that may have concentrated as a result of the unconfirmed experiments conducted within the building.

The following text accompanies the Boxes; Pipes CSM diagram in relating information and assumptions that are used in developing this CSM:

Figure A.1-18
CAU 357 CSM #2: For Boxes; Pipes-Cut Away View of Building 1-31.2e1
• **Exposure Scenario:** Site workers may be exposed to COCs through ingestion, inhalation, or dermal contact (by absorption) of COCs absorbed onto the soils outside the building.

• **Affected Media:** The possibly affected media in the Boxes and Pipes CAS are the surface soil and shallow subsurface soil around Building 1-31.2e1. The concrete floor and foundation are at least 20 in. thick. Soils directly beneath the building should not be impacted or affected.

• **Location of Contamination/Release Points:** The native soil interface below and adjacent to the disposed waste (just outside the front door, or behind the building below the back window) are the most likely location for soil contamination. Any contaminants migrating from these areas are expected to be in soil adjacent to vertically encountered native-soil interfaces.

• **Transport Mechanisms:** Contaminants can be expected to be found relatively close to release points (front door or back window). COPC infiltration beyond the shallow substrate is not a concern at this CAS site.

• **Preferential Pathways:** There are two preferential pathways at this CAS: (1) lateral migration across the floor and out the door or window; (2) vertical migration of COPCs from within the building and traveling down into the soil due to gravity.

• **Lateral and Vertical Extent of Contamination:** Contamination, if present, is expected to be contiguous around the buildings proximity. Concentrations are expected to decrease with distance and depth from the source. Surface migration is a biasing factor considered in the selection of sampling points.

• **Groundwater Impacts and Future Land Use:** Impacts to groundwater and future land use are not expected to be of particular concern for the same reasons identified for CSM #1.

The source and type of possible contributors to COPCs from this CAS are:

• Radionuclides, from nearby past testing and experiments conducted within Building 1-31.2e1, are identified as the COPC for this CAS. They are possibly located in, throughout, and surrounding the building’s near proximity. The CAS scope of investigation is limited to localized exterior soils.

Identification of possible pipe runs (buried utilities) extending beyond the Building 1-31.2e1 will be confirmed with geophysical investigation.
A.1.3 Step 2, Identify the Decisions

This step is to identify the decision that requires new environmental data to address each CAS’s potential contamination problem. Figure A.1-19 is a flow chart that identifies decisions and alternative actions needed for performing an effective SAFER investigation.

A.1.3.1 Develop a Problem and Decision Statement(s)

Problem Statement: There is an insufficient amount of information to characterize the nature and extent of contamination released to these CAS sites to determine if there is a risk to human health and the environment.

Two decision statements are required for a SAFER investigation. The first decision statement is: “Is contamination present within CAU 357 at concentrations that could pose an unacceptable risk to human health and the environment?” Any contaminant detected at concentrations exceeding the corresponding PALs, defined in Section A.1.4.2, will be considered a COC. The presence of a COS is defined as a concentration greater than PALs. To determine the presence of COCs, samples will be collected during the initial investigation and analyzed.

“If a COC is present, is the information available sufficient to evaluate appropriate closure?” Sufficient information is defined as the data needs identified in this DQO to include the lateral and vertical extent of all COCs within each CAS. In other words, determine if a COC has migrated by determining extent. Samples used to resolve extent are identified as Decision II samples.

A.1.3.2 Alternative Actions to the Decision

For each decision identified in the previous section there is an alternate decision.

The alternate for Decision I is: For each CAS within CAU 357, if a COC is not present, further assessment of the CAS is not required. If a COC is present, resolve extent.

The alternate for Decision II is: For each CAS within CAU 357, if the extent of a COC is defined in both the lateral and vertical direction, further assessment of the CAS is not required. If the extent of a COC is not defined, re-evaluate site conditions, notify the decision makers (NNSA/NSO and NDEP) and decide on whether to continue with the SAFER.
Perform site preparation activities and collect preliminary field data

Conceptual site model
Configuration of mud pit and other sites
Identify potential remedial options

Are areas most likely to be contaminated located with high confidence?

Yes

Decision I
Conduct biased sample collection and analyze for COPCs in target population

Identify which COPCs are present for each CAS

Are COPCs detected above PALs for the target population?

No*

Yes*

Site is below action levels; no further action required, prepare closure report

Proceed to a Decision II investigation

Have COCs been defined?

No

Characterize contamination through additional sampling

Yes

Continue SAFER

Determine extent of contamination through additional biased sampling

Has extent of contamination been determined?

No

Is contamination decreasing?

No

Notify decision makers

Is there concurrence to continue investigation?

No*

Yes*

Place CAS in complex CAU

Evaluate closure alternatives of clean closure or close-in-place

Select closure alternative*

If clean closure, determine volume of material to be remediated

Removal material and collect verification samples

Are verification samples below PALs?

No

Yes*

Investigation complete; prepare closure report

If close-in-place, determine appropriate use restrictions and implement*

*DOE and NDEP will be notified prior to proceeding
A.1.4  **Step 3, Identify the Inputs to the Decision**

This step identifies the information needed and the information sources; determines the basis for establishing action level; the methods that meet the data requirements; and identifies sampling and analysis methods that meet the data requirements. To determine if a COC is present, each sample result (or population parameter, Section A.1.6.1) is compared to the PAL (Section A.1.4.2). If any sample result is greater than the PAL, then the CAS is advanced to Decision II activities to define the vertical and lateral extent for that analyte. This approach does not use a statistical mean/average for comparison to the PAL, but rather a point-by-point comparison to the established screening criteria to identify COCs.

A.1.4.1  **Information Needs and Sources**

Historical records do not always provide sufficient information regarding the source, general location, and types of potential COCs that could be expected at the various CASs in CAU 357. Previous sampling efforts do not accurately define the contaminant concentrations greater than PALs within each CAS. In order to resolve the decision, new sample data must be collected and analyzed following these two criteria: (1) sample in areas most likely to be contaminated, and (2) the analytical suite must be sufficient to detect any contamination in the samples. Biasing factors to support Criteria I (nature) include:

- Documented process knowledge on source and location of release
- Field observations
- Field-screening results
- Historical sample results
- Experience and data from investigations of similar sites
- Professional judgement

Additional biasing factors to support the sample collection activities and meet the first criterion include configuration of the 11 mud pits and 3 other CAS sites, field-screening methods, and pertinent field observations. The selection of biased sample locations will be based on all available biasing factors. A general list of the biasing factors to be considered during the selection of the sample location are as follows:

- Visual indicators (i.e., staining, discoloration, and/or textural discontinuities)
- Location of debris/waste
- Odor
- Elevated screening results
- Geophysical survey data
- Radiological survey data
- Physical and chemical characteristics of contaminants
- Known source and location of release
- Geologic and/or hydrologic conditions
- Process knowledge and experience at similar sites

As the sampling strategy for each CAS is developed, specific biasing factors will be described. In the absence of other biasing factors, default sampling locations are described for each CAS.

Table A.1-3 lists the information needs, the source of information for each input, and the proposed methods to collect the data to resolve Decisions I and II. The last column addresses the appropriate QA/QC required for a particular data collection activity and is determined by the intended use of the resulting data in decision making.

In order to determine the extent of a COC, sample data must be collected and analyzed at locations to bound the lateral and vertical extent of COCs. For Decision II sampling, analytical suites will only include those parameters that exceed PALs (i.e., COCs identified in previous samples). The data required to satisfy the information needed to determine the extent for each COC is a sample result that is below the corresponding PAL. Step-out locations will be selected based on the CSMs biasing factors, field-screening results, and initial analytical results. Biasing factors to support these informational needs may include the factors previously listed and initial analytical results.

Other information needs identified for Decision I, not directly related to determining if contamination is present above PALs, also are listed in Table A.1-3 and include:

- Collect Global Positioning System (GPS) coordinates of all sample locations within the delineation of boundaries of each CAS feature (e.g., mud pit, or waste dump)
- Perform housekeeping removal activities on miscellaneous debris at sites, as required
- Collect waste characterization data to meet closure requirements under NAC regulations

To resolve the decision statement(s), the necessary information for implementing a corrective action must be identified and collected.
### Table A.1-3
Identified Information/Data Needs to Resolve Decision
(Page 1 of 3)

<table>
<thead>
<tr>
<th>Information Needs</th>
<th>Information Source</th>
<th>Collection Methods</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information needs to meet Criteria #1: If contamination is present, it will be sampled</td>
<td>(1) Historical records and process knowledge (i.e., CSM) provide sources of effluent stream and general location of release of COCs for both mud pits and waste dump.</td>
<td>Documented; therefore, no additional data collection needed.</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Biasing Factors in Choosing Sample Locations:</td>
<td>(1) Source and location of release of COCs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Configuration of mud pit areas and lead brick scatter area</td>
<td>(2) Lateral boundaries of mud pits known and scatter area approximated from previous site visits (Bull, 2001).</td>
<td>Perform geophysical surveys consisting of electrical imaging methods prior to sample collection.</td>
<td>Semiquantitative</td>
</tr>
<tr>
<td></td>
<td><strong>Data Need:</strong> Collect geophysical data for configuration of mud pits and lead brick areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Configuration of waste dump area and Building 1-31.2e1 components</td>
<td>(3) General configuration of waste dump and Building 1-31.2e1 available, but inconsistencies have been identified.</td>
<td>Locate/verify configuration by conducting visual, and/or electromagnetic surveys of waste dump area to establish content locations, which may be verified by excavation with backhoe. Verify Building 1-31.2e1 configuration and locate utilities.</td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td><strong>Data Need:</strong> Locate and verify area components.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Field-screening results</td>
<td>(4) <strong>Data Need:</strong> Possibly field screen soil for TPH at mud pits only if data from other biasing factors are insufficient to make decision on sample location.</td>
<td>An area near proposed sample collection points (based on CSM) within the mud pit may be field screened for TPH (primary COPC) to help guide the selection of most appropriate sample to submit to laboratory (i.e., submit sample with highest field-screening result). Perform radiological survey using appropriate technology for the site to initially screen for presence of radionuclides.</td>
<td>Semiquantitative</td>
</tr>
<tr>
<td></td>
<td><strong>Data Need:</strong> Collect radiological survey data on surface of mud pits, waste dump, lead bricks, and boxes &amp; pipes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Field observations of surface and soil conditions</td>
<td>(5) Current field observations are limited due to tumbleweeds and access restrictions.</td>
<td>Conduct field observations after prefield activities are complete (e.g., removal of tumbleweeds) and during sample collection. The observations will be documented in the field and may be used in selecting biased sample locations.</td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td><strong>Data Need:</strong> Collect field observations on surface and subsurface conditions for staining, odor, presence of debris, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) Utilities or other access problems</td>
<td>(6) <strong>Data Need:</strong> Document all utilities and access restrictions in relation to potential sampling areas.</td>
<td>Complete a checklist to document locations of underground and aboveground utilities prior to intrusive work. Determine if an alternate sampling technique can access sampling location; if not, then determine alternate sampling area.</td>
<td>Qualitative</td>
</tr>
</tbody>
</table>
Table A.1-3
Identified Information/Data Needs to Resolve Decision
(Page 2 of 3)

<table>
<thead>
<tr>
<th>Information Needs</th>
<th>Information Source</th>
<th>Collection Methods</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continued Criteria #1: If contamination is present, it will be sampled.</td>
<td>The culmination of all the biasing data collected above will aid in determining the areas most likely to be contaminated anywhere within a CAS. <strong>Data need:</strong> Collect samples from affected media in areas most likely contaminated and submit for laboratory analysis.</td>
<td><strong>Mud Pits, Waste Dump, and Lead Bricks:</strong> Appropriate sampling techniques will be used to collect mud/soil cutting samples at biased locations within mud pits, waste dumps, and collect soil in contact with the lead bricks and submit for analyses. <strong>Boxes &amp; Pipes:</strong> Appropriate techniques will be used to collect limited number of soil samples around Building 1-31.2e1 and rad swipes within and submit for analysis.</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Information Needs to Meet Criteria #2: If contamination is present, it will be detected. Types of analyses</td>
<td>Historical records of drilling practices provide general list of potential contaminants to be expected at mud pits. Historical records and interviews provide a general list of potential contaminants from the lead bricks area and Building 1-31.2e1. Existing sample data from the preliminary assessment conducted in 1997 on CAS 07-09-02, 07-09-04, 07-09-05, and 08-09-01 (Bordelois, 1998a, b, and c; Forsgren, 1998); TPH, VOCs, SVOCs, RCRA metals, and radionuclides were detected but levels were not above PALs, except for arsenic, which was within NTS background concentrations. <strong>Data Need:</strong> Submit newly collected samples to laboratory and analyze for full suite of COPCs to include TPH, VOCs, SVOCs, RCRA metals, PCBs, and radionuclides.</td>
<td>Existing data documented in site background and CSM. All new samples collected will be analyzed using the appropriate analytical method provided in <strong>Table 6-2</strong> of the SAFER Plan.</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Waste Management Requirements</td>
<td>IDW determined through environmental sample results. Waste will not be considered “listed” unless contrary information is discovered during the investigation.</td>
<td>Not applicable</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Housekeeping Activities</td>
<td>The types and amount of debris for removal is generally known through visual observations. <strong>Data need:</strong> Collect samples anywhere potentially hazardous substances may have leaked or if contents are unknown (e.g., unlabeled drum). <strong>Data need:</strong> Collect verification samples for any soil or brick removal activities associated with housekeeping.</td>
<td>Remove debris and photodocument with notification. Submit samples to laboratory for full-suite analysis unless specific COCs can be determined.</td>
<td>Qualitative for photodocumentation and Quantitative for analyses</td>
</tr>
</tbody>
</table>
Table A.1-3
Identified Information/Data Needs to Resolve Decision
(Page 3 of 3)

<table>
<thead>
<tr>
<th>Information Needs</th>
<th>Information Source</th>
<th>Collection Methods</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS Coordinates</td>
<td><strong>Data Need:</strong> Collect GPS measurements for all sample and screening locations as well as physical boundaries.</td>
<td>GPS measurements will be collected as points, lines, and areas in accordance with standard procedures. GPS measurements will be acquired in a manner capable of achieving horizontal accuracy of less than 50 centimeters.</td>
<td>Quantitative</td>
</tr>
</tbody>
</table>

*This column addresses the measurement quality assigned to all data collection activities, and is determined by the intended use of the resulting data in decision making. The levels are assigned as quantitative, semiquantitative, and qualitative.  
Quantitative: Data measures the quantity or amount of a characteristic or component within the population of interest. These data require the highest level of QA/QC in collection and measurement systems because the intended use of the data is to resolve primary decisions (i.e., rejecting or accepting the null hypothesis) and/or verifying closure standards have been met. Laboratory analytical data are usually assigned as quantitative data.  
Semiquantitative: Data indirectly measures the quantity or amount of a characteristic or component of interest. Inferences are drawn about the quantity or amount of a characteristic or component because a correlation has been shown to exist between the indirect measurement and the results from a quantitative measurement. The QA/QC requirements on semiquantitative collection and measurement systems are high but may not be as rigorous as a quantitative measurement system. Semiquantitative data contribute to decision making, but are not used alone to resolve primary decisions. The data are often used to guide investigations toward quantitative data collection.  
Qualitative: Data identify or describe the characteristics or components of the population of interest. The QA/QC requirements are the least rigorous on data collection methods and measurement systems. Professional judgement is often used to generate qualitative data. The intended use of the data is for information purposes, to refine conceptual models, and guide investigations rather than resolve primary decisions. This measurement of quality is typically assigned to historical information and data where QA/QC may be highly variable or not known.
The following information inputs are needed to support soil sample collection during Decision II activities:

- Limit COC list for laboratory analysis of Decision II samples to analytes initially detected
- Conduct field screening using methods appropriate to COCs present
- Sample using appropriate methods to bound contamination

The following information needs are identified for both close-in-place or clean closure as preferred alternatives:

- Soil samples within native soil, both vertically and laterally, to determine where the extent of contamination decreases below PALs
- Resource availability (cost analysis of preferred closure alternatives)

The following information needs are identified, if clean closure is chosen as the preferred alternative:

- Volume of material to be removed
- Potential remediation waste characteristics
- Post-removal concentrations of COCs at or below PALs

**Data Types:** All data to be collected are classified into one of three measurement quality categories: quantitative, semiquantitative, and qualitative. The categories for measurement quality are defined in the following paragraphs.

**Quantitative Data:** Quantitative data results from direct measurement of a characteristic, or component, within the population of interest. These data require the highest level of QA/QC in collection and measurement systems because the intended use of the data is to resolve the primary decision (i.e., rejecting, or accepting, the Null Hypothesis) and/or verifying closure standards have been met. Laboratory analytical data are usually assigned as quantitative data.

**Semiquantitative Data:** Semiquantitative data are generated from a measurement system that indirectly measures the quantity (or amount) of a characteristic (or component) of interest. Inferences are drawn about the quantity/amount of a characteristic/component because a correlation has been shown to exist between results from indirect measurement and the quantitative measurement. The
QA/QC requirements on semiquantitative collection and measurement systems are high, but may not be as rigorous as a quantitative measurement system. Semiquantitative data contribute to decision making, but are not generally used alone to resolve primary decisions. The data are often used to guide investigations toward quantitative data collection.

**Qualitative Data:** Qualitative data identifies and/or describes the characteristics/components of the population of interest. The QA/QC requirements for qualitative data are the least rigorous on data collection methods and measurement systems. Professional judgement is often used to generate qualitative data. The intended use of the data is for information purposes, to refine conceptual models, and guide investigations rather than resolve primary decisions. This measurement of quality is typically associated with historical information and data where QA/QC may be highly variable or not known.

**A.1.4.2 Determine the Basis for Preliminary Action Levels**

Preliminary Action Levels will be used as a screening tool to approximate decision levels. Site-specific PALs may be generated to address site-specific contamination problems.

Industrial site workers, construction/remediation workers, and military personnel (i.e., ground troops) may be exposed to contaminants through oral ingestion, inhalation, external (radiological), or dermal contact (adsorption) of soil during disturbance of this media. Laboratory analytical results for soils will be compared to the following PALs to determine if COCs are present:

- EPA Region 9 risk-based PRGs for industrial soils (EPA, 2002).
- TPH concentrations above the TPH limit of 100 ppm per the NAC 445A.2272 (NAC, 2000b).
- Background concentrations for metals will be evaluated when natural background exceeds the PAL (i.e., arsenic). A sediment sampling effort performed by the Nevada Bureau of Mines and Geology (NBMG, 1998) provides relevant analytical data for numerous metals, including the eight RCRA metals. Statistical analysis of this data indicate background concentrations (mean plus two standard deviations) applicable to soil samples collected from the NTS for investigation of CASs (Moore, 1999).
- For COPCs without established PRGs, a similar protocol as EPA Region 9 will be used in establishing an action level.
The PALs for radionuclides are isotope-specific and defined as the maximum concentration for that isotope found in environmental samples taken from undisturbed background locations in the vicinity of the NTS, as presented in McArthur and Miller (1989) and US Ecology and Atlan-Tech (1991). See Section 2.4 for establishment for radiological PALs.

The PALs for Decision II are the same as those used in Decision I.

**A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods**

As discussed in Section A.1.4.1, the collection, measurement, and analytical methods will be selected so the results will be generated for all of the suspected contaminants as well as all other potential contaminants at CAU 357. This effort will include geophysical surveys, field screening, soil sampling, and laboratory analysis to determine the presence of COPCs and extent of identified COCs.

For CAU 357, site characterization sampling and analysis are the focus of the DQO process. However, waste characterization sampling and analysis has been included to support the decision-making process for waste management, and to ensure an efficient field program. Soil samples will be submitted for IDW analysis, as necessary. Specific analyses required for the disposal of IDW are identified in Section 5.0 of the SAFER Plan.

**A.1.4.3.1 Geophysical Surveys**

Electromagnetic surveys may be used to determine presence/lateral extent of metallic waste. Resistivity surveys may be used to determine presence/vertical extent of CAS wastes. Geophysical surveys will follow standard procedures. Direct soil sampling will be required and implemented, if geophysical surveys are unable to conclusively determine the presence or absence of disposed waste (e.g., waste dump area’s soil piles).

**A.1.4.3.2 Geodetic Surveys**

Geodetic surveys are performed using standard procedures for identifying soil sampling locations.

**A.1.4.3.3 Field Screening**

Field-screening activities may be conducted for the following analytes and/or parameters:
TPH - A gas chromatograph, or equivalent instrument or method, will be used at all CASs because TPH is a common concern at the NTS and primary COPC for mud pits based upon process knowledge of similar sites investigated in the past.

VOCs - A PID, or equivalent instrument or method, will be used to conduct headspace analysis at all CASs because VOCs are a common concern at the NTS and have not been ruled out based upon process knowledge.

Alpha-, Beta- and Gamma-Emitting Radionuclides - Handheld radiological survey equipment, or equivalent instrument or method, may be used at all CASs because radiation is a common concern at the NTS and has not been ruled out based upon process knowledge.

Gamma-Emitting Radionuclides - Gamma spectroscopy, or equivalent instrument or method, provides semiquantitative results and is used at CASs where gamma-emitting radionuclides may be present. Gamma-emitting radionuclides are a concern at the NTS and cannot be ruled out based on process knowledge.

Alpha-Emitting Radionuclides - Isotopic uranium and isotopic plutonium analysis of samples provides a quantitative result and may be used at all CASs where field-screening measurements demonstrate alpha-emitting radionuclide concentrations exceeding FSLs.

Based on the results of previous CAU investigations and common NTS practices, the aforementioned field-screening techniques will provide good semiquantitative data that can be used to guide soil sampling activities.

**A.1.4.3.4  Soil Sampling**

Drilling (i.e., hollow-stem auger, hand auger, direct push), excavation, or other appropriate sampling methods will be used to collect soil samples for laboratory analysis. Sample collection and handling activities will be conducted in accordance with approved procedures.

**A.1.4.3.5  Analytical Program**

The analytical program for CAU 357 shown in Table A.1-4 has been developed based on the specific contamination information presented in Section A.1.1. Possible CAS (dependent) chemical and radiological parameters for initial soil samples include:

- TPH (diesel- and gasoline-range organics \([C_6-C_{38}]\))
- Total VOCs
- Total SVOCs
## Table A.1-4
Contaminants of Potential Concern for CAU 357 CASs

<table>
<thead>
<tr>
<th>COPC</th>
<th>Organics</th>
<th>Inorganics</th>
<th>Radionuclides</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>-- X --</td>
<td>-- -- --</td>
<td>X X X X X X X X X X</td>
</tr>
<tr>
<td>Total Metals: to include antimony, arsenic, barium, beryllium, cobalt, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, vanadium, and zinc</td>
<td>-- -- X X X X X X X X X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isotopic Uranium and Isotopic Plutonium</td>
<td>X -- X X X X X X X X X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strontium 90</td>
<td>X -- X X X X X X X X X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gamma Spectroscopy</td>
<td>X -- X X X X X X X X X X X X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Radionuclides</td>
<td>X -- X X X X X X X X X X X X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a For those COPCs identified that include multiple parameters, the parameters with PALs will be evaluated.

X = COPC
-- = Not a COPC analyte for this CAS
- Total Metals
- PCBs
- Gamma Spectrometry
- Isotopic Plutonium
- Isotopic Uranium
- Strontium-90

Section 6.0 of the SAFER Plan provides the analytical methods and laboratory requirements (i.e., detection limits, precision, and accuracy requirements). Specific analyses required for the disposal of IDW are identified in Section 5.0 of the SAFER plan. Unless otherwise required by the results of this DQO and stated in the SAFER plan, this investigation will adhere to the Industrial Sites QAPP (NNSA/NV, 2002b).

To ensure that laboratory analyses are sufficient to detect contamination in soil samples at concentrations exceeding minimum reporting level (MRL), initial chemical and radiological parameters of interest have been selected for each CAS. Solid media (e.g., wood, concrete, lead bricks) will not be analyzed by a laboratory for chemical or radiological parameters, unless characterization is requested by waste management.

Only those COCs identified initially in Decision I above PALs will be analyzed for during Decision II. Appropriate sample collection techniques will be utilized for Decision II activities to determine the vertical and lateral extent of contamination.

**A.1.5 Step 4, Define the Boundaries of the Study**

This step defines the target population of interest, specifies the spatial and temporal features of that population that are pertinent for decision making, determines practical constraints on data collection, and defines the scale of decision making relevant to target populations for Decision I and Decision II activities.

**A.1.5.1 Define the Target Population**

First - Target populations represent locations within the CAS that contain COCs, if present.
Second - Target populations are locations within the CAS where COC concentrations are less than PALs, and that when sampled will provide sufficient data to resolve the primary problem statement (Section A.1.3.1) (i.e., COCs < PALs).

Two target populations have been identified for the Mud Pits. One population is the COC concentrations within mud/soil cuttings from the surface to the textural discontinuity. This equals the mud pit’s excavated base. The second target population consists of COC concentrations in the native soil below and adjacent to the textural discontinuity. The first target population implies sampling in step-out locations at increased depths to determine the lateral and vertical extent.

The target population identified for the waste dump consists of COC concentrations in the native soil below and/or adjacent to the base of the pit textural discontinuity. This includes the area from the waste dump’s excavated base to the waste dump feature’s walls (and possibly the three soil pile’s base). The objective is to identify the potential of environmental impact resulting from the contents in the dump area (and possibly within the soil piles), but not to identify the contained contents itself. If necessary, additional samples would be collected below the previous sample depth and in step-out locations to define the horizontal and vertical extent of contamination.

The target population for the lead bricks consists of identifying COC concentrations resulting from the bricks on the near-contact soil material adjacent to the bricks. Sampling will be conducted once the bricks are identified and removed. The results will be compared to natural background in soil from undisturbed, nonimpacted, background locations to provide natural background comparisons. If required, Decision II will proceed in predetermined step-out locations surrounding the scatter zone, by analysis for COCs greater than PALs.

The first target population for the boxes and pipes consists of COC concentrations for the soil and/or unconsolidated sediments within and around the general proximity (5 ft) from the building. Soil directly beneath the building is not accessible; therefore, it is not considered in the CSM as a migration pathway.
A.1.5.2 Determine the Spatial and Temporal Boundaries

The spatial boundaries for each CAS are defined as the vertical or horizontal boundaries beyond which the CSM and/or the scope of the investigation will require re-evaluation. The spatial boundaries that determine the presence of a COC are the sample locations selected to satisfy the criteria. In general, geographic boundaries are defined by the area impacted from releases attributed to each CAS. Intrusive activities are not intended to extend into boundaries of neighboring areas of environmental concern (e.g., other CASs).

The spatial boundaries that apply to each CAS are the maximum, reasonably expected, extent of potential contamination as determined by the CSM. Contamination found beyond these boundaries would indicate a potential error in the CSM and would require that the CSM be re-evaluated before the investigation would/could continue. Figures A.1-3 to A.1-16, presented earlier, depict the sites and surrounding boundaries, which are essentially the CAS footprints, and Figures A.1-20 to A.1-33, add illustration of the proposed sampling locations and are presented later in DQO step seven.

Each mud pit can be divided into two strata: (1) surface of mud down to the textural discontinuity (i.e., base of the pit), and (2) native material below the pit.

The lateral spatial boundaries are defined by the surrounding berm for each mud pit or by topographical slope(s). The geographic boundaries will be further expanded laterally to capture the potential extent of contamination migration. Each mud pit CAS is defined by a 5-ft buffer zone around the berm, or pit edge, regardless if bermed or not.

The spatial boundaries for the Waste Dump are the disturbed area located in between the surrounding three soil piles and measuring approximately 200 by 120 ft. The waste dump geographic boundary remains defined as the original CAS footprint that encompasses the outside parameter of the three soil piles.

The spatial boundary for the Lead Bricks is the area of visible scatter located west of the T-4 Bunker (approximately 320 by 200 ft in area), but this boundary may be altered by the geophysical survey of the area. Numerous lead bricks have visually been identified on the ground surface.
Spatial boundary for the Boxes and Pipes CAS is defined as the inside and 5 ft beyond the outerwalls of the Building 1-31.2e1. However, the lateral spatial boundaries may be expanded on all sides of the building to capture the extent of COCs.

The spatial boundaries on all CASs have the potential to increase in size, if the extent of contamination above PALs is shown to exist beyond these boundaries defined by their respective CSM.

Temporal boundaries are those time constraints set up by weather conditions and project schedules set in the FFACO baseline. Significant temporal constraints due to weather conditions are not expected at the NTS. However, rare snow/rain events may impact sampling and surveying of radiologically contaminated soils because of the attenuating effect of moisture on alpha/beta-emitting radionuclides. Field activities will be re-scheduled around forecasted inclement weather. No temporal constraints for collecting samples are anticipated. The environmental conditions at all CASs are not expected to significantly change in the near future, as general CAS conditions have stabilized over the last 10 to 30-plus years since the systems were last used.

**A.1.5.3 Identify Practical Constraints**

The NTS-controlled activities may affect the ability to characterize these CAS sites. Practical constraints include underground and overhead utilities, rough terrain, access restrictions, such as: scheduling conflicts at the NTS, posted contamination area requirements (CASs 08-09-02, 08-09-03, 10-09-04, and 04-26-03), physical barriers (e.g., fences, steep slopes), and areas requiring authorized access. Underground utility surveys will be conducted at each applicable CAS prior to the start of investigative activities, to determine if utilities exist and, if so, determine the limit of spatial boundaries for intrusive activities. Deactivated and abandoned underground utilities may be expected at CAS 01-99-01. Adverse weather conditions and health and safety concerns may affect all CAS sites. No NTS area identified in this investigation is remote enough to create logistical constraints of practical concern. Certain health and safety hazards (slip/trip/fall) may exist in attempting to access all CASs, especially the mud pit and waste dump areas. No other practical constraints have been identified.
A.1.5.4 Define the Scale of Decision Making

The scales of decision making for the initial investigation are defined here as each individual CAS. The scale of decision making for Decision II is defined as a contiguous area contaminated with any COC originating from the CAS. The decision scale also allows for corrective actions appropriate to each CAS rather than the entire CAU. This approach enables individual CASs to be advanced to characterization, if necessary, rather than submitting the entire CAU to characterization.

A.1.6 Step 5, Develop a Decision Rule

This step integrates outputs from previous steps with the inputs developed in this step into a decision rule (“If...then...”) statement. This rule describes the conditions under which possible alternative actions would be chosen.

A.1.6.1 Specify the Population Parameter

The population parameter for initial data, collected from biased sample locations, is the maximum observed concentration of each COC within the target population.

The population parameter for Decision II data will be the observed concentration of each unbounded COC in any sample.

A.1.6.2 Choose an Action Level

Action levels are defined as the PALs, which are determined by EPA standards and deemed as appropriate values for CAU 357 SAFER. However, those levels of contamination are not anticipated to be reached in this investigation. Action levels may also be the unrestricted release criteria given in the NV/YMP Radiological Control Manual (DOE/NV, 2000a).

A.1.6.3 Decision Rule

If the concentration of any COPC in a target population exceeds the PAL for that COPC during the initial investigation, then that COPC is identified as a COC and Decision II sampling will be conducted. If the Site Supervisor determines that sufficient indicators (e.g., staining) are present, Decision II sampling may be conducted before the results of the Decision I sampling are available. If
all COPC concentrations are less than the corresponding PALs, then the investigation will be stopped, 
the decision will be: “No Further Action,” and an applicable closure report will be prepared.

If the observed population parameter of any COC in a sample exceeds the PALs during Decision II 
activities, additional samples will be collected to define the extent. If all observed COC population 
parameters are less than PALs, the decision will be that the extent of contamination has been defined 
 in the lateral and vertical directions.

If contamination is inconsistent with the CSM, or extends beyond the spacial boundaries, work will 
be suspended and the investigation strategy will be re-evaluated. If contamination is consistent with 
the CSM and within spatial boundaries, then the decision will be to continue sampling to define 
extent.

A.1.7 Step 6, Specify Tolerable Limits on Decision Errors

The sampling approach for the initial investigation relies upon biased samples; therefore, statistical 
analysis is not appropriate. Only validated analytical results (quantitative data) will be used to 
determine if COC are present (Decision I), or the extent of a COC (Decision II), unless otherwise 
stated.

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

- Baseline condition - A COC is present
- Alternative condition - A COC is not present

The baseline conditions (i.e., null hypotheses) and alternative conditions for determining the extent of 
a COC are:

- Baseline condition - The extent of a COC has not been defined
- Alternative condition - The extent of a COC has been defined

Decisions and/or criteria have an alpha (false rejection) or beta (false acceptance) error associated 
with their determination (discussed in the following subsections). Since quantitative data relies upon 
biased samples that are individually compared to action levels, statistical evaluations and analysis of 
the data, such as averages and/or confidence levels, are not appropriate.
A.1.7.1 False Rejection Decision Error

The false rejection (alpha error) would mean:

- Deciding that a COC is not present, when it is (Decision I)
- Deciding that the extent of a COC has been defined, when it has not (Decision II)

In these scenarios, the consequence is the increased risk to human health and environment by not determining the full extent of contamination; thereby, implementing an inappropriate corrective action at the site that would not adequately protect against exposure to future receptors.

Two basic assumptions regarding the area of contamination contribute to minimizing the chances of making a false rejection (alpha) error. The first is that the area of contamination is contiguous, and secondly that the extent of COC concentration decreases away from the area of contamination. The criteria for bounding the extent of contamination greater than PALs requires that two consecutive lateral and vertical samples, collected and submitted to the laboratory for analysis, show analytical results below PALs. Established QA/QC and procedures help minimize false-negative lab results.

A false rejection decision error (where consequences are more severe) is controlled by meeting the following two criteria: (1) having a high degree of confidence that location selected will identify contamination of concern if it were present anywhere within the CAS, and (2) having a 95 percent confidence level that the minimum detectable concentration for the analyses conducted will detect any COC at the PAL concentration in the samples.

This error is reduced by: (1) having a high degree of confidence that the sample locations selected will identify the extent of COCs, (2) having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples, and (3) having a high degree of confidence that the data set is of sufficient quality and completeness.

To satisfy that the first criterion is met, the data and samples will be initially collected in areas that are assumed to be contaminated (worst case) by any COPCs. Next, data collection activities will identify sample areas that represent the lateral and vertical extent of contamination.

The following characteristics are considered during both decisions to accomplish the first criterion:
• Source and location of release
• Chemical nature and fate properties
• Physical transport pathways and properties
• Transport drivers

These characteristics were considered during the development of the CSM (see Section A.1.3). The biasing factors, as listed in Step 5 in Section A.1.6.1, will be utilized during the investigation to further ensure that the criteria is met. To meet the second criterion, all initial samples will be analyzed for the chemical and radiological parameters listed in Section A.1.6.3. Additional samples will be analyzed for COCs detected in the initial samples.

To satisfy the third criterion for extent, the entire data set, as well as individual sample results, will be assessed against the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002b). The goal for the DQI of completeness is that 100 percent of the critical COPC results are valid for every sample. Critical COPCs are defined as those contaminants that are known, or expected to be present within a CAS. In addition, sensitivity has been included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in Section 6.0 of the SAFER. Strict adherence to established procedures and QA/QC protocol also protects against false negatives.

If any criteria described above are not met, then the investigation will go directly to Decision II.

A.1.7.2 False Acceptance Decision Error

The false acceptance (beta error) would mean:

• Deciding that a COC is present, when it is not
• Deciding that a COC is unbounded, when it is
• Determining that a COC has migrated beyond the spatial boundaries, when it did not

These scenarios result in increased costs for unneeded characterization and unnecessary corrective action costs.

The false acceptance decision error is controlled by protecting against false-positive analytical results. False-positive analytical results are typically attributed to laboratory errors and/or sampling/handling errors. Quality assurance/quality control samples such as field blanks, trip blanks,
laboratory control samples, and method blanks are used to determine if a false-positive analytical result may have occurred. The blanks should minimize the risk of a false-positive analytical result. Other measures include proper decontamination of sampling equipment and using certified clean sampling equipment and containers to avoid cross contamination, and knowing the history of similar CAS sites with low beta errors.

**A.1.7.3 Quality Assurance/Quality Control**

Radiological survey instruments and field-screening equipment will be calibrated and checked in accordance with the manufacturer’s instructions or approved procedures.

Quality control samples will be collected as required by the IS QAPP (NNSA/NV, 2002b) and in accordance with established procedures.

The required QC samples include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per water source used for dust suppression)
- Field duplicates (1 per 20 mud pit samples - CASs are grouped collectively, or 1 per CAS - excluding mud pits - if less than 20 environmental samples are collected for that CAS)
- Field blanks (1 per 20 environmental samples)
- Matrix spike/matrix spike duplicate (1 per 20 environmental samples, or 1 per CAS per matrix if less than 20 collected, or as required by radioanalytical methods)

Additional QC samples may be submitted based on site conditions.

Quality data indicators of precision, accuracy, comparability, completeness, and representativeness are defined in the Industrial Sites QAPP (NNSA/NV, 2002b). Site-specific data quality indicators are discussed in more detail in Section 6.0 of the SAFER Plan.
A.1.8 **Step 7, Optimize the Design for Obtaining Data**

This section presents an overview of the resource-effective sampling and analysis design to obtain data that satisfy the project DQOs developed in the previous six steps.

If field data generated during Decision I activities strongly indicate that contaminants are above decision levels, Decision II data may be collected without the support of Decision I analytical results (i.e., heavy concentrations of hydrocarbon staining and odor). Contaminants determined not to be present in Decision I samples may be eliminated from Decision II analyses. Contaminants can also be eliminated from Decision II analyses based on previous knowledge.

The objective of the investigation strategy of a SAFER Plan is to determine whether COCs are present and, if so, define the horizontal and vertical extent above PALs. Geophysical surveys and biased intrusive soil sampling for field screening and laboratory analysis will be conducted at CAU 357 during the investigation, as necessary. The biased locations will be selected by the Site Supervisor as field data are generated by geophysics and field-screening results. Additional samples may be collected for waste management as needed for characterization and disposal purposes. The Site Supervisor has the discretion to modify the biased locations based on biasing factors or analytical results, but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.3, which provides the general approach for obtaining the information necessary to resolve the decisions. A Record of Technical Change (RTC) will be submitted to document justification to change a sample location, as required. It is important to note that the target populations to be investigated may be different than those to determine the presence of COCs.

The initial sampling strategy targets worst-case contamination by sampling the soils at the mud pits, the waste dump, beneath the lead bricks and surrounding the Building 1-31.2e1 locations assume to have the highest potential for contamination. Field-screening will be instituted to assist in providing an additional semiquantitative screening measurement of COPC concentrations when other biasing data are insufficient to locate the area most likely to be contaminated. These field-screening results will help guide the selection of the most appropriate sampling location for collection of laboratory samples. Potential field-screening methods with the respective field-screening levels are presented below:
TPH screening levels are established at 100 ppm, using field gas chromatograph (GC) or other appropriate field test kit. Soil will be field screened for TPH only at the mud pit/disposal and waste dump sites.

The radiation (alpha/beta) screening level is defined as the mean surficial-background activity level plus two times the standard deviation of that mean.

VOC headspace screening levels are established at 20 ppm or 2.5 times background, whichever is greater, using a photoionization detector.

Drilling, direct-push, excavation, or other appropriate soil collection techniques will be used to collect soil samples for laboratory analysis. Biased locations for these activities are determined based on the biasing factors listed in Section A.1.4.2. The proposed sample locations are discussed in the following sections; however, process knowledge indicates that CAU 357 contamination, if any, is confined to within the spatial boundaries of the individual CASs. The initial analytical results will be used to confirm the presence or absence of COPCs and if the concentrations exceed PALs. If COCs are located within a CAS, that CAS will be further assessed in a Decision II investigation. The COPCs determined not to be present will be eliminated from further consideration during a Decision II characterization effort.

Activities at these CASs will consist of confirming the location of each sample point proposed within the CAS, and sample collection for laboratory analysis for the target population of COPCs (i.e., mud pits - within mud/soil cuttings from the surface to the textural [base of pit] discontinuity). The sampling strategy consists of biased sampling.

Efforts will consist of additional sampling at sites where COCs were confirmed to be present above PALs during initial sampling activities, and that the extent of the COC has not been defined. The analytical results will be used to determine where the extent of contamination has decreased below PALs. Only the COCs determined to be present will be analyzed in samples collected to determine the extent of contamination. It is important to note that the target population(s) to be investigated may be different from those in the initial investigation. The target populations are discussed in the following sections.

Environmental soil samples may be field screened to guide sample collection activities, to assist in waste management decisions, and to provide health and safety information provided that the COCs
identified have an appropriate screening method. Field-screening methods and field-screening levels will be established prior to the start of sampling activities.

Step-out locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected, and other biasing factors listed in Section A.1.4.2. If the biasing factors indicate COCs extend beyond the initial Decision II sample locations, further step-out locations may be necessary. In general, samples submitted for off-site laboratory analysis would be those that define the lateral and vertical extent of COCs.

Some of the CASs have overgrown vegetation (e.g., tumble weeds) and miscellaneous debris that will need to be removed and properly disposed during site preparation activities. Details will be provided to the NTS Performance-Based Management Contractor (i.e., housekeeping) prior to the start of the investigation.

The sampling strategies outlined below will ensure that the lateral and vertical extent of contamination has been adequately located, identified, and quantified. Site preparation activities for each CAS are documented below in the relevant section.

**A.1.8.1 CSM #1: For Mud Pit CASs 07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 08-09-03, 10-09-02, 10-09-04, 10-09-05, 10-09-06, Waste Dump CAS 25-15-01, and Lead Bricks CAS 04-26-03**

Several site preparation activities and preliminary investigation techniques must be completed prior to the initiation of sampling activities for the CASs. These activities include the following:

- Removing tumbleweeds from within each pit/or location, if needed
- Inspecting the surface features of each pit for staining, debris, etc.
- Constructing access ramps into pits, where required, for backhoe and personnel entrance
- Conducting geophysical surveys within each pit/dump and across the brick scatter area
- Conducting radiological surveys within each pit/dump and across the brick scatter area

Sampling locations will be selected in areas most likely to be contaminated based on the conceptual model and other biasing factors outlined in Step 3 (e.g., field screening, geophysics). Exact sample locations will be determined in the field by the Site Supervisor. Figure A.1-16 provides a three-dimensional plan map view of the general CSM. Figure A.1-17 illustrates the cross-sectional
view of a typical mud pit and illustrates idealized potential sample locations. Figure A.1-17 may be applicable to the other CASs in the CSM.

Geophysical surveys will be performed within the spatial boundaries of each mud pit to facilitate the selection of biased sample locations, determine the configuration of each pit (e.g., construction of the base), and identify if debris is present within the pits. The surveys may be extended several feet past the boundaries to gather data on contrasting soil characteristics. The geophysical surveys will consist of electrical imaging methods to measure the subsurface resistivity and identify the transition between the clay characteristics of mud and the sands/gravels of native soil, if possible; and identify any metallic debris that may be buried within the mud pit.

A sample target area will be identified based on geophysical anomalies and field observations. Surface samples will be collected from biased locations within the center of each identified anomaly and/or from the topographic high and low points within the pit for TPH screening samples. The locations with the highest TPH field-screening results will then be considered, along with other biasing data collected, in selecting the sample point(s) for surface and subsurface sample collection and laboratory submittal. Field screening for TPH may be conducted at initial areas targeted for biased sampling to further enhance the selection of sample areas most likely to be contaminated. For the initial Decision step of data collection in the Mud Pits, Waste Dump, and Lead Bricks CASs, biased samples will be collected within the mud/soil cuttings from locations determined by the criteria discussed in Table A.1-3.

**Mud Pit CAS-Specific Sampling Information for CASs: 07-09-02, 07-09-03, 07-09-04, 07-09-05, 08-09-01, 08-09-02, 08-09-03, 10-09-02, 10-09-04, 10-09-05, and 10-09-06**

Each mud pit will be sampled at a minimum of two biased locations within the defined spatial boundaries (Figures A.1-20 to A.1-30). Each sample location will consist of two discrete samples, unless the configuration and depth of mud at a given location precludes two separate depths; in which case, only one sample will be collected at that particular location. One sample will be collected at the surface (0 to 6 in.) within the mud/soil cuttings matrix, while the second sample will consist of an approximately 6-in. interval comprised of mud and native soil at the textural (base of pit) discontinuity. Collecting both mud and native soil at this discontinuity ensures that contamination, if
Figure A.1-20
CAU 357, CAS 07-09-02, Mud Pit

Explanation
- Bermed Area and Slope Direction
- • • • CAS 07-09-02 Footprint
- Stained Area
- bgs - Below Ground Surface
- ✭ Proposed Biased Sample Location

Site Marker
CAS 07-09-02

Light Reddish
Soil/Cement Area

Scattered Debris
(Metal, Plastic Crates,
Wooden Stakes)

Former Sample Point
ERS 00068

40 ft

115 ft

Dirt Access Road

Source: IT, 2002
Figure A.1-21
CAU 357, CAS 07-09-03, Mud Pit
Figure A.1-22
CAU 357, CAS 07-09-04, Mud Pit
Figure A.1-23

CAU 357, CAS 07-09-05, Mud Pit

Explanation

- - - - - CAS 07-09-05 Footprint
◎ Previous Sampling Stake
* Proposed Biased Sample Location
bgs - Below Ground Surface
☆ Site Marker
◊ Drill Hole

Bermed Area and Slope Direction

Scale

Source: IT, 2002
Figure A.1-24
CAU 357, CAS 08-09-01, Mud Pit
Figure A.1-25
CAU 357, CAS 08-09-02, Mud Pit
Figure A.1-26
CAU 357, CAS 08-09-03, Mud Pit
Figure A.1-27

CAU 357, CAS 10-09-02, Mud Pit
Figure A.1-28
CAU 357, CAS 10-09-04, Mud Pit
Figure A.1-29
CAU 357, CAS 10-09-05, Mud Pit

Explanation

- Site Marker
- CAS 10-09-05 Footprint
- Bermed Area and Slope Direction
- Proposed Biased Sample Location

Source: IT, 2002
Figure A.1-30
CAU 357, CAS 10-09-06, Mud Pit; Stains; Material
present, will be detected whether it is bound in mud matrix or leached into the nearby native soil. Additional material adjacent to the initial sample location may be collected to ensure sufficient volume is submitted to satisfy analytical requirements.

The mud/grout spills of CASs 10-09-04 and 10-09-06 may be sampled during the initial activities. The mud characteristics at these locations can be assumed consistent with the results of the return mud pit and suction mud pit associated with these CASs. Therefore, the analytical results from these two mud pits will be utilized to determine if any further characterization strategies are necessary at the locations during the Decision II efforts.

Subsurface soil sampling may be conducted to determine the extent of COC above PALs. Hand auguring, backhoe excavation, or direct-push will be the primary techniques of investigation for these CASs. If the vertical extent of contamination is deeper than the limits of these techniques, then an appropriate drilling technique will be used.

To investigate the vertical and lateral extent of contamination where COCs above PALs were detected in Decision I sample locations, subsurface samples will be collected below the textural discontinuity (vertical) and adjacent to those locations (lateral) at depth/step-out locations selected by the Site Supervisor up to approximately 15 ft beyond the outer boundary of the Decision I sample locations. Each sample will be submitted to the laboratory for analysis for only the COCs identified in Decision I. Initial sample locations are tentatively planned for the topographic highs and lows, areas of concentrated mud flow discharge/in-flow, and any stain areas within the physical boundaries of the mud pits with depth/step-out locations to be determined by site conditions.

Vertical and lateral extent of contamination will be bounded by laboratory analytical results that show concentrations of COCs below PALs. If any of the step-out analytical results indicate COCs are still present, additional depth step-out locations (vertically and/or laterally) will be sampled until it can be demonstrated that COC concentrations below PALs have been achieved. If results indicate the extent of contamination extends beyond 50 ft of the spatial boundaries, the conceptual model has failed and the investigation will need rescoping.

Housekeeping activities have been identified for each of the mud pit CASs and involve the removal of various wood and metal scraps located within the spatial boundaries of the mud pits. The
remaining surface debris that requires content identification will be sampled and then removed through housekeeping operations. Any additional housekeeping activities identified during the course of the investigation will be documented and implemented.

**Waste Dump CAS-Specific Sampling Information: CAS 25-15-01**

The sampling strategy for the waste dump will be similar to activities outlined in the mud pit section, and as modified from the Corrective Action Investigation Plan for CAU 5: Landfills, Nevada Test Site, Nevada (NNSA/NV, 2002a). Initial activities at this CAS will consist of confirming the configuration of system components, as defined by the geophysical survey, and sample collection within or nearby the geophysically identified anomalies of the following target population: soil below and/or adjacent to the backfill/native soil interface within the zone of original excavation. The sample will be collected as near an anomaly’s maximum concentration within the disturbed area where excavation and burial of debris may have occurred as field conditions allow. The surface (backfill) soils above the debris will not be sampled because it is native soil used for cover and retards contaminant release to the environment beyond the CAS.

As noted above, soil from the three soil piles base will also be sampled, if it is determined geophysically that debris resides within them. To confirm a geophysically determined anomaly, each soils pile may be breached with a backhoe to visually determine the presence or absence of debris. If debris is present, soil beneath the debris at the soil/native soil interface may be collected using a hand auger and analyzed. If no debris is located in the piles, the soil piles may be either left-in-place or leveled to provide a cap of native soil across the waste dump area, dependent on waste management and NDEP directive. Either way, the corrective action chosen will be close-in-place.

Site preparation for the initial investigation activities will consist of removing the few tumbleweeds from the waste dump area, inspecting the surface features of the disturbed area, conducting a radiological walkover survey, and through extrusive (geophysics) and/or intrusive (e.g., backhoe, hand-auger, or direct-push) investigations. The investigators will locate and verify the backfilled configuration (and content presence) of the landfilled area and soil piles (anticipate clean, native-soil within these areas).
Sampling will not be conducted for characterization of the waste dump’s debris contents except for waste management purposes, as appropriate. Samples of soil beneath the debris (if physically recoverable), or as near as field conditions allow, will be collected and analyzed. A sediment/soil sample will be collected from the topographic lowest point(s) that coincide beneath each geophysically determined anomalous high and/or elevated PID/flame-ionization detector (FID) field-screening level within the excavated area as determined by Site Supervisor observations. Field screening for TPH will be conducted at initial areas targeted for biased sampling to provide additional biasing information regarding sample areas likely to be contaminated. The locations with the highest TPH field-screening results will then be considered, along with other biasing data collected, in selecting the sample point(s) for surface and subsurface sample collection and laboratory submittal.

A minimum of four biased-locations, as identified above, will be sampled within and around the waste dump area. These biased locations will target areas most likely to have been contaminated by the disposal process and provide a “worst-case” scenario and/or at least define extent. The exact locations within each sampling area will be selected by the Site Supervisor based upon site characteristics determined through field observations. For the waste dump, samples will potentially consist of soil collected within the first 12 in. of soil immediately beneath the native soil base. If the presence of debris is confirmed within the soil piles, only one sample per pile will be collected and analyzed from as near the center of the pile as physically possible within the first 12 in. of soil beneath the native soil base. Figure A.1-31 shows the potential sample locations based on current site conditions.

Soil sampling may be conducted simultaneously with activities to determine the lateral extent of COC. Geographic access limitations of this site and unknown debris within the back-filled area may hamper backhoe excavation or direct-push techniques feasibility to determine lateral extent within the excavated walls of the waste dump. Therefore, to define extent, sampling will be conducted beyond the excavated parameter. However, during the investigation to define the vertical and lateral extent of contamination, every attempt will be made to collect samples from below the textural discontinuity at each determined sample location. Each sample will be submitted to the laboratory for analysis for the COCs initially identified. The lateral and vertical extent of contamination will be bounded by laboratory analytical results that show concentrations of COCs below PALs. If any of the step-out analytical results indicate COCs are still present, additional depth step-out locations will be sampled.
Figure A.1-31
CAU 357, CAS 25-15-01, Waste Dump
until it can be demonstrated that COC concentrations below PALs have been achieved. If bedrock refusal is encountered before the extent has been determined, the investigation will stop and the conceptual model re-evaluated.

All necessary closure activities associated with the waste dump will be considered initial investigation activities. Following delineating the extent, surface/exposed debris will either be removed or left in-place, as determined by waste management. Backfilling, if determined by waste management, would proceed according to NAC regulations (NAC, 2000a). Hauling off of debris determined hazardous or radiological (unexpected) will also be considered initial investigation activities.

To facilitate the closure of the waste dump under NAC requirements (NAC, 2000a), samples will be initially collected in soils adjacent to and/or beneath the most contaminated debris piles identified, which may or may not conform to geophysical anomaly highs, to confirm releases have not occurred from these structures. The waste dump’s actual dimensions, types of construction debris that may be identified, and estimated volume of refuse landfilled will be documented for closure purposes.

The objective of the SAFER investigation at this CAS is not to identify contents of the debris disposed in the dump, but to identify impact to the environment at this point in time resulting from the debris’ burial. The strata sampled within the waste dump will be determined by the depth to native soil/rock interface, which is assumed to be less than 7 ft. Surface cover material will not be sampled.

**Lead Bricks CAS-Specific Sampling Information: CAS 04-26-03**

Activities at this CAS will consist of determining the configuration of the scattered lead brick within the area and sample collection of the target population (i.e., the COC concentrations within surface soils in contact or near contact with the located bricks). The sampling strategy for CAS 04-26-03 consists of identifying and sampling three biased surface locations within the brick scatter area based on brick cluster patterns and identified geophysical and radiological anomalies. Approximately 50 lead bricks have been identified and are exposed on the ground surface. All bricks, and several other surface debris items initially identified are within and around the area of the scattered lead brick and
will be removed from the area for future housekeeping activities and prior to the initial investigation should it be deemed necessary.

Site preparation activities are minimal at this CAS and should consist primarily of health and safety precautions for accessing the area, which is within a known Underground Radiological Material Area. Access into the area is restricted to personnel working under an approved RWP. A health and safety item to consider for field activity planning is that no more than 2 bricks should be carried at a time to the disposal bin by any one person, as each brick weighs 26 pounds. Site Supervisors should remind personnel performing the task of removal to bend at the knees and not with the back. Figure A.1-32 shows the potential sample locations based on known current site conditions.

The observable bricks will be collected and placed on a sturdy pallet for waste management. The location from which they were removed will be pin-flagged. Once identified bricks are out of the CAS area, a geophysical sweep of the area will be conducted to identify buried brick locations, and those bricks will be similarly collected and locations flagged. Each brick location will then be revisited, and one full shovel of soil will be collected and drummed for a waste management composite characterization and disposal; whereby, remediation should be complete. Three biased-soil samples will be collected from across the scatter area from former brick locations. The samples will be collected below scoop depth across the scatter area for COC analysis. Sampling activities may be conducted in all areas prescribing brick removal at the discretion of the Site Supervisor based on field observations (e.g., soil staining).

Miscellaneous debris including wood and metal scraps and other objects (i.e., bucket, gas cylinder), and barbed-wire and assorted cabling will be removed as housekeeping activities, if required. The metal objects may contain unknown material. The contents of the metal bucket and gas cylinder (if present and unknown) may be drummed and sampled for waste management purposes.

If initial analytical results indicate COCs above PALs, increased depth and step-out sampling will be collected. Additional soil sampling will consist of collecting and drumming an additional scoop (or two) from each of the pin-flagged locations (defines vertical extent) and four additional sample locations around and outside the scatter area and toward the CAS boundary to define lateral extent. This information, combined with analytical results from the background locations compared to the drummed soil results should provide confirmatory abatement evidence, as required, for a clean
Figure A.1-32
CAU 357, CAS 04-26-03, Lead Bricks
closure corrective action report. All flags will be retrieved for waste management upon this sampling’s completion.

**A.1.8.2 CSM #2 for CAS 01-99-01, Boxes; Pipes**

Site preparation activities are minimal at the Boxes and Pipes CAS and should consist primarily of health and safety precautions for accessing the area, which is within a known former Nuclear Testing Area. Access into the area may be restricted to personnel working under an approved RWP.

Decision I activities at this CAS will be primarily limited to the outside of Building 1-31.2e1, which houses all the boxes and pipes identified in the CAS. The flooring material of Building 1-31.2e1 is a 2-ft thick concrete slab and foundation. It is impractical to sample soils beneath the slab. Sampling below the 2-ft pad is not necessary because there is not a CSM-identified migration pathway for contaminant release. Decision I activities will consist of determining the locations for sample collection of the target population (i.e., the COC concentrations within surface soils in contact or near contact with Building 1-31.2e1). The sampling strategy for CAS 01-99-01 consists of identifying and sampling two biased-soil locations around Building 1-31.2e1’s proximal area. One sample will be collected from near the front doorway and one will be collected from beneath the back window. **Figure A.1-33** illustrates the two proposed sample locations which are located nearest to release pathways from the building that contaminants generated or concentrated within could use to exit the building and impact the environment. Also, a geophysical review of the area (lateral geographic boundary is 15 ft beyond the walls of Building 1-31.2e1) will be conducted to encompass and identify all the potentially unidentified buried utility run(s) that may have serviced the building.

Activities to be performed inside the building will include a visual inspection for contamination (staining), monitoring with a PID for organics, and a radiological survey. If there is a PID detection and/or the radiological survey identifies a radiological contamination above FSL, samples will be collected. No inside samples will be collected if there is not indication of contamination. Care will be taken not to disturb items contained within the building.

Initially, the surface soil locations selected proximal to and surrounding Building 1-31.2e1 will be sampled for COPC analysis from the native soil interface, assumed to be 0 to 6 in. Decision II soil sampling is not anticipated since the scope of work for this CAS has been identified as COC.
identification and characterization of soils outside the building only. Decision I data should provide information adequate to support a clean closure corrective action report.

Items within and around Building 1-31.2e1 may require housekeeping removal activities following the investigation, per waste management direction. Miscellaneous debris including wood pieces (and boxes), metal scraps, and objects may be removed as housekeeping items, if required.
Figure A.1-33

CAU 357, CAS 01-99-01, Boxes; Pipes - "Building 1-31.2e1"
A.2.0 References


Center for Land Use Interpretation. 1996. The Nevada Test Site, A Guide to America’s Nuclear Proving Ground. Las Vegas, NV.


DOE, see U.S. Department of Energy.

DRI, see Desert Research Institute.


EPA, see U.S. Environmental Protection Agency.

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


Fenix & Scisson, Inc. 1971b. “Hole History Data for U-10as,” 16 December. Las Vegas, NV.


Fowkes, A., Professional Analysis, Inc. 1999. Record of Telecon with C. Fillmore (SAIC) concerning CAS 25-15-01, 16 August. Las Vegas, NV.


Hunter, R., Bechtel Nevada. 1999. Record of Telecon with C. Fillmore (SAIC) concerning CAS 25-15-01, 12 August. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 1998. Field Forms for CAU 357, CASs 07-09-02, 07-09-03, and 25-15-01 from Site Investigation. Las Vegas, NV.
IT Corporation. 1999. Field Forms for CAU 357, CAS 10-09-04 from August Site Investigation. Las Vegas, NV.

IT Corporation. 2002. Field Activity Daily Log and Field Forms for CAU 357 from January Site Investigation. Las Vegas, NV.


LANL, see Los Alamos National Laboratory.


NAC, see Nevada Administrative Code.

NBMG, see Nevada Bureau of Mines and Geology.

NCRP, see National Council on Radiation Protection and Measurements.


RSN, see Raytheon Services Nevada.

REECo, see Reynolds Electrical & Engineering Co., Inc.

Reynolds Electrical and Engineering Co., Inc. 1991a. *Inventory of Inactive and Abandoned Facilities and Waste Sites Areas 1-4*, Volume 1 of 5, April. Las Vegas, NV.

Reynolds Electrical and Engineering Co., Inc. 1991b. *Inventory of Inactive and Abandoned Facilities and Waste Sites Areas 5-10*, Volume 2 of 5, April. Las Vegas, NV.


Rowe, P., Stone and Webster Incorporated. 2001. Record of Telecon with Beatriz Bordelois (SAIC) concerning mud pits and cellars/sumps, 22 January. Las Vegas, NV.


Wilkes, M., Bechtel Nevada. 2000a. Interview with B. Bailey (IT), B. Bull (SAIC), B. Bordelais (SAIC), K. Wilse (IT), K. Sculthorpe (SAIC-TDY), T. Renninger (SAIC-TDY), and Jerry Prothro (BN) regarding mud pit investigations, 3 November. Las Vegas, NV.

Witt, J.W., SAIC. 2000. Interview with B. Bailey (IT), B. Bull (SAIC), and K. Willse (IT) regarding mud pit investigations, 19 October. Las Vegas, NV.

Appendix B

Project Organization
B.1.0 Project Organization

The NNSA/NVO Industrial Sites Project Manager is Janet Appenzeller-Wing and her telephone number is (702) 295-0461. The identification of the project Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate plan. However, personnel are subject to change and it is suggested that the appropriate DOE Project Manager be contacted for further information. The Task Manager will be identified in the FFACO Biweekly Activity Report prior to the start of field activities.
Appendix C

NDEP Comment Responses
## NEVADA ENVIRONMENTAL RESTORATION PROJECT
### DOCUMENT REVIEW SHEET

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) General</td>
<td></td>
<td>Each CAS in a SAFER Plan is required to have a defined closure scenario(s). This plan does not clearly identify and present the closure alternatives for each CAS. For example, there is no closure alternative presented for CAS 25-15-01 - Waste Dump. Section 3.5 Closure should present a closure alternative(s) for each CAS and what constitutes a satisfactory closure and any decision points. NDEP recognizes that as new information is gathered that variations in the closure activity may be needed to properly address the particular needs of a CAS.</td>
<td>Section 3.5 was rewritten to include specific closure alternatives and decisions for each CAS. Table ES.1-1 and Table 3-2 were updated to include expected closure alternatives.</td>
<td>Yes</td>
</tr>
<tr>
<td>2) General</td>
<td></td>
<td>The SAFER Plan has not provided sufficient information on the locations of the CAS’s. The location maps and/or description should contain enough detail or site coordinates that would allow the site to be found in the field.</td>
<td>Figure 1-1 was revised to better show locations and driving directions were added for each CAS in Section 2.2. Table 2-1 provides UTM coordinates for each CAS.</td>
<td>Yes</td>
</tr>
<tr>
<td>3) General</td>
<td></td>
<td>Historic information on the mud pits, and data from other mud pit closures can be used to establish no further action/closure in place options. However, not all of this information has been brought forward to help to justify and support these types of closures. This information must be presented.</td>
<td>A discussion of the previous investigation results from the mud pit closures was added to Section 2.3.1.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

1. Document Title/Number: Draft Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 357: Mud Pits and Waste Dump, Nevada Test Site, Nevada

2. Document Date: February 2003

3. Revision Number: 0

4. Originator/Organization: Shaw Environmental, Inc.

5. Responsible NNSA/NSO ERP Project Mgr.: Janet Appenzeller-Wing

6. Date Comments Due: March 28, 2003

7. Review Criteria: Full

8. Reviewer/Organization/Phone No.: Clem Goewert, NDEP, 486-2865

9. Reviewer’s Signature:
### NEVADA ENVIRONMENTAL RESTORATION PROJECT
**DOCUMENT REVIEW SHEET**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4) General Page 46, Last Sentence Section 2.4, Page 47</td>
<td></td>
<td>The SAFER Plan does not differentiate between performance action levels (PALs), closure standards, and clean closure. PALs are not necessarily the closure standards. Different closure standards can be used for remedial alternatives, clean closure, closure in place without monitoring, and closure in place with post closure monitoring. The last sentence on page 46 states “Clean Closure will be complete when verification samples of remaining soils show the levels below closure.” Clean closure is reached when the analysis indicates that contamination is no longer present. Clean closure and closure standards are not necessarily the same. Section 2.4 on page 47 is supposed to provide Closure Standards. This section however only focuses on PALs. This section should focus on the Closure Standards that can then be used to determine Corrective Actions. The Data Quality Objectives Process I Appendix needs to be reviewed and revised to establish the Data Quality Objectives for closure standards.</td>
<td>Section 2.4 “Closure Standards” was revised to more clearly define closure standards.</td>
<td>Yes</td>
</tr>
<tr>
<td>5) Figure 2-7 Page 24</td>
<td></td>
<td>On page 24, Figure 2-7 provides a layout of CAS 08-09-01 - Mud pit. The figure indicates that there are 2 drums in the mud pit. However, the site description does not mention these drums. It is NDEP’s understanding that these drums are being addressed under CAU 346. The SAFER Plan must discuss the fact that another CAU is addressing part of this CAU. If there are any other CASs that are being affected by work under work in another CAU, then this must be discussed as well.</td>
<td>A statement indicating the drums will be addressed as part of CAU 346, CAS 08-22-04, was added to Section 3.2.1.1.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### 6) General

A field inspection has indicated that 2 drums are located in the CAS 08-09-01 Mud Pit. Figures, descriptions, and Decision I Activities do not take these drums into account. If these drums are not part of another CAU, they must be discussed in the SAFER Plan. The SAFER Plan must address sampling disposal and any contaminants resulting from these drums. This site DQO's, conceptual site model, and SAFER plan must be reevaluated using these drums as a specific issue.

All other CASs in this CAU should be revised for missing items that are not included in this SAFER Plan.

The CAS 08-09-01 is not part of CAU 357, it is part of CAU 346 (CAS 08-22-04) (see Section 3.2.1.2). Any drums that are part of this CAU will be addressed as a housekeeping issue as part of the CAS closure. All housekeeping activities conducted as part of this SAFER will be documented in the closure report.

---

### 7) Pages 11 and 41

On pages 11 and 41, it states, "Many sumps and cellars of concern have been left unfilled and will require sampling and analysis to determine whether further action is required." The alternatives for further action must be discussed as well as the outcome for these sites.

The reference to sumps and cellars was deleted.

---

### 8) Page 46 1st Paragraph

On page 46, the first paragraph states "...it is uncertain if the dump received any waste generated during the MX Program, whereby radiological COPC’s might include: americium-24,...". This would indicate that the MX project had used radionuclides in the project. It is NDEP’s understanding that the MX project did not use any radionuclides. Other activities in the tunnel did use DU and the disposal of those wastes has been documented. Therefore, the issue of the waste from the MX project and radioactivity should be reviewed for accuracy and clarity.

The reference to radionuclides possibly generated by the MX program was deleted. However, a radiological survey will still be performed at this CAS because of its vicinity to other radiologically contaminated area.

---

### 9) Section 2.3.4 Page 46

On page 46, Section 2.3.4 Process Knowledge - Boxes; Pipes - CAS 01-99-01 discusses information on Building 1:31.2e1. In the DQO kickoff meeting it was noted that the building and its contents may have been or could be listed as a historical site. This listing could impact the disposition and corrective action decisions, yet there is no discussion of the historical significance of this building.

At the DQO meeting, the historical significance of the structure was being reviewed by DOE. The building issue has been resolved and is included in Section 2.1.4 and was added to Section 3.5 Closure.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10) Page 47</td>
<td></td>
<td>On page 47, the document discusses the A-K factors in NAC 459.9973. The A-K factors will be required for closure in place. If any of the CASs have closure in place as a closure alternative, then the SAFER Plan must have sufficient information for the CAS to demonstrate that A-K is an appropriate closure option.</td>
<td>A preliminary evaluation of A-K factors for CASs proposed for closure in place was added. Revised A-K factors will be included in the Closure Report if required.</td>
<td>Yes</td>
</tr>
<tr>
<td>11) Page 53 3rd Paragraph</td>
<td></td>
<td>In the 3rd paragraph on page 53, it is stated “The mud spill at CAS 10-09-04 may be sampled during the Decision I activities.” In Appendix A, Figure A.1-28 indicates that a biased sampling location in the spill has already been selected. A sampling decision for this location must be more clearly defined.</td>
<td>The text was changed to state that the spill will be sampled as part of the Decision I sampling activities.</td>
<td>Yes</td>
</tr>
<tr>
<td>12) Section 3.5 Page 61</td>
<td></td>
<td>Section 3.5 Closure on page 61 should fully describe closure plans and the decisions. Currently, this section only provides some limited logic points. The corrective action decision and options for each CAS must be discussed and presented in this section.</td>
<td>The specific proposed closure for each CAS was added to Section 3.5. Table ES.1-1 and Table 3-2 were updated to include expected closure alternatives.</td>
<td>Yes</td>
</tr>
<tr>
<td>13) Page 68 Last Paragraph</td>
<td></td>
<td>The last paragraph on the bottom of page 68 refers to the “current NNSA/NSO Fluid Management Plans for the NTS”. The next 2 paragraphs, which are on the top of page 69, discuss the disposal of rinsate and the disposal standards. The document is not listed in Section 7.0 References, nor is NDEP aware of its existence. If the document exists, then it must be submitted for NDEP approval. Otherwise, approval disposal methods and standards must be cited.</td>
<td>The NNSA/NSO Fluid Management Plan is an NDEP approved plan for the UGTA project. The plan was added to the references.</td>
<td>Yes</td>
</tr>
<tr>
<td>14) Figure A.1-21</td>
<td></td>
<td>Figure A.1-21 CAU 357, CAS 07-09-03. Mud Pit indicates that sampling will be conducted at only 2 locations in Area A, and on only 1 location in Area B. Area A is approximately 500 feet in length. As pointed out by NDEP in the DQO kickoff meeting, 2 sampling locations in an area of this size is not adequate. Additional random samples will be required. An approach to determine the appropriate numbers must be developed and presented. In addition, one sample from Area B is not acceptable.</td>
<td>Additional sample locations were added based on the COPCs.</td>
<td>Yes</td>
</tr>
<tr>
<td>15) Page 47 and Figure A.1-17</td>
<td></td>
<td>Page 47 and Figure A.1-17 Typical Mud Pit Cross Section Illustrating Idealized Sampling Locations indicate that the mud pit sampling will assume vertical relationships in the sampling. However the issue of vertical sampling is not discussed beyond this section, or where sampling strategies are discussed and presented.</td>
<td>The justification for sample locations and depths was added to Section A.1.8.1.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>16) Section 3.2.1.3</td>
<td></td>
<td>Section 3.2.1.3 Decision I Activities - Lead Bricks CAS 04-26-03 discusses the proposed activities for the removal of the lead bricks. The SAFER Plan, however, does not address the disposition of the lead bricks, and how the bricks will be managed after picking them up. If they become a waste, they will need to be addressed in Section 5.0 Waste Management.</td>
<td>The disposal of the lead bricks was added to Section 5.2.2, Management of Debris.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Comment Types: M = Mandatory, S = Suggested.
Return Document Review Sheets to NNSA/NSO Environmental Restoration Division, Attn: QAC, M/S 505.
Distribution

*Provide copy in distribution of Revision 0 and subsequent revisions, if applicable. Copies of only the NDEP-approved document will be distributed to others.

Copies

Paul J. Liebendorfer 1 (Controlled)*
State of Nevada
Bureau of Federal Facilities
Division of Environmental Protection
333 W. Nye Lane, Room 138
Carson City, NV 89706-0851

Donald R. Elle, Las Vegas Office 1 (Controlled)*
State of Nevada
Bureau of Federal Facilities
Division of Environmental Protection
1771 E. Flamingo Rd., Suite 121-A
Las Vegas, NV 89119

Sabrina Lawrence 1 (Controlled)*
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Environmental Restoration Division
P.O. Box 98518, M/S 505
Las Vegas, NV 89193-8518

Janet Appenzeller-Wing 1 (Uncontrolled)*
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Environmental Restoration Division
P.O. Box 98518, M/S 505
Las Vegas, NV 89193-8518
Sabine Curtis 1 (Uncontrolled)*
U.S. Department of Energy
National Nuclear Security Administration
    Nevada Site Office
Environmental Restoration Division
P.O. Box 98518, M/S 505
Las Vegas, NV 89193-8518

Jeff Smith 1 (Uncontrolled)*
Bechtel Nevada
P.O. Box 98521, M/S NTS306
Las Vegas, NV 89193-8521

Glenn Richardson 1 (Uncontrolled)*
Bechtel Nevada
P.O. Box 98521, M/S NTS306
Las Vegas, NV 89193-8521

Lowell Wille 1 (Controlled)*
Shaw Environmental, Inc.
P.O. Box 93838
Las Vegas, NV 89193

Pete Ferron 1 (Controlled)*
Shaw Environmental, Inc.
P.O. Box 93838
Las Vegas, NV 89193

Philip Claire 2 (Uncontrolled)
Community Advisory Board
6252 Santander Avenue
Las Vegas, NV 89103

Shaw Environmental, Inc. 1 (Uncontrolled)*
Central Files
P.O. Box 93838
Las Vegas, NV 89193

FFACO Support Office 1 (Controlled)
Shaw Environmental, Inc.
P.O. Box 93838
Las Vegas, NV 89193
Nevada Testing Archive
755 East Flamingo Road
Las Vegas, NV 89119

Manager, Northern Nevada FFACO
Public Reading Facility
c/o Nevada State Library & Archives
Carson City, NV 89701-4285

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Technical Library
P.O. Box 98518, M/S 505
Las Vegas, NV 89193-8518

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062