RECORD OF TECHNICAL CHANGE

Technical Change No. 01

Project/Job No. CAU 214: Bunkers and Storage Areas / ISO4-123 Date: 02/23/04

Project/Job Name CAU 214 CAI / YMP Supplemental Sampling

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

Name(s): Robert F. Boehlecke, Task Manager, Industrial Sites
Brian C. Hoenes, Project Manager, Industrial Sites

Description of Change:

1. The conceptual site model (CSM) for *Materials and Equipment Storage Yards* (CAS 25-23-01, *Contaminated Materials*, and, CAS 25-23-19, *Radioactive Material Storage*) will be expanded to include possible TPH (DRO) contamination from the spraying of hydrocarbons for dust suppression in the CAS 25-23-01 and CAS 25-23-19 yards.

2. The lateral boundary for CAS 25-23-01 will be extended to include additional areas for the purpose of defining the lateral extent of TPH (DRO) contamination. Also, an investigation will be conducted within the lateral extent of the TPH (DRO) contaminated area for the purpose of making proper recommendations for closure of these contaminated areas.

Note: For FFACO tracking purposes, the additional lateral extent has been attached to CAS 25-23-01. The new area will be investigated along with CASs 25-23-01 and 25-23-19 as one site.

Justification for Change:

During the initial investigation of CASs 25-23-01 and 25-23-19, widespread TPH (DRO) contamination was identified throughout the surface soils of the yard. Based on observations, site knowledge, and analytical results, the TPH (DRO) contamination is most likely the result of dust control measures implemented in the yard sometime in the past. The application of hydrocarbons applied for dust control was not identified in the original CSM as a potential source of contamination. Attempts to define the lateral extent of the contamination to the east were not successful and it appears the yard directly east of CASs 25-23-01 and 25-23-19, (the Yucca Mountain Project-Sample Management Facility [YMP-SMF] yard), was also treated with hydrocarbons for dust control and/or as a base for asphalt.

The extent of contamination needs to be defined in order to establish recommendations for the closure of CASs 25-23-01 and 25-23-19. To achieve this, additional sampling will be conducted within the YMP-SMF yard and around its perimeter. Although portions of the YMP-SMF yard are currently active and being used by the YMP, the YMP has communicated to NNSA/NSO their intention to vacate the yard prior to the FFACO deadline for the CAU 214 CADD.

The focus of the investigation within the YMP-SMF yard is to define the extent of the potential TPH (DRO) contamination. However, the investigation will also account for the additional sources of contamination within the YMP-SMF yard. An investigation of the past and present uses of the yard has been conducted. Findings from this investigation are accounted for in the sampling plan and are detailed below.

Specific Changes:

The following sections, tables and figures in the CAU 214 CAIP have been modified to reflect these changes.

MAIN DOCUMENT of CAU 214 CAIP

Section 2.2: *Operational History*

Add the following paragraph at the end of the section:

An additional site visit was made to the yard located to the east of CASs 25-23-01 and 25-23-19 on February 18, 2004 to observe and describe existing conditions in this yard. This yard was not included in the original description of CAS 25-23-01 but is now included because TPH contamination is known to be contiguous between these two yards. The yard is currently used by the Yucca Mountain Project-Sample Management Facility (YMP-SMF) for storage and will be referred to as the YMP-SMF yard. This field trip included representatives from NNSA/NSO and NNSA/NSO contractors. Notes from this site visit have been added to the CAS history for CASs 25-23-01 and 25-23-19 to support additional PA findings provided for the YMP-SMF yard.

Section 2.2.4: CAS 25-23-01 and CAS 25-23-19 and Adjacent YMP-SMF

Add the following paragraphs at the end of the section:

The YMP-SMF storage yard was historically used by the following agencies and programs: Boeing Corporation, MX Project, NRDS Program, United States Geological Survey (USGS); YMP, and REECo. In 1988, the YMP began using the yard for storage. Prior to 1988, the USGS used the yard for storage. Prior to the USGS using the yard, various entities and programs mentioned above used the yards for storage (Hoenes, 2004). The YMP continues to occupy the majority of the yard (i.e., except an approximate 50 by 50 ft fenced area in the northwest corner of the yard) including the southwest corner which has been segregated by a fence for use as the Project Accumulation Area (PAA) for hazardous waste. The PAA has been in operation at this location since approximately 1992 (Hoenes, 2004). Based on interviews with the operators of the PAA and the YMP-SMF yard, no known contamination to the soil in the YMP-SMF have been attributable to YMP operations. The only recorded spill in the yard was hydraulic, and possibly other fluids from a large vehicle used during the MX program (Hoenes, 2004; Lewis, 2004). The spill included various leaks from the equipment while it was stored in the yard for several years prior to its removal from the yard (circa 1991). Based on interviews and other sources, it appears all contaminated soil associated with this spill was removed from the yard and the excavation backfilled with clean fill (Hoenes, 2004; Lewis, 2004). Additional information in this release is provided below in Section 2.4.4.

Access to specific areas of the YMP-SMF yard may be limited due to the presence of stored materials. Although the overwhelming majority of the yard is open (i.e., not currently used for storage of equipment), performance of a radiological survey and collection of soil samples may be limited to accessible portions of the YMP-SMF yard.

Section 2.3: *Waste Inventory*

<u>Section 2.3.4</u>: *CAS 25-23-01 and CAS 25-23-19 and Adjacent YMP-SMF*

<u>Add the following paragraph at the end of the section</u>:

Waste items identified at the YMP-SMF yard include small equipment and concrete structures associated with the MX program, and construction debris including wood and various metal scrap. Equipment and materials (including the waste and buildings within the PAA), are scheduled to be removed from the yard by June 15, 2004. The YMP PAA will be emptied of all hazardous waste and closure of the facility will be documented by the YMP in accordance with the appropriate regulations (Hoenes, 2004).

Section 2.4: *Release Information*

<u>Section 2.4.4</u>: *CAS 25-23-01 and CAS 25-23-19 and Adjacent YMP-SMF*

<u>Add the following paragraphs at the end of the section:</u>

At the adjoining YMP-SMF yard, a hydraulic leak from a Boeing-owned vehicle (i.e., a Scheuerble MTK missile transporter) was discovered in June of 1988 (Haworth, 1989a). This vehicle was located west of Building 4320 (see attached Figure A.1-18a). The leak introduced an estimated 1,500 gallons of hydraulic fluid into the ground beneath the vehicle.

Documentation of the spill event indicates sampling was performed on the same day the hydraulic oil spill was discovered. Samples of the hydraulic oil itself were taken as well as samples of the impacted soil. Concentrations of contamination were not high enough to classify the soil for disposal as hazardous waste (Haworth, 1990). In May of 1989, cleanup of the spill was ordered and documented with REECo to perform the work (Stewart, 1989). By December 1990, documentation indicates that all fluids leaking from this vehicle had been sampled and characterized as non-hazardous and non-PCB. Measures were taken at this time to help prevent further ground contamination (i.e., placement of the vehicle on plastic sheeting, regular inspection, and placement of absorbent material under leaks. Ultimately, this vehicle was sold and removed from the yard in circa 1991 (Hoenes, 2004

During the site visit on February 18, 2004, two areas of soil staining were noted in the YMP-SMF yard. These areas include one small black stain (center is approximately 2 ft in diameter) and one slightly larger gray stained area of unknown origin (center is clear, approximately 2 ft in diameter and appears to be a hardened cement mixture). The origin of the black stain was later confirmed by YMP-SMF personnel to be soot and rust removed from the furnace inside the building that was placed on the ground outside the building. The material will be removed and disposed of by the YMP. In addition to the stained areas, an approximate 20 by 20 ft area was identified where fluorescent tubes (including some broken tubes) were historically accumulated. Small pieces of broken glass are still visible at this location. The area where the hydraulic oil spill occurred from the MX Program vehicle was also identified during the February 2004 site visit (Hoenes, 2004).

Section 2.5: *Investigative Background*

Section 2.5.2: *CAS 25-23-01 and CAS 25-23-19 and Aadjacent YMP-SMF*

Add the following paragraphs at end of section:

At the YMP-SMF, samples were collected in June, September, and November of 1988, and May of 1989. It was concluded that the soil contaminated with fluids from the MX Program vehicle was not hazardous waste nor contaminated with PCBs (Haworth, 1989b). No documentation was identified for verification samples (i.e., sample results to confirm the hydraulic contaminated soil was removed). No samples results are available for the gray-stained area or the fluorescent tube accumulation area.

Based on laboratory analytical results from the initial investigation of CAU 214 CASs 25-23-01 and 25-23-19, low-level TPH (DRO) contamination was identified in the surface soils of these CASs. Samples collected at deeper intervals indicate that the widespread TPH-DRO contamination is limited to the surface soils. Observations, sample analytical results, and historical site knowledge indicate the TPH (DRO) contamination at CASs 25-23-01 and 25-23-19 is most likely the result of the application of hydrocarbons for dust suppression. Step-out sampling conducted in the YMP-SMF yard indicate the lateral extent of the TPH (DRO) contamination includes all or portions of the YMP-SMF yard. Observations and sample results from within the YMP-SMF yard indicate the source of the TPH (DRO) contamination in this yard is likely to be from hydrocarbon application for dust suppression. Results from five step-out sample locations indicate that TPH (DRO) contamination is present in the top three inches of soil throughout the majority of the YMP-SMF yard. No TPH (DRO) was identified above PALs in samples collected below the top six inches of soil.

Table 3-2: *Suspect Contaminants and Critical Analyses for CAU 214*

Add mercury and lead to the list of suspected contaminants and critical analyses for CASs 25-23-01 and 25-23-19.

Note: Mercury and lead are being added to Table 3-2 to account for potential contamination associated with the accumulation of fluorescent tubes in the YMP-SMF yard.

Section 4.2: *Field Activities*

Add following paragraphs to the end of Section 4.2:

During the initial investigation of CASs 25-23-01 and 25-23-19, low-level TPH (DRO) contamination was found (i.e., from non-detect to approximately 300 mg/kg) to be widespread in the surface soil (0 to 3 in. bgs). Samples collected at deeper intervals indicate that the widespread TPH (DRO) contamination is limited to the surface soils. Observations, sample analytical results, and historical site knowledge indicate the TPH (DRO) contamination at CASs 25-23-01 and 25-23-19 is most likely the result of the application of hydrocarbons for dust suppression. Several locations were sampled within the YMP-SMF yard in an attempt to differentiate between the sources of hydrocarbon contamination on either side of the fence. Based on the reported analytical results, no conclusions could be drawn on the similarity and/or difference of the source materials or application processes. Therefore, additional investigations including soil sampling will be conducted within the YMP-SMF yard to define the lateral extent of the TPH (DRO) contamination. It is generally assumed that the surface TPH (DRO) contamination is present throughout the majority of the YMP-SMF yard. Therefore, additional investigations will focus on the perimeter of the yard. As part of this investigation, the following actions will be taken:

- The lateral extent of TPH (DRO) contamination will be defined in the YMP-SMF yard (see Figure A.1-18a). However, sampling will not be conducted from the western edges of Buildings 4221 and 4320 (i.e., the YMP-SMF building and the YMP-SMF warehouse) to the north, south and east of these buildings all the way to the bordering streets (D Street, C Street and 2nd Street, respectively). This area is considered active and is, therefore, not under the purview of the FFACO. Sample locations will include a minimum of four locations along the eastern side of the yard, an additional two locations within the yard (to supplement the five locations already sampled), and a minimum of four locations outside the fence on the north and south sides of the yard. These samples will be sent to the laboratory for TPH (DRO) analysis.

- A visual survey will be conducted of the entire YMP-SMF yard including the two segregated fenced areas. The survey will be conducted by walking transects at a minimum of every 40 ft and recording observations including stained areas or areas of suspect contamination. Sample collection depths and analyses for stained or suspect contamination areas not identified below will be determined in the field.

- A radiological walkover survey will be conducted of the entire yard. A minimum of one soil sample will be collected from any area, hotspot, or group of hotspots, with a localized gamma emission rate statistically exceeding background as determined by the post-processed contour plot of the radiological data.

- A minimum of three locations within the estimated area of the historical hydraulic fluid spill will be sampled to a minimum depth of 6 ft bgs to confirm all the contaminated soil was removed. Samples will be analyzed for TPH (DRO).

- A minimum of two locations within the estimated area where fluorescent tubes were historically accumulated will be sampled. Samples will be collected from the surface soil (0 to 6 in. bgs) and at one deeper interval (approximately 1 ft bgs). Samples will be analyzed for mercury and lead. Step-out sampling will be conducted as necessary.

- A minimum of one location within the gray-stained area will be sampled. Samples will be collected from the surface soil (0 to 6 in. bgs) and at one deeper interval (approximately 1 ft bgs). Samples will be analyzed for total VOCs, total SVOCs, TPH (DRO), RCRA metals, beryllium, PCBs, and gamma spectroscopy. Step-out sampling will be conducted as necessary.

Section 8.0: *References*

Add the following references:

Haworth, O.L., Reynolds Electrical & Engineering Co., Inc. 1989a. Letter to S. A. Mellington (DOE NV) entitled, "Oil Spill Area 25, Building 4221". 27 January. Las Vegas, NV.

Haworth, O.L., Reynolds Electrical & Engineering Co., Inc. 1989b. Memo to C. G. Lawson (REECo) entitled, "Disposal of Soil Contaminated with Hydraulic Fluid, Area 25". 28 August. Las Vegas, NV.

Haworth, O.L., et. al., Reynolds Electrical & Engineering Co., Inc. 1990. Internal Memo entitled, "Leaking Scheuerble Missile Transporter, Area 25". 13 December. Las Vegas, NV.

Hoenes, B.C., Stoller-Navarro Joint Venture. 2004. Letter to S.T. Curtis (NNSA/NSO) entitled, "Meeting Notes from February 18, 2002 Meeting with Yucca Mountain Project (YMP) personnel Regarding the Continuation of Corrective Action Unit (CAU) 214 Investigative Activities into the Storage Yard Behind the YMP-Sample Management Facility (SMF)". 23 February. Las Vegas, NV.

Lewis, C., Bechtel/SAIC LLC. 2004. Record of Telecon with B. Iverson (Stoller-Navarro) regarding Area 25, YMP Storage Yard, Building 4221. 3 February. Las Vegas, NV.

Stewart, J. D., US Department of Energy, Nevada Test Site Office. 1989. Letter to D.N. McNelis (REECo) entitled, "Oil Spill Area 25, Building 4221". 19 May. Las Vegas, NV.

APPENDIX A.1 of CAIP (DQO Process for CAU 214)

Section A.1.1.4: *CAS 25-23-01 and CAS 25-23-19 and Adjacent YMP-SMF*

Physical Setting and Operational History-

Add following paragraph to end of section:

The yard to the east of the CASs 25-23-19 and 25-23-01 will be investigated to define the lateral extent of contamination. This yard is referred to as the YMP-SMF yard. The operational history of this site includes by the following agencies and programs: Boeing Corporation, MX Project, NRDS Program, USGS, YMP, and REECo. The yard is currently used by the YMP-SMF for storage. The southwest corner of the yard has been segregated and fenced off for use as the YMP-PAA for hazardous waste. Based on available information, it has been determined that the northwest corner of the yard has been segregated and fenced off since the construction of the yard. Specific uses for this corner of the yard have not been identified. Currently, various scrap materials and equipment are stored in this corner of the yard along the outside fence line. The YMP has initiated plans to remove all materials and equipment from the yard and turn the real estate over to the M&O contractor for the NTS. However, the YMP-SMF will maintain an active presence in Buildings 4320 and 4221 which border on the eastern side of the yard, and in the asphalt paved and concreted areas on the north, south, and east sides of these buildings.

Sources of Potential Contamination –

Add following paragraph to the end of the section:

Sources of potential contamination in the YMP-SMF yard are limited. Based on data collected during the initial investigation of CASs 25-23-01 and 25-23-19 hydrocarbons were apparently used within the YMP-SMF yard for dust control and/or as a base for asphalt. Intact and/or deteriorating asphalt is present in portions of the YMP-SMF yard. Additionally, it is known that a hydraulic fluid spill occurred in the yard. Additional sources of contamination would be from stored materials and/or equipment.

Previous Investigation Results –

Add the following paragraphs to the end of the section:

At the adjoining YMP-SMF yard, a hydraulic leak from a Boeing-owned vehicle (i.e., a Scheuerble MTK missile transporter) was discovered in June of 1988 (Lewis, 2004). This vehicle was located behind building 4221 (see attached Figure A.1-18a). The leak introduced an estimated 1,500 gallons of hydraulic fluid into the ground beneath the vehicle.

Documentation indicates sampling was performed on the same day the hydraulic oil spill was discovered. Samples of the hydraulic oil itself were taken as well samples of the impacted soil. Concentrations of contamination were not high enough to classify the soil for disposal as hazardous waste (Haworth, 1990). In May of 1989, cleanup of the spill was ordered and documented with REECo to perform the work (Stewart, 1989). By December 1990, documentation indicates that all fluids leaking from this vehicle had been sampled and characterized as non-hazardous and non-PCB. Measures were taken at this time to help prevent in further ground contamination (i.e., placement of the vehicle on plastic sheeting, regular inspection and placement of absorbent material under leaks) (Haworth, 1990). Ultimately, the vehicle was sold and removed from the yard, circa 1991 (Hoenes, 2004).

During the site visit on February 18, 2004, two areas of soil staining were noted in the YMP-SMF yard. These areas include one small black stain (center is approximately 2 ft in diameter) and one slightly larger gray stained area of unknown origin (center is clear, approximately 2 ft in diameter and appears to be a hardened cement mixture). The origin of the black stain was later confirmed by YMP-SMF personnel to be soot and rust removed from the furnace inside the building that was placed on the ground outside the building. The material will be removed and disposed of by the YMP. In addition to the stained areas, an approximate 20 by 20 ft area was identified where fluorescent tubes (including some broken tubes) were historically accumulated. Small pieces of broken glass are still visible at this location. The area where the hydraulic oil spill occurred from the MX Program vehicle was also identified during the February 2004 site visit (Hoenes, 2004).

Contaminants of Potential Concern –

Add the following paragraph to the end of the section:

Critical COPCs were identified for the YMP-SMF portion of the investigation and include TPH (DRO), mercury and lead. The sample locations were chosen to define the lateral extent of the surface contamination, confirm the contaminated soil from hydraulic fluid release has been removed, and to determine if mercury and/or lead is present in the soil where the fluorescent tubes were accumulated. The non-critical COPCs for the YMP-SMF portion of the investigation include total VOCs, total SVOCs, RCRA metals, beryllium, PCBs, and gamma emitting radionuclides.

Table A.1-10: *Spatial Boundaries of CAU 214 CASs*

Revise the spatial boundaries of the CASs 25-23-01 and 25-23-19 to read:

The fence line of the yard with a lateral buffer zone to include the whole block of land that is bordered by D Street to the north, C Street to the south, 3rd Street to the west, and Buildings 4221 and 4320 to the east (see Figure A.1-18a).

Section A.1.8.4: *CAS 25-23-01, Contaminated Materials and CAS 25-23-19, Radioactive Materials Storage*

Add the following paragraphs at the end of the section:

During the initial investigation of CASs 25-23-01 and 25-23-19, low-level TPH (DRO) contamination was found (i.e., from non-detect to approximately 300 mg/kg) to be widespread in the surface soil (0 to 3 in. bgs). Samples collected at deeper intervals indicate that the widespread TPH (DRO) contamination is limited to the surface soils.

Observations, sample analytical results, and historical site knowledge indicate the TPH (DRO) contamination at CASs 25-23-01 and 25-23-19 is most likely the result of the application of hydrocarbons for dust suppression. Several locations were sampled within the YMP-SMF yard in an attempt to differentiate between the sources of hydrocarbon contamination on either side of the fence. Based on the reported analytical results, no conclusions could be drawn on the similarity and/or difference of the source materials or application processes. Therefore, additional investigations including soil sampling, will be conducted within the YMP-SMF yard to define the lateral extent of the TPH (DRO) contamination. It is generally assumed that the surface TPH (DRO) contamination is present throughout the majority of the YMP-SMF yard. Therefore, additional investigations will focus on the perimeter of the yard. As part of this investigation, the following actions will be taken:

- The lateral extent of TPH (DRO) contamination will be defined in the YMP-SMF yard (see Figure A.1-18a). However, sampling will not be conducted from the western edges of Buildings 4221 and 4320 (i.e., the YMP-SMF building and the YMP-SMF warehouse) to the north, south and east of these buildings all the way to the bordering streets (D Street, C Street and 2nd Street, respectively). This area is considered active and is, therefore, not under the purview of the FFACO. Sample locations will include a minimum of four locations along the eastern side of the yard, an additional two locations within the yard (to supplement the five locations already sampled), and a minimum of four locations outside the fence on the north and south sides of the yard. These samples will be sent to the laboratory for TPH (DRO) analysis.

- A visual survey will be conducted of the entire YMP-SMF yard including the two segregated fenced areas. The survey will be conducted by walking transects at a minimum of every 40 ft and recording observations including stained areas or areas of suspect contamination. Sample collection depths and analyses for stained or suspect contamination areas not identified below will be determined in the field.

- A radiological walkover survey will be conducted of the entire yard. A minimum of one soil sample will be collected from any area, hotspot, or group of hotspots, with a localized gamma emission rate statistically exceeding background as determined by the post-processed contour plot of the radiological data.

- A minimum of three locations within the estimated area of the historical hydraulic fluid spill will be sampled to a minimum depth of 6 ft bgs to confirm all the contaminated soil was removed. Samples will be analyzed for TPH (DRO).

- A minimum of two locations within the estimated area where fluorescent tubes were historically accumulated will be sampled. Samples will be collected from the surface soil (0 to 6 in. bgs) and at one deeper interval (approximately 1 ft bgs). Samples will be analyzed for mercury and lead. Step-out sampling will be conducted as necessary.

- A minimum of one location within the gray-stained area will be sampled. Samples will be collected from the surface soi(0 to 6 in. bgs) and at one deeper interval (approximately 1 ft bgs). Samples will be analyzed for total VOCs, total

SVOCs, TPH (DRO), RCRA metals, beryllium, PCBs, and gamma spectroscopy. Step-out sampling will be conducted as necessary.

Section A.1.9: *References*

Add the following references:

Haworth, O.L., Reynolds Electrical & Engineering Co., Inc. 1989a. Letter to S. A. Mellington (DOE NV) entitled, "Oil Spill Area 25, Building 4221". 27 January. Las Vegas, NV.

Haworth, O.L., Reynolds Electrical & Engineering Co., Inc. 1989b. Memo to C. G. Lawson (REECo) entitled, "Disposal of Soil Contaminated with Hydraulic Fluid, Area 25". 28 August. Las Vegas, NV.

Haworth, O.L., et. al., Reynolds Electrical & Engineering Co., Inc. 1990. Internal Memo entitled, "Leaking Scheuerble Missile Transporter, Area 25". 13 December. Las Vegas, NV.

Hoenes, B.C., Stoller-Navarro Joint Venture. 2004. Letter to S.T. Curtis (NNSA/NSO) entitled, "Meeting Notes from February 18, 2002 Meeting with Yucca Mountain Project (YMP) personnel Regarding the Continuation of Corrective Action Unit (CAU) 214 Investigative Activities into the Storage Yard Behind the YMP-Sample Management Facility (SMF)". 23 February. Las Vegas, NV.

Lewis, C., Bechtel/SAIC LLC. 2004. Record of Telecon with B. Iverson (Stoller-Navarro) regarding Area 25, YMP Storage Yard, Building 4221. 3 February. Las Vegas, NV.

Stewart, J. D., US Department of Energy, Nevada Test Site Office. 1989. Letter to D.N. McNelis (REECo) entitled, "Oil Spill Area 25, Building 4221". 19 May. Las Vegas, NV.

The project time will be **Unchanged**

Applicable Project-Specific Document(s): CAU 214 CAIP

CC:

Approved By: Sabine Curtis Date 2/24/04
Sabine T. Curtis, Acting Project Manager
Industrial Sites Project

Janet Appenzeller-Wing Date 3/2/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence Yes X No___ Date 3/2/04

NDEP Signature ______

Contract Change Order Required Yes___ No___

Contract Change Order No. ______

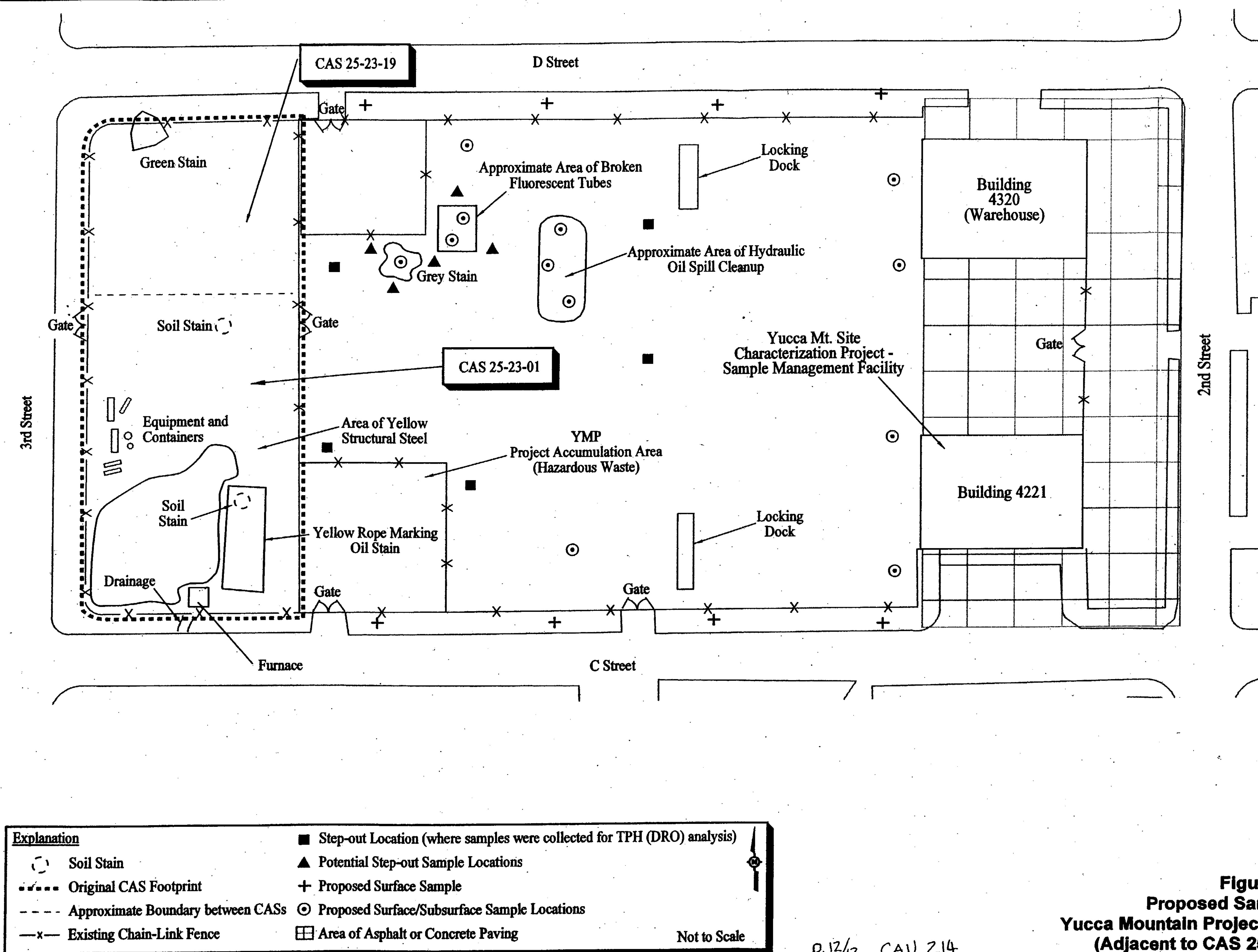


Figure A.1-18(a)
Proposed Sampling Locations at
Yucca Mountain Project Sample Management Facility
(Adjacent to CAS 25-23-01 and CAS 25-23-19)

p. 12/12 CAU 214 CAIP-ROTC#1

PROJECT NUMBER IS04.123

CHECKED BY

APPROVED BY

h:\214\CAIP\214caip252301_b.dgn

23-FEB-2004

RECORD OF TECHNICAL CHANGE

Technical Change No. 02 Page 1 of 3

Project/Job No. Industrial Sites/ IS04 - 110 Date: 3/10/04

Project/Job Name Corrective Action Investigation Plan for CAU 214: Bunkers and Storage Areas

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

Robert F. Boehlecke	Task Manager
(Name)	(Title)

Description of Change

1. **Section 3.3 Preliminary Action Levels**. Replace the 4th bullet in the section with 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). The PALs for the CAU 214 Corrective Action Investigation (CAI) are listed in Table 3-5."

- Replace existing Table 3-5 with the new Table 3-5 attached.

2. **Section A.1.4.2 Determine the Basis for the Preliminary Action Levels**. Replace the 5th and 6th bullet with 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). The PALs for the CAU 214 CAI are listed in Table 3-5."

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

3. **Sections 8.0 and A.1.9 References**. Add the following references:

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

- US Department of Energy (DOE). 1993. "Radiation Protection of the Public and the Environment". DOE Order 5400.5 Change 2. January 7, 1993.

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 the 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 CAU 214 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 **Unchanged**

Applicable Project-Specific Document(s):	**Corrective Action Investigation Plan for Corrective Action Unit 214: Bunkers and Storage Areas Nevada Test Site, Nevada Rev. 0, May 2003**

CC:

Approved By: Kevin Cabble Date 3-14-04
Kevin Cabble, Acting Project Manager
Industrial Sites Project

Janet Appenzeller-Wing Date 3/15/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence Yes___ No___ Date ____________

NDEP Signature ____________

Contract Change Order Required Yes___ No ____

Contract Change Order No. ____________

The project time will be Unchanged

Applicable Project-Specific Document(s): Corrective Action Investigation Plan for Corrective Action Unit 214: Bunkers and Storage Areas Nevada Test Site, Nevada Rev. 0, May 2003

CC:

Approved By: Kevin Cabble Date 3-14-04
Kevin Cabble, Acting Project Manager
Industrial Sites Project

Date 3/15/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence Yes X No ___ Date 3/19/04
NDEP Signature ___
Contract Change Order Required Yes ___ No ___
Contract Change Order No. ___

Table 3-5
Preliminary Action Levels for Radionuclides in Samples Collected at CAU 214

Radionuclide	PAL (pCi/g)[a]
Cobalt-60	1.61E+00
Strontium-90	5.03E+02
Nobium-94	2.43E+00
Cesium-137	7.30E+00
Europium-152	3.40E+00
Europium-154	3.24E+00
Europium-155	8.11E+01
Thorium-230[b]	5/15[d]
Thorium-232[c]	5/15[d]
Uranium-234	8.59E+01
Uranium-235	1.05E+01
Uranium-238	6.32E+01
Plutonium-238	7.78E+00
Plutonium-239	7.62E+00
Plutonium-240	7.62E+00
Americium-241	7.62E+00

[a] pCi/g is Picocuries per gram.

[b] Thorium-230 and it's daughters Radium-226, Radon-222, Polonium-218, Lead-214, Bismuth-214, Polonium-214, Lead-210, Bismuth-210 and Polonium-210 are considered to be in equilibrium and will use the DOE 5400.5 general guidance of 5 and 15 pCi/g for the PALs (DOE, 1993).

[c] Thorium-232 and it's daughters Radium-228, Actinium-228, Thorium-228, Radium-224, Radon-220, Polonium-216, Lead-212, Bismuth-212, Polonium-212, and Thallium-208 are considered to be in equilibrium and will use the DOE 5400.5 general guidance of 5 and 15 pCi/g for the PALs.

[d] The 5/15 pCi/g represents PALs for these radionuclides in the surface soil (0-0.5 ft depth) and the subsurface soil (>0.5 ft depth), respectively (DOE, 1993).

Nevada Environmental Restoration Project

DOE/NV--893

National Nuclear Security Administration

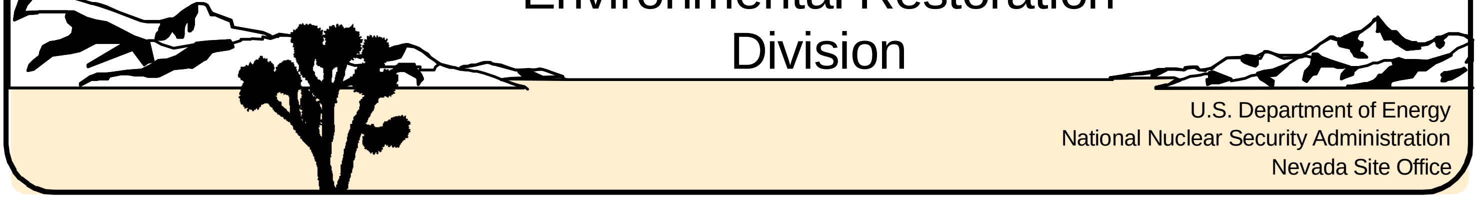
Corrective Action Investigation Plan for Corrective Action Unit 214: Bunkers and Storage Areas Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

May 2003

Approved for public release; further dissemination unlimited.

Environmental Restoration Division



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

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

DOE/NV--893

CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 214: BUNKERS AND STORAGE AREAS 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

May 2003

**CORRECTIVE ACTION INVESTIGATION PLAN FOR
CORRECTIVE ACTION UNIT 214: BUNKERS AND STORAGE AREAS
NEVADA TEST SITE, NEVADA**

Approved by: Signature Approved Date: 5/7/03

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: Signature Approved Date: 5-7-03

Runore C. Wycoff, Division Director
Environmental Restoration Division

Table of Contents

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents (Continued)

List of Figures

List of Figures (Continued)

Number ***Title*** ***Page***

List of Tables

List of Tables (Continued)

Number	Title	Page

List of Acronyms and Abbreviations

%R	Percent recovery
bgs	Below ground surface
BN	Bechtel Nevada
BREN	Bare Reactor Experiment Nevada
CADD	Corrective Action Decision Document
CAI	Corrective Action Investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CERCLA	*Comprehensive Environmental Resource Conservation and Liability Act*
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Contaminant of concern
COPC	Contaminant of potential concern
CRQL	Contract Required Quantitation Limit
CSM	Conceptual site model
CWD	Contaminated Waste Dump
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
DR/GR	Drive/gear
DRI	Desert Research Institute

Acronyms and Abbreviations *(Continued)*

DRO	Diesel-range organics
EPA	U.S. Environmental Protection Agency
ERDA	U.S. Energy Research and Development Administration
ETS-1	Engine Test Stand 1
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
ft	Foot (feet)
GRO	Gasoline-range organics
HASP	Health and Safety Plan
IDW	Investigation-derived waste
in.	Inch(es)
IRIS	Integrated Risk Information System
ISMS	Integrated Safety Management System
ITLV	IT Corporation, Las Vegas Office
LCS	Laboratory control sample
m	Meter
MDC	Minimum detectable concentration
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
mi	Mile
mrem/yr	Millirem per year
MS	Matrix spike
MSD	Matrix spike duplicate
msl	Mean sea level

Acronyms and Abbreviations *(Continued)*

MX	Missile experiment
NAC	*Nevada Administrative Code*
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NEPA	*National Environmental Policy Act*
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NRS	*Nevada Revised Statutes*
NTS	Nevada Test Site
NTSWAC	Nevada Test Site Waste Acceptance Criteria
PAL	Preliminary action level
PCB	Polychlorinated biphenyls
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
POC	Performance Objective for the Certification of Nonradioactive Hazardous Waste
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RadCon	Radiological control
RCRA	*Resource Conservation and Recovery Act*
RMA	Radioactive materials area

Acronyms and Abbreviations *(Continued)*

RMSF	Radiological Material Storage Facility
RPD	Relative percent difference
SD	Standard deviation
SDG	Sample delivery group
SDWS	*Safe Drinking Water Standards*
SSHASP	Site-specific health and safety plan
SVOC	Semivolatile organic compounds
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbon
TSCA	*Toxic Substance Control Act*
USGS	U.S. Geological Survey
UST	Underground storage tank
µg/L	Micrograms per liter
µg/kg	Micrograms per kilograms
VOC	Volatile organic compounds
VSP	Visual Sample Plan

Executive Summary

This Corrective Action Investigation Plan (CAIP) contains project-specific information for conducting site investigation activities at Corrective Action Unit (CAU) 214: Bunkers and Storage Areas. Information presented in this CAIP includes facility descriptions, environmental sample collection objectives, and criteria for the selection and evaluation of environmental samples.

Corrective Action Unit 214 is located in Areas 5, 11, and 25 of the Nevada Test Site, which is 65 miles northwest of Las Vegas, Nevada. Corrective Action Unit 214 is comprised of the nine Corrective Action Sites (CASs) listed below:

- 05-99-01, Fallout Shelters
- 11-22-03, Drum
- 25-99-12, Fly Ash Storage
- 25-23-01, Contaminated Materials
- 25-23-19, Radioactive Material Storage
- 25-99-18, Storage Area
- 25-34-03, Motor Dr/Gr Assembly (Bunker)
- 25-34-04, Motor Dr/Gr Assembly (Bunker)
- 25-34-05, Motor Dr/Gr Assembly (Bunker)

These sites are being investigated because existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives. Additional information will be obtained by conducting a corrective action investigation (CAI) prior to evaluating corrective action alternatives and selecting the appropriate corrective action for each CAS. The results of the field investigation will support a defensible evaluation of viable corrective action alternatives that will be presented in the Corrective Action Decision Document.

Five conceptual site models were developed for the nine CASs to address all releases associated with the site.

The sites will be investigated based on data quality objectives (DQOs) developed on February 24, 2003, by representatives of the Nevada Division of Environmental Protection; U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office; Shaw Environmental, Inc.; and Bechtel Nevada. The DQOs process was used to identify and define the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for

CAU 214. The following two decisions statements were identified to resolve the DQO problem statement:

- Decision I: "Is any potential contaminant of concern (COC) present in environmental media within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?"

- Decision II: "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?"

Appendix A.1 provides a detailed discussion of the DQO methodology and the DQOs specific to each CAS.

Based on existing data and process knowledge, the contaminants of potential concern for Corrective Action Unit 214 include constituents associated with volatile organics, semivolatile organics, petroleum hydrocarbons, polychlorinated biphenyls, asbestos, *Resource Conservation Recovery Act* metals, aluminium, beryllium, and radionuclides.

The scope of the CAI for CAU 214 includes the following activities:

- Move surface debris and/or materials, as needed, to facilitate sampling.
- Conduct radiological surveys.
- Perform field screening.
- Collect and submit environmental samples for laboratory analysis to determine if COCs are present.
- If COCs are present, collect additional step-out samples to define the extent of the contamination.
- Collect samples of investigation-derived waste, as needed, for waste management and minimization purposes.

The general technical approach for investigation of Corrective Action Unit 214 will consist of the following activities:

- Collect environmental soil samples and submit for laboratory analysis to determine if contaminants of concern are present and/migrating. In general, field activities will consist of collecting soil samples at biased locations according to approved procedures.

- Additional random soil samples will be collected at CASs 25-23-01, 25-23-19, and 25-99-18 storage areas since biasing factors may not be present to adequately indicate contamination associated with materials previously stored in these areas.

- Collect required quality control samples.
- Collect additional environmental soil samples to define the lateral and vertical extent of contaminants of concern, if necessary.
- Inspect the gear assembly for the presence of organic contaminants for corrective action sites with gear machinery. If present, collect samples for analysis.
- Inspect the drum contents, debris, and cable for evidence of organic contaminants, for corrective action sites with drums, debris and cable. If present, collect samples from the underlying soil for analysis.

Additional samples will be collected and analyzed for the purpose of waste characterization and developing corrective action alternatives for the disposal of the waste.

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Under the *Federal Facility Agreement and Consent Order*, this CAIP will be submitted to the Nevada Division of Environmental Protection for approval. Field work will be conducted following approval of the plan.

1.0 Introduction

This Corrective Action Investigation Plan (CAIP) contains project-specific information including facility descriptions, environmental sample collection objectives, and criteria for conducting site investigation activities at Corrective Action Unit (CAU) 214: Bunkers and Storage Areas, Nevada Test Site (NTS), Nevada.

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996) that was agreed to by the State of Nevada, the U.S. Department of Energy (DOE), and the U.S. Department of Defense (DoD).

Corrective Action Unit 214 is located in Areas 5, 11, and 25 of the NTS, which is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1). Corrective Action Unit 214 is comprised of the nine Corrective Action Sites (CASs) shown on Figure 1-1 and listed below:

- 05-99-01, Fallout Shelters
- 11-22-03, Drum
- 25-99-12, Fly Ash Storage
- 25-23-01, Contaminated Materials
- 25-23-19, Radioactive Material Storage
- 25-99-18, Storage Area
- 25-34-03, Motor Dr/Gr Assembly (Bunker)
- 25-34-04, Motor Dr/Gr Assembly (Bunker)
- 25-34-05, Motor Dr/Gr Assembly (Bunker)

Corrective Action Site 05-99-01 is located in Area 5 and consists of fallout shelters associated with an experiment assessing the effects of atmospheric tests on different construction types and structure designs. These fallout shelters have been identified as being potentially eligible for inclusion in the National Register of Historic Places. Corrective Action Site 11-22-03 is located in Area 11 (Plutonium Valley) and consists of drums and debris that may be associated with nuclear safety experiments. The seven CASs in Area 25 are bunkers and storage areas associated with the Nuclear Rocket Development Station.

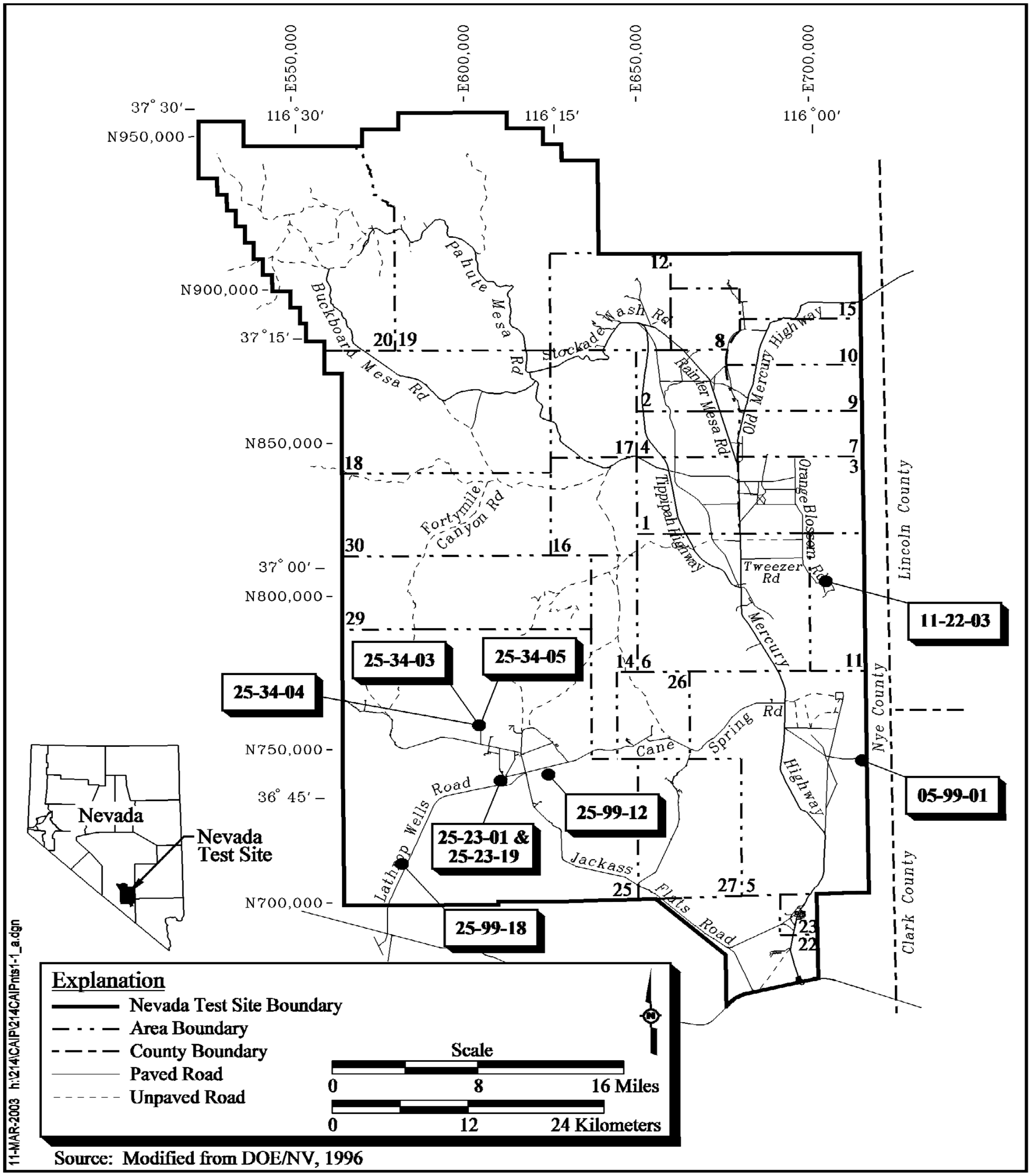


Figure 1-1
Nevada Test Site Map with CAU 214 CAS Locations

The corrective action investigation (CAI) will include field inspections, radiological surveys, and sampling of media, where appropriate. Data will also be obtained to support waste management decisions.

1.1 Purpose

The CASs in CAU 214 are being investigated because hazardous and/or radioactive constituents may be present in concentrations that could potentially pose a threat to human health and/or the environment. The nine CASs at CAU 214 consist of storage areas and bunkers. Existing information on the nature and extent of potential contamination at these sites are insufficient to evaluate and recommend corrective action alternatives for the nine CASs. Therefore, additional information will be obtained by conducting a CAI prior to evaluating corrective action alternatives and selecting the appropriate corrective action for each CAS.

The sites will be investigated based on data quality objectives (DQOs) developed by representatives of the Nevada Division of Environmental Protection (NDEP); DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO); Shaw Environmental, Inc.; and Bechtel Nevada. The DQOs are used to identify and define the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for CAU 214. This CAIP will describe the investigation developed to collect the data needs identified in the DQO process. While a detailed discussion of the DQO methodology and the DQOs specific to each CAS are presented in Appendix A.1 to this document, a summary of the results of the DQO process is provided below.

The DQO problem statement for CAU 214 is: "Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for the CASs in CAU 214." To address this question, the resolution of two decisions statements is required:

- Decision I: "Is any contaminant of concern (COC) present in environmental media within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?" A COC is defined as any contaminant associated with a CAS activity that is present at concentrations exceeding its corresponding preliminary action level (PAL). If a COC is detected, then Decision II must be resolved. Otherwise, the investigation for that CAS is complete.

- Decision II: "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?" Sufficient information is defined as the data needs identified in the DQO process to include data needed to support waste management decisions and the maximum lateral and vertical extent of any COC within each CAS.

The informational inputs and data needs to resolve the problem statement and the decision statements were generated as part of the DQO process for this CAU and are documented in Appendix A.1. The information necessary to resolve the DQO decisions will be generated for each CAU 214 CAS by collecting and analyzing samples generated during a field investigation. The presence and nature of contamination at each CAS will be determined by sampling locations that are determined to be the most probable to contain COCs if they are present anywhere within the CAS. The absence of COCs at CAS 25-99-12 and CAS 11-22-03 may also be established if the contaminant source material is determined not to contain COCs. If while defining the nature of contamination it is determined that COCs are present at a CAS, that CAS will be further addressed by determining the extent of contamination before evaluating corrective action alternatives.

1.2 Scope

To generate information needed to resolve the decision statements identified in the DQO processes, the scope of the CAI for CAU 214 includes the following activities:

- Move surface debris and/or materials, as needed, to facilitate sampling.
- Conduct radiological surveys.
- Perform field screening.
- Collect and submit environmental samples for laboratory analysis to determine if COCs are present.
- If COCs are present, collect additional step-out samples to define the extent of the contamination.
- Collect samples of source material to determine the potential for a release at CAS 25-99-12 and CAS 11-22-03.

- Collect samples of investigation-derived waste (IDW), as needed, for waste management and minimization purposes.
- Collect Quality Control (QC) samples.

Soil contamination originating from nuclear weapons testing in the vicinity of CAS 05-99-01 and CAS 11-22-03 is not considered part of this CAU. As such, contamination originating from these sources will not be considered for sample location selection, and/or will not be considered COCs for Decision II. If such contamination is present, it will be addressed by the Soils Project's CAUs 541 and 366. Radiological surveys will be performed at the CASs 25-34-03, 25-34-04, and 25-34-05 in Area 25 where bunkers areas were associated with the Nuclear Rocket Development Program. The surface will be evaluated for radiological contamination in the footprint of each CAS. If radiological contamination is widespread, this contamination will be addressed by the Soils Project rather than the CAU 214 investigation.

1.3 CAIP Contents

Section 1.0 presents the purpose and scope of this CAIP, while Section 2.0 provides background information about CAU 214. Objectives of the investigation, including conceptual site models, are presented in Section 3.0. Field investigation and sampling activities are discussed in Section 4.0, and waste management issues for this project are discussed in Section 5.0. General field and laboratory quality assurance (QA) and QC requirements (including collection of QC samples) are presented in Section 6.0 and in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002a). The project schedule and records availability are discussed in Section 7.0 and Section 8.0 provides a list of references.

Appendix A.1 provides a detailed discussion of the DQO methodology and the DQOs specific to each CAS, while Appendix A.2 contains information on the project organization. Appendix A.3 contains a description of the Visual Sample Plan (VSP) software (PNNL, 2002) and the criteria to be used for its use in selecting randomized sample locations. Appendix A.4 provides background information on the use and acceptance of the VSP software model.

The health and safety aspects of this project are documented in the Environmental Architecture-Engineer (A-E) contractor's *Health and Safety Plan* (HASP), and will be supplemented with a site-specific health and safety plan written prior to the start of field work.

Public involvement activities are documented in the "Public Involvement Plan" contained in Appendix V of the FFACO (1996). The managerial aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994) and will be supplemented with a site-specific field management plan that will be developed prior to field activities.

2.0 Facility Description

Corrective Action Unit 214 is comprised of nine CASs which were grouped together based on the geographical location of the sites, technical similarities (bunkers and storage areas), and the agency responsible for closure. The bunkers are located in Areas 5 and 25 and include CASs 05-99-01, 25-24-03, 25-34-04, and 25-34-05. Storage areas are located in Areas 11 and 25 and include CASs 11-22-03, 25-23-01, 25-23-19, 25-99-12, and 25-99-18. Descriptions and figures for each of the CASs are presented in Appendix A.1.

2.1 Physical Setting

The following sections describe the general physical settings of Areas 5, 11, and 25 of the NTS. General background information pertaining to topography, geology, hydrogeology, and climatology are provided for these specific areas or the NTS region in the *Geologic Map of the Nevada Test Site, Southern Nevada* (USGS, 1990)**;** *CERCLA Preliminary Assessment for DOE's Nevada Operations Office Nuclear Weapons Testing Areas* (DRI, 1988); the *Nevada Test Site Final Environmental Impact Statement* (ERDA, 1977); and the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996).

Geological and hydrological setting descriptions for each of the CASs are detailed in the following subsections.

2.1.1 Area 5

Corrective Action Site 05-99-01 lies within the Frenchman Flat Hydrographic Area of the NTS. The Frenchman Flat area is a topographically closed basin surrounded by low-lying mountains that separate it from the Mercury Valley Hydrographic Area located to the south, and from the Yucca Flat Hydrographic Area to the north (Laczniak et al., 1996). Erosion of the surrounding mountains has resulted in the accumulation of more than a 1,000 feet (ft) of alluvial deposits in some areas of Frenchman Flat. Volcanic rocks underlie the alluvium in the northern and western parts of Frenchman Flat and, where exposed, form the surrounding low-lying mountains. Carbonate rocks primarily underlie the alluvium in the eastern and southeastern parts of Frenchman Flat and form much of the surrounding mountains in this area. The soil in Frenchman Flat is typical desert alluvium composed of mostly fine soil and rock particles and includes loose rocks measuring up to 3 inches (in.) in diameter.

Groundwater occurs in Frenchman Flat within alluvial and volcanic aquifers that overlie a carbonate aquifer. The carbonate aquifer underlies large areas of the NTS and is part of a regional groundwater flow system. Within the overlying alluvial and volcanic aquifers, lateral groundwater flow occurs from the margins to the center of the basin. Groundwater also moves downward from these overlying aquifers into the carbonate aquifer. Lateral groundwater movement beneath the Frenchman Flat area primarily occurs within the carbonate aquifer. The direction of groundwater flow in this region of the carbonate aquifer generally is from the northeast to southwest. The hydraulic-head gradient in most areas of the alluvial aquifer in Frenchman Flat is relatively flat (less that 1 foot per mile) (Laczniak et al., 1996).

The closest water well, WW-5b, is located approximately 2 mi to the west of the fallout shelters. Water Well WW-5b was constructed in 1951. The depth to groundwater at WW-5b was 689 ft below ground surface (bgs), as measured on May 6, 1991 (USGS, 2002).

Average annual precipitation at raingauge Station Well 5b (W5B) is 4.93 in. for the observation period of 1962 to 2002 (NOAA, 2002). As the name implies, this raingauge station is located near Water Well WW-5b in Frenchman Flat.

2.1.2 Area 11

Area 11 is located on the eastern edge of Yucca Flat near the eastern boundary of the NTS. Corrective Action Site 11-22-03 is located in an area referred to as the Plutonium Valley, which spans approximately 12 square miles, and is characterized by thin bouldery alluvium overlying fractured bedrock of sedimentary or igneous origin. The alluvium- and tuff-filled valleys are rimmed mainly by Precambrian and Paleozoic sedimentary rocks and Cenozoic volcanic rocks (DOE/NV, 1992). The average thickness of the alluvium that fills Yucca Flat basin is about 300 meters (m), although in some places it is as thick as 2,000 m (NBMG,1972; LLNL, 1982).

The average precipitation in Yucca Flat is approximately 5 in. per year (DOE/NV, 1998) resulting in very little recharge to groundwater (DOE/NV, 1992). Surface water flow from Yucca Flat into downgradient Frenchman Flat is small relative to inflows from the east and southwest and is estimated to be no greater than 3 percent of the total outflow at the Ash Meadows discharge area. Some surface runoff into the valleys from nearby highlands may recharge the flow system along the margins of the valleys.

Area 11 is located in the Ash Meadows Groundwater Subbasin, where the groundwater generally moves downward through the alluvium and volcanic rocks to the Paleozoic carbonate-rock aquifer. In Yucca Flat, groundwater is semiperched and moves principally downward into the underlying lower carbonate aquifer (Winograd and Thordarson, 1975). Static water levels within the eastern two-thirds of the Yucca Flat range from 1,500 to 1,885 ft bgs. Water Well C is an active well located approximately 8 mi southwest of CAS 11-22-03. The water level measured in 1975 was 725 m above mean sea level (msl) (DOE/NV, 1999).

The alluvium serves as a localized source of water and is controlled by low permeability rocks, faults, fractures, and joints within the lower carbonate-rock aquifer (Laczniak, et al., 1996). This aquifer is the only subsurface pathway by which groundwater leaves the basin. The groundwater generally flows south from Yucca Flat into Frenchman Flat. The water then flows southwest toward the major downgradient discharge areas (primarily Ash Meadows, but possibly Alkali Flat or Death Valley).

2.1.3 Area 25

Corrective Action Sites 25-99-12, 25-23-01, 25-99-18, 25-34-03, 25-34-04, and 25-34-05 are located in Area 25. The sites are unpaved and generally flat with sparse vegetation. The soil surrounding the sites are typical desert alluvium composed of mostly fine soil and loose rocks. Depth to bedrock and the existence of localized caliche is unknown in this area.

Area 25 (Jackass Flats) is a valley of the NTS bordered by highlands on all sides except for a large drainage outlet to the southwest. Elevations range from 3,400 to 5,600 ft above msl (DOE, 1988).

The Jackass Flats basin is underlain by alluvium, colluvium, and volcanic rocks of Cenozoic age. The alluvium and colluvium are above the saturated zone throughout most of Jackass Flats. Paleozoic age sedimentary rocks, limestones, and dolomites occur at greater depths.

Jackass Flats lies within the Alkali Flat-Furnace Creek Ranch subbasin. The welded-tuff aquifer (the Topapah Spring member of the Paintbrush tuff) is a water-producing aquifer with transmissivities ranging from 68,000 to 48,800 gallons per day per cubic ft (DRI, 1988). Depths to groundwater for the three water supply wells located within Area 25 are 1,041 ft, 928 ft and 740 ft bgs (USGS, 1995). The movement of groundwater within Jackass Flats is to the southwest, ultimately discharging into discharge areas within the Amargosa River Valley (DRI, 1988 and DOE, 1988).

2.2 Operational History

The following subsections provide a description of the use and history of each CAS in CAU 214 that may have resulted in a potential release to the environment. The CAS-specific summaries are designed to illustrate all significant, known activities. When appropriate, field observation notes have been added to the CAS histories to describe existing conditions observed during a site visit on April 15, 2003. The field trip included representatives from NDEP, NNSA/NSO, and NNSA/NSO subcontractors. To support the information provided in Section 2.2, these notes have been added to the individual CAS operational histories.

2.2.1 CAS 05-99-01, Fallout Shelters

Corrective Action Site 05-99-01, Fallout Shelters, is located within the Frenchman Flat Historic District in Area 5 and the shelters have been identified as being potentially eligible for inclusion in the National Register of Historic Places in the *Nevada Test Site Historic Building Survey* (DRI and Carey & Co., 1996).

The shelters were built during Operation Plumbbob in 1957 and instrumented to study the effects of nuclear blasts on different construction types and structure design. The shelter foundations are constructed of concrete and steel and the domes were coated with aluminum sheeting bonded to asbestos cloth. Both domes were destroyed and collapsed during the tests, however, the foundations are still intact. There is an excavated area on the downwind side of each shelter that served as an instrument pit and provided access to shelter doors located below grade (Figure A.1-2).

2.2.2 CAS 11-22-03, Drum

The CAS consists of two, 55-gallon steel drums and steel cable piles located in Area 11 on the NTS. The drums and cable are stored within a radiologically-posted and fenced area stating, "Danger High Contamination Area" and "Caution Underground Radioactive Materials." This part of Area 11 is known as Plutonium Valley and was the site of four nuclear safety experiments in 1955 and 1956. Although soil throughout this area is contaminated from the safety experiments, it is not known if contamination was released from the drums and/or cable pile that constitute this CAS. Also, it is not known if the drums and cable pile were generated from the safety experiments (Figure A.1-3).

2.2.3 CAS 25-99-12, Fly Ash Storage

The fly-ash wooden storage structure (e.g., shed; dimensions approximately 10 x 12 x 8 ft) is located adjacent to and west of a wooden one-story building with oriental-style architecture. This adjacent building is of historical significance and was reportedly moved to this CAS from the Japanese Village in Area 4. There is evidence in the fly-ash structure of previous use/occupancy by site personnel (e.g., photographs on ceiling and walls). However, the exact use of either building is unknown, although it may have been used in various experiments at the nearby Bare Reactor Experiment Nevada (BREN) Tower.

The fly-ash structure appeared to be in "poor" condition. The sides of the structure were prevented from collapse by the presence of steel bands around the exterior walls. The fly ash contained in the structure appeared to have a solidified surface (Figure A.1-4).

2.2.4 CAS 25-23-01, Contaminated Materials and CAS 25-23-19, Radioactive Material Storage

The contaminated materials and radioactive materials storage yard was historically used to store radioactive equipment, hazardous waste, heavy equipment, reactor components, and drums and tanks containing unspecified material. Some of the material stored in the yard was originally generated at Test Cell A and Test Cell C (Sorom, 1998). In the mid-1990s, radiologically-contaminated material was segregated into the northern portion of the storage yard as a posted and fenced radioactive materials area (RMA). This RMA was designated as CAS 25-23-19 and the remainder of the yard was designated as CAS 25-23-01. Cleanup of the yard began in 1995 and solid waste, scrap metal, and equipment were taken to the Area 23 salvage yard. In addition, approximately 20,000 pounds of radioactively contaminated material and equipment in the RMA was taken to the Area 25 Radiological Material Storage Facility (RMSF), and the fence between the two CASs was removed (Kendall, 1995). Other potentially contaminated sources have largely been removed and disposed as nonhazardous (Guymon, 1995), although several containers with known contents are still present (Figure A.1-5).

Access to the storage yard at CAS 25-23-01 is expected to be limited due to the presence of stored materials (i.e., structural steel, furnace, and miscellaneous building materials). As discussed during the site visit, performance of a 100 percent radiological survey and collection of soil samples will be limited to accessible portions of the storage yards. As agreed during the April 15, 2003, site visit, materials stored in the yard will not be moved or relocated as part of the investigation.

2.2.5 CAS 25-99-18, Storage Area

The storage yard was used to store heavy equipment and materials used during the Missile Experiment (MX) Program. The site later became the storage yard for materials and scrap prior to sale as salvage. Hazardous materials such as paint, hydraulic fluid, and batteries were found during inspections but were removed prior to the 1996 auction (Figure A.1-6).

2.2.6 CASs 25-34-03, 25-34-04, and 25-34-05, Motor Dr/Gr Assembly (Bunker)

The bunkers were part of the Nuclear Rocket Development Station and were used to house the cable spools and gear motor drives used for manipulating (i.e., raising and lowering) an engine exhaust downhole cover and two radiation shields used during the testing of nuclear engines. The power source for the gear motors in each bunker appears to be electricity. No underground storage tanks (USTs) or generator pads were observed in the vicinity of the Nuclear Rocket Development Station. The bunkers appear to be constructed of reinforced concrete and have an open roof. Steel plates cover the roof opening. Each bunker has a concrete floor and a floor drain, (i.e., opening through rear wall of bunker). Rainwater entering the bunker is believed to have drained out of the bunker through the opening in the rear wall of the bunker (Figures A.1-7, A.1-8, A.1-9, and A.1-12).

2.3 Waste Inventory

Materials remaining from past activities conducted at, or near, each CAS may be considered hazardous and/or radioactive waste by current standards. Historical information and site visits indicate that the sites contain wastes such as construction materials, equipment, asbestos, and other miscellaneous debris. Some of these wastes may have also been released to underlying soils.

2.3.1 CAS 05-99-01, Fallout Shelters

Asbestos-containing material from the destroyed shelters is potentially present in the soil or on the ground surface in the ramp area of the fallout shelters. Miscellaneous debris consisting of cables, wood scrap, pieces of rubber hoses, an electrical plate and a battery were noted to be present in the ramp area of the shelters.

2.3.2 CAS 11-22-03, Drum

Waste items identified at this site include two 55-gallon drums and two piles of metal cable. During a site visit on January 24, 2002, metal cable was visible in the open-top drum without a lid; however, it is not known if the drum contains any other debris and/or waste materials. The other drum is an open-top container with a lid in place. There are no labels or other information indicating what this drum may contain. Two piles of metal cable (approximately 5 cubic yards) is also present at the site. The area containing these items is fenced and posted as a high contamination area (HCA) and buried radioactive material. Information suggests the presence of buried radioactive material might be present within portions of the HCA.

An interview with a former employee of Reynolds Electrical & Engineering Co., Inc. (REECo) suggested that the metal and cable inside the drum and on the ground is highly contaminated with americium and plutonium (REECo, 1991). A determination will be made during our investigation.

2.3.3 CAS 25-99-12, Fly Ash Storage

The fly ash within the wooden structure is the primary waste at this CAS. Approximately 15 cubic yards of fly ash is contained in the wooden structure. Some fly ash has migrated out of the structure (e.g., wall cracks, front door opening) onto the ground surface below. The wooden structure sits approximately 5 ft from the Japanese House.

2.3.4 CAS 25-23-01, Contaminated Materials and CAS 25-23-19, Radioactive Material Storage

Corrective Action Site 25-23-01 is an equipment storage area. Wood and metal debris are scattered throughout the CAS 25-23-01 storage area. A 55-gallon drum is present on a wooden pallet in a roped area, it has no labels or other information indicating what this drum may have contained. Portions of the ground surface soil beneath and around the drum appeared to be stained (9 x 9 ft) and discolored. Stained surface soil was observed in the majority of the roped area. In addition, an area of stained soil was identified in the north central portion of the CAS.

Also present is a variety of metal containers (open top without lids) with unknown contents. A large furnace (e.g., natural gas-fired furnace) is present adjacent to the chain-link fence at the southern end of the CAS. Assorted building materials (e.g., steel columns and beams) and debris are staged throughout the southern, southwest, and central portions of the storage area.

No equipment or debris were observed at CAS 25-23-19 (north of CAS 25-23-01). A portion of the ground surface was stained (i.e., green soil stain) in the northwest corner of the CAS. The green stained area was approximately 6 x 12 ft and extended from inside the CAS beneath the chain-link fence and along a portion of slope outside of the fence.

2.3.5 CAS 25-99-18, Storage Area

Three large concrete and steel plugs (i.e., two plugs at 4 ft diameter and one plug at 15 ft diameter), a large concrete trough (approximately 72 ft), and a lead brick are present at site. Stained surface soil was observed in the southeast portion of the CAS. Some scrap material is present at site that may potentially contain asbestos. Also present are scattered debris and equipment. Information regarding the history or prior use of the concrete plugs was not available. Preliminary observations identified only solid waste debris at the CAS.

2.3.6 CASs 25-34-03, 25-34-04, and 25-34-05, Motor Dr/Gr Assembly (Bunker)

Hydrocarbon contamination may be present in the bunkers as a result of leaks/drips of grease from gear-drive equipment within each bunker. The bunkers are covered with steel plates; however, the roof is not considered waterproof. Rainwater seeping into the bunkers and discharging out the rear drain potentially spread petroleum hydrocarbons outside of the bunker onto surface soil behind the bunkers.

Portions of the steel cables used to maneuver (raise and lower) concrete deflectors located on the engine test tower are present at each CAS. Due to the use of the cables during the engine test program, portions of the cable are potentially contaminated with radioactivity.

Small piles of dirt and gravel are present in each bunker, which is believed to have sifted in from openings at the tops and sides of the bunkers. Wood and metal debris are present both inside and outside of the bunkers (Figure A.1-7 to Figure A.1-9).

2.4 Release Information

Release information, migration routes, exposure pathways, and affected media are discussed in this section.

There has been no known migration of contamination at any CAU 214 CASs beyond a shallow layer of surface soil. The limited recharge to groundwater from precipitation does not provide a significant mechanism for vertical migration of contaminants to groundwater (DOE/NV, 1992). Lateral migration is expected to be limited due to shallow surface slopes and the absence of drainages at or near the potential release sites. Spills or leaks at the ground surface may have had limited lateral migration prior to infiltration. The presence of relatively impermeable layers could modify transport pathways, both on the ground surface (e.g., concrete) and in the subsurface (e.g., caliche layers).

Potentially affected media for all CASs include surface and shallow subsurface soil. Exposure routes to site workers include ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils, debris, and/or structures. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated materials.

At CAS 05-99-01 and CAS 11-22-03, surface soils may have been impacted by radiological contamination associated with atmospheric testing. As discussed in Section 1.2, this contamination will not be included in CAU 214 as it will be addressed by the Soils Project. Within the footprint area of CASs 25-34-03, 25-34-04, and 25-34-05, the surface will be evaluated for widespread radiological contamination. Isolated areas above PRGs will be addressed in the CADD. However, if radiological contamination is widespread, this contamination will be addressed by the Soils Project rather than the CAU 214 investigation.

The following subsections contain CAS-specific descriptions of known or potential releases associated with CAU 214.

2.4.1 CAS 05-99-01, Fallout Shelters

There is no reason to suspect that equipment and materials inside of the fallout shelters, or operations associated with the shelters, released any contamination. The excavations are filled with tumbleweeds and the bottoms of the excavations are not visible. However, the presence of suspected asbestos insulation was noted as part of the material covering the roof. The majority of the asbestos cover material was destroyed and/or separated from the roof during the experiments (DASA, 1960). Asbestos material is potentially present in the soil at the fallout shelters.

2.4.2 CAS 11-22-03, Drum

There is no documentation to suggest that the drums or cable pile have been the source of contamination due to a release. Observations during the January 24, 2002, field visit did not report evidence of visible soil stains or other biasing factors (participants during the site visit did not enter the posted area). Although unlikely, materials may have leaked from the drums subsequent to their placement at the site and/or during transport or handling. If a release occurred, contaminants would have been limited in volume (e.g., volume of drum) and expected to be located in the soil within close proximity to the drums.

2.4.3 CAS 25-99-12, Fly Ash Storage

The source of potential soil contamination is fly ash migrating through openings in the walls and the door and window opening of the storage building. This material is present in limited amounts in close proximity under and around the building. The building and its contents (i.e., fly ash material) will be characterized for disposal.

2.4.4 CAS 25-23-01, Contaminated Materials, and CAS 25-23-19, Radioactive Material Storage

Several soil stains have been identified at this site that are associated with materials released or eroded from equipment and materials that were stored in the yards. A discussion of preliminary analytical results is described in Section 2.5.2.

2.4.5 CAS 25-99-18, Storage Area

Equipment and material staging at this storage area may have released contamination. There is one identified soil stain in the southeast portion of the CAS.

2.4.6 CASs 25-34-03, 25-34-04, and 25-34-05, Motor Dr/Gr Assembly (Bunker)

Potential releases at these bunkers are associated with materials used for maintenance or operation of the drive gears. Migration of contamination from the bunkers to the environment would be largely limited to contaminants entering the floor drain and discharging at the outfall at each bunker.

2.5 Investigative Background

The following subsections summarize the investigations conducted at the CAU 214 sites. More detailed discussions of these investigations are found in Appendix A.1. No previous investigative results have been identified for soils or materials currently present at CASs 05-99-01, 11-22-03, 25-99-18, or the bunkers at CASs 25-34-03, 25-34-04, and 25-34-05.

2.5.1 CAS 25-99-12, Fly Ash Storage

A sample of the fly ash was analyzed for *Resource Conservation and Recovery Act* (RCRA) metals, toxicity characteristic leaching procedure (TCLP) RCRA metals, pH, and gamma-emitting radionuclides. Analytical results did not exceed regulatory thresholds for RCRA metal. Current analytical data for the fly ash indicates it is characterized as a sanitary waste. Additional sampling will be performed to fully characterize the waste material.

2.5.2 CAS 25-23-01, Contaminated Materials and CAS 25-23-19, Radioactive Material Storage

Eight soil samples were collected from oil-stained areas and submitted for various analyses including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH) gasoline-range organics (GRO), TPH diesel-range organics (DRO), RCRA metals, polychlorinated biphenyls (PCBs), pesticides, herbicides, pH, TCLP metals, TCLP VOCs, TCLP pesticides, and gamma-emitting radionuclides. The only reported contaminants were TPH at a concentration of up to 45,600 milligrams per kilogram (mg/kg), chlordane at a concentration of up to 2,020 mg/kg, and heptachlor at a concentration of 294 mg/kg.

One soil sample collected from the green stain in CAS 25-23-19 was analyzed for SVOCs, TPH (DRO), TPH (GRO), RCRA metals, pH, and gamma-emitting radionuclides. Chromium was detected at a concentration of 880 mg/kg.

In May 1998, a radiological survey was performed by IT of the contaminated storage yard. The beta readings documented were below background levels (IT, 2002).

2.5.3 National Environmental Policy Act

The *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996) includes site investigation activities such as those proposed for CAU 214.

In accordance with the NNSA/NSO *National Environmental Policy Act* (NEPA) compliance program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 214. This checklist compels NNSA/NSO project personnel to evaluate their proposed project activities against a list of potential impacts that include, but are not limited to: air quality, chemical use, waste generation, noise level, and land use. Completion of the checklist results in a determination of the appropriate level of NEPA documentation by the NNSA/NSO NEPA Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 214 and formulation of the conceptual site models (CSMs). Also presented is a summary listing of the contaminants of potential concern (COPCs) and PALs for the investigation. Additional details and figures depicting the CSMs are located in Appendix A.1.

3.1 Conceptual Site Models

The CSMs describe the most probable scenario for current conditions at each site and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. Two CSMs have been developed for CAU 214 using information from the physical setting, potential contaminant sources, knowledge from similar sites, release information, historical background information, and physical and chemical properties of the potentially affected media and COPCs. Table 3-1 identifies the CSMs that apply to the each CAS. Conceptual Site Model #1 represents contamination of storage areas due to leakage or spilling from stored materials while CSM #2 describes contamination of soil under or around facilities.

Table 3-1
CSMs and Associated CASs

Conceptual Site Model (CSM)	05-99-01	11-22-03	25-99-12	25-23-01	25-23-19	25-99-18	25-34-03	25-34-04	25-34-05
Materials and Equipment Storage Yards (#1)		X		X	X	X			
Facilities and Associated Soil (#2)	X		X				X	X	X

If evidence of potential contamination that is outside the scope of the presented CSMs is identified during investigation activities, the situation will be reviewed and a recommendation will be made as to how best to proceed. In such cases, identified decision makers will be notified and given the opportunity to comment on and/or concur with the recommendation.

The following sections discuss future land use and the identification of exposure pathways (i.e., combination of source, release, migration, exposure point, and receptor exposure route) for the CAU.

3.1.1 Future Land Use

As described in this section, the land-use zones where the CAU 214 CASs are located dictate that future land uses will be limited to nonresidential (i.e., industrial) activities.

Corrective Action Sites 25-34-03, 25-34-04, 25-34-05, 25-99-12, and 05-99-01 are located in the land-use zone described as the "Research, Test, and Experiment Zone." This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of material and equipment under controlled conditions. This zone includes compatible defense and nondefense research, development and testing projects and activities. (DOE/NV, 1998).

Corrective Action Site 11-22-03 is located in the land-use zone described as "Reserved" within the NTS. This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short-duration exercises and training such as nuclear emergency response, Federal Radiological Monitoring and Assessment Center training, and DoD land-navigation exercises and training (DOE/NV, 1998).

Corrective Action Sites 25-23-01, 25-23-19, and 25-99-18 are located in the "Yucca Mountain Site Characterization Zone." This land-use zone restricts future use to industrial activities; therefore, residential land use is not considered.

3.1.2 Contaminant Sources

Conceptual Site Model #1 sources are:

- Leaking containers
- Residues from stored equipment and materials

Conceptual Site Model #2 sources are:

- Lubrication and cleaning of equipment;
- surface disposal of discarded equipment and materials,
- cable that may have been in proximity to Engine Test Stand 1 (ETS-1)
- Fly ash sifting from structure

3.1.3 Release Mechanisms

Release mechanisms for both conceptual models are spills and leaks onto surface soils from equipment or stored materials. Materials stored in containers may have leaked or have been spilled. Equipment may have released lubricants onto the areas where they were stored. Solid material such as the lead brick may have corroded, thus dispersing the corroded material onto the soil surface.

3.1.4 Migration Pathways

Migration pathways at the CASs are expected to be generally limited to vertical migration through the near-surface soil as all the CASs have very minor surface gradients and are not located in drainage channels. Spills may have migrated somewhat laterally prior to vertical infiltration as evidenced by the stained areas in CASs 25-23-01 and 25-23-19. The migration pathway for CASs 25-34-03, 25-34-04, and 25-34-05 also includes lateral movement along the concrete floor out the bunker door or through the floor drain to the exterior soil.

Infiltration and percolation of precipitation serves as a driving force for downward migration of contaminants. However, potential evapotranspiration (the evaporative capacity of the atmosphere at the soil surface) at the NTS is significantly greater than precipitation, thus limiting vertical migration of contaminants. The annual average precipitation for this region is only 3 to 6 in. per year (Winograd and Thordarson, 1975). The total potential evapotranspiration at the Area 3 Radiological Waste Management Site has been estimated at 62.6 in. (Shott et al., 1997). These data indicate that evapotranspiration is the dominant factor influencing the movement of water in the upper unsaturated zone. Therefore, recharge to groundwater from precipitation is not significant at the NTS and does not provide a significant mechanism for migration of contaminants to groundwater.

3.1.5 Exposure Points

Exposure points for both CSMs are expected to be discrete locations of surface contamination where visitors and site workers will come in contact with soil surface. Contamination, if present, is expected to be contiguous to the release site. Concentrations of contaminants are expected to decrease with increasing horizontal and vertical distance from the locations of release.

3.1.6 Exposure Routes

Exposure routes to site workers include oral ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated materials.

3.1.7 Additional Information

Topographic information, climatic conditions, groundwater data, and floodplain information for the CAU are well documented. These are available and have been addressed in the CSM or will be considered during corrective action, as necessary. No further information is required.

General surface and subsurface soil descriptions as well as specific structure descriptions will be observed and recorded during the CAI. Active working utilities will not be impacted by the investigation.

3.2 Contaminants of Potential Concern

Suspected contaminants for CAU 214 were identified through a review of site history documentation, process knowledge information, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs. Suspected contaminants for each CAU 214 CAS are listed in Table 3-2.

Because complete information regarding activities performed at the CAU 214 sites is unavailable, additional analytes have been included as COPCs. These are reflected in the analytical program for the CAU 214 investigation described in Section 3.4. Chemical COPCs are defined as the analytes reported from the analytical methods for which the U.S. Environmental Protection Agency (EPA) Region IX has established *Preliminary Remediation Goals* (PRG) (EPA, 2002) or for which toxicity data are listed in the EPA *Integrated Risk Information System* (IRIS) database (EPA, 2001b). Radiological COPCs are defined as the radionuclides reported from the analytical methods listed in Section 3.4.

Table 3-2
Suspect Contaminants and Critical Analytes for CAU 214 Nature of Contamination Sampling

CAS	Chemical		Radiological	
	Suspect Contaminant	**Critical Analyte()**	**Suspect Contaminant**	**Critical Analyte(s)**
25-23-01, 25-23-19	Oil	TPH(DRO)	None	
	Oil, Hydraulic Oil	PCBs		
	Pesticides	Chlordane, Heptachlor, 4,4-DDT		
	Arsenic, Barium, Cadmium, Chromium			
05-99-01	Asbestos	None	None	
11-22-03, 25-34-03, 25-34-04, 25-34-05	None		None	
25-99-18	Lubricants	TPH(DRO), TPH(GRO)	None	
25-99-12	Fly ash	Arsenic	None	

CAS = Corrective Action Site
DRO = Diesel-range organics
PCB = Polychlorinated biphenyls
TPH = Total petroleum hydrocarbons

At a given CAS, each COPC that is detected in a sample at concentrations exceeding the corresponding PAL becomes a COC for subsequent sampling to define the extent of contamination (Decision II).

3.3 Preliminary Action Levels

Laboratory analytical results for COPCs in soil samples will be compared to the following PALs to evaluate the presence of COCs:

- EPA *Region 9 Risk-Based Preliminary Remediation Goals* for chemical constituents in industrial soils (EPA, 2002).
- Background concentrations for RCRA metals and zinc will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic on the NTS. Background is considered the mean plus two standard deviations of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999).

- The TPH action limit of 100 parts per million (ppm) per the *Nevada Administrative Code* (NAC) 445A.2272 (NAC, 2000e).
- The PALs for radionuclides 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; BN, 1996). The PAL is equal to the minimum detectable concentration (MDC) for isotopes not reported in soil samples from undisturbed background locations. The PAL is also equal to the MDC if the maximum background concentration is less than the MDC (Table 3-5).
- For detected chemical COPCs without established PRGs that are listed in the EPA IRIS database (EPA, 2001b), the protocol used by the EPA Region 9 in establishing PRGs (or similar) will be used in establishing the PALs.

Solid media such as concrete and/or structures may pose a potential radiological exposure risk to site workers if contaminated. The radiological PAL for solid media will be defined as the unrestricted-release criteria defined in the *NV/YMP Radiological Control* (RadCon) *Manual* (DOE/NV, 2000).

The comparison of laboratory results to PALs will be discussed in the corrective action decision document (CADD). Laboratory results above PALs indicate the presence of COCs that will require further evaluation. The evaluation of potential corrective actions and the justification for a preferred action will be included in the CADD based on the results of this field investigation. Proposed cleanup levels will be presented in the CADD, if applicable.

3.4 DQO Process Discussion

This section contains a summary of the DQO process that is presented in Appendix A.1. The DQO process is a strategic planning approach based on the scientific method that is used to prepare for site characterization data collection. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommendation of viable corrective actions (e.g., no further action or closure in place). The DQO process is implemented by completing the following seven steps:

- State the problem.
- Identify the decision.
- Identify the inputs to the decision.
- Define the boundaries of the study.

- Develop a decision rule.
- Specify tolerable limits on decision errors.
- Optimize the design for obtaining data.

The DQO strategy for CAU 214 was developed at a meeting on February 12, 2003. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented.

The problem statement for CAU 214 is: "Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for the CASs in CAU 214." To address this question, the resolution of two decisions statements is required:

- Decision I: "Is any COC present in environmental media within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?"

- Decision II: "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?"

Decision I samples will be submitted for the analytical methods listed in Table 3-3. The analytical requirements for the CAU 214 COPCs are listed in Table 3-4 and Table 3-5.

Table 3-3
Analytical Program[a]
(Includes Site and Waste Characterization Analyses)

Analyses[b]	05-99-01	11-22-03	25-99-12	25-23-01 25-23-19	25-99-18	25-34-03 25-34-04 25-34-05
Organics						
Total Petroleum Hydrocarbons (Diesel-Range Organics)		X	X	X	X	X
Total Petroleum Hydrocarbons (Gasoline-Range Organics)		X	X	X	X	X
Polychlorinated Biphenyls	X	X	X	X	X	X
Semivolatile Organic Compounds[c]	X	X	X	X	X	
Volatile Organic Compounds[c]	X	X	X	X	X	X
Pesticides[c]			X	X		
Herbicides[c]				X		
Inorganics						
Asbestos	X				X	
Metals						
Total *Resource Conservation and Recovery Act* Metals[c]	X	X	X	X	X	
Total Beryllium	X	X	X	X	X	
Radionuclides						
Gamma Spectrometry	X	X	X	X	X	X
Isotopic Uranium	N		N	X	N	N
Isotopic Plutonium	N	X	N	X	N	N
Strontium-90	N		N	X	N	N

X - Required analytical method
N - Results of gamma analysis will be used to determine if further this radioanalytical analysis is warranted.

[a]The contaminants of potential concern are the analytes reported from the analytical methods listed.
[b]If the volume of material is limited, prioritization of the analyses will be necessary.
[c]May also include Toxicity Characteristic Leaching Procedure metals if sample is collected for waste management purposes.

Table 3-4
Analytical Requirements for CAU 214
(Page 1 of 4)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
ORGANICS						
Total Volatile Organic Compounds (VOCs)	Aqueous Soil	8260B[c]	Parameter-specific estimated quantitation limits[d]	Not Applicable (NA)	Lab-specific[e]	Lab-specific[e]
Toxicity Characteristic Leaching Procedure (TCLP) VOCs						
Benzene	Aqueous	1311/8260B[c]	0.050 mg/L[d]	0.5 mg/L[f]	Lab-specific[e]	Lab-specific[e]
Carbon Tetrachloride			0.050 mg/L[d]	0.5 mg/L[f]		
Chlorobenzene			0.050 mg/L[d]	100 mg/L[f]		
Chloroform			0.050 mg/L[d]	6 mg/L[f]		
1,2-Dichloroethane			0.050 mg/L[d]	0.5 mg/L[f]		
1,1-Dichloroethene			0.050 mg/L[d]	0.7 mg/L[f]		
Methyl Ethyl Ketone			0.050 mg/L[d]	200 mg/L[f]		
Tetrachloroethene			0.050 mg/L[d]	0.7 mg/L[f]		
Trichloroethene			0.050 mg/L[d]	0.5 mg/L[f]		
Vinyl Chloride			0.050 mg/L[d]	0.2 mg/L[f]		
Total Semivolatile Organic Compounds (SVOCs)	Aqueous Soil	8270C[c]	Parameter-specific estimated quantitation limits[d]	NA	Lab-specific[e]	Lab-specific[e]
TCLP SVOCs						
o-Cresol	Aqueous	1311/8270C[c]	0.10 mg/L[d]	200 mg/L[f]	Lab-specific[e]	Lab-specific[e]
m-Cresol			0.10 mg/L[d]	200 mg/L[f]		
p-Cresol			0.10 mg/L[d]	200 mg/L[f]		
Cresol (total)			0.30 mg/L[d]	200 mg/L[f]		
1,4-Dichlorobenzene			0.10 mg/L[d]	7.5 mg/L[f]		
2,4-Dinitrotoluene			0.10 mg/L[d]	0.13 mg/L[f]		
Hexachlorobenzene			0.10 mg/L[d]	0.13 mg/L[f]		
Hexachlorobutadiene			0.10 mg/L[d]	0.5 mg/L[f]		
Hexachloroethane			0.10 mg/L[d]	3 mg/L[f]		
Nitrobenzene			0.10 mg/L[d]	2 mg/L[f]		
Pentachlorophenol			0.50 mg/L[d]	100 mg/L[f]		
Pyridine			0.10 mg/L[d]	5 mg/L[f]		
2,4,5-Trichlorophenol			0.10 mg/L[d]	400 mg/L[f]		
2,4,6-Trichlorophenol			0.10 mg/L[d]	2 mg/L[f]		
Polychlorinated Biphenyls (PCBs)	Aqueous Soil	8082[c]	Parameter-specific (CRQL)[g]	NA	Lab-specific[e]	Lab-specific[e]
Total Petroleum Hydrocarbons (TPH) [C_6-C_{38}]	Aqueous Gasoline	8015B modified[c]	0.1 mg/L[h]	NA	Lab-specific[e]	Lab-specific[e]
	Soil Gasoline		0.5 mg/kg[h]			
	Aqueous Diesel		0.5 mg/L[h]			
	Soil Diesel		25 mg/kg[h]			

Table 3-4
Analytical Requirements for CAU 214
(Page 2 of 4)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
Total Pesticides	Aqueous Soil	8081A[c]	Parameter-specific estimated quantitation limits[g]	NA	Lab-specific[e]	Lab-specific[e]
TCLP Pesticides						
Alpha Chlordane	Aqueous	1311/8081A[c]	0.0005 mg/L[g]	0.03 mg/L[f]	Lab-specific[e]	Lab-specific[e]
Gamma Chlordane			0.0005 mg/L[g]	0.03 mg/L[f]		
Endrin			0.001 mg/L[g]	0.02 mg/L[f]		
Heptachlor			0.0005 mg/L[g]	0.008 mg/L[f]		
Heptachlor Epoxide			0.0005 mg/L[g]	0.008 mg/L[f]		
Lindane (Gamma-BCH)			0.0005 mg/L[g]	0.4 mg/L[f]		
Methoxychlor			0.005 mg/L[g]	10.0 mg/L[f]		
Toxaphene			0.05 mg/L[g]	0.5 mg/L[f]		
Total Herbicides	Water Soil	8151A[c]	Parameter-specific estimated quantitation limits[d]	NA	Lab-specific[e]	Lab-specific[e]
TCLP Herbicides						
2,4,5-TP (Silvex)	Aqueous	1311/8151A[c]	0.00075 mg/L[d]	1.0 mg/L[d]	Lab-specific[e]	Lab-specific[e]
2,4-D			0.002 mg/L[d]	10.0 mg/L[d]		
INORGANICS						
Total *Resource Conservation and Recovery Act* (RCRA) Metals, Beryllium, and Zinc						
Arsenic	Aqueous	6010B[c]	10 µg/L[h, i]	NA	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80-120[i]
	Soil	6010B[c]	1 mg/kg[h, i]		30[h, o]	
Barium	Aqueous	6010B[c]	200 µg/L[h, i]		20[i]	
	Soil	6010B[c]	20 mg/kg[h, i]		30[h, o]	
Beryllium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		30[h, o]	
Cadmium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		30[h, o]	
Chromium	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil	6010B[c]	1 mg/kg[h, i]		30[h, o]	
Lead	Aqueous	6010B[c]	3 µg/L[h, i]		20[i]	
	Soil	6010B[c]	0.3 mg/kg[h, i]		30[h, o]	
Mercury	Aqueous	7470A[c]	0.2 µg/L[h, i]		20[i]	
	Soil	7471A[c]	0.1 mg/kg[h, i]		30[h, o]	

Table 3-4
Analytical Requirements for CAU 214
(Page 3 of 4)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
Selenium	Aqueous	6010B[c]	5 µg/L[h, i]	NA	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80-120[i]
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[h]	
Silver	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[h]	
Zinc	Aqueous	6010B[c]	20 µg/L[h, i]		20[i]	
	Soil	6010B[c]	2 mg/kg[h, i]		35[h]	
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B[c] 1311/7470A[c]	0.10 mg/L[h, i]	5 mg/L[f]	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80-120[i]
Barium			2 mg/L[h, i]	100 mg/L[f]		
Cadmium			0.05 mg/L[h, i]	1 mg/L[f]		
Chromium			0.10 mg/L[h, i]	5 mg/L[f]		
Lead			0.03 mg/L[h, i]	5 mg/L[f]		
Mercury			0.002 mg/L[h, i]	0.2 mg/L[f]		
Selenium			0.05 mg/L[h, i]	1 mg/L[f]		
Silver			0.10 mg/L[h, i]	5 mg/L[f]		
RADIOCHEMISTRY						
Gamma Spectrometry	Aqueous	EPA 901.1[j]	The Minimum Detectable Activities for Radionuclides are given in Table 3-5	NA	Relative Percent Difference (RPD[a]) 20% (Water)[h] 35% (Soil)[h] Normalized Difference (ND) -2<ND<2[k]	Laboratory Control Sample Recovery 80-120[i]
	Soil	HASL-300[l]				
Isotopic Uranium	Aqueous	HASL-300[l] ASTM D3972-02[m]		NA		Chemical Yield 30-105[n] Laboratory Control Sample Recovery 80-120[i]
	Soil	HASL-300[l] ASTM C1000-00[m]				
Isotopic Plutonium	Aqueous	D3865-02[m] ASTM HASL-300[l]		NA		
	Soil					
Strontium - 90	Aqueous	ASTM D5811-00[m]		NA		
	Soil	HASL-300[l]				

Table 3-4
Analytical Requirements for CAU 214
(Page 4 of 4)

[a] Relative percent difference (RPD) is used to calculate precision.
Precision is estimated from the relative percent difference 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 x $\{(|C_1-C_2|)/[(C_1+C_2)/2]\}$, where C_1 = Concentration of the parameter in the first sample aliquot, C_2 = Concentration of the parameter in the second sample aliquot.
[b]%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: percent recovery (%R) = 100 x (C_s-C_u/C_n), where C_s = Concentration of the parameter in the spiked sample,
C_u = Concentration of the parameter in the unspiked sample, C_n = Concentration increase that should result from spiking the sample
[c] U.S. Environmental Protection Agency (EPA) *Test Methods for Evaluating Solid Wast*e, 3rd Edition, Parts 1-4, SW-846 CD ROM, Washington, DC (EPA,1996)
[d] Estimated Quantitation Limit as given in SW-846 (EPA, 1996)
[e] 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 ± 2 SD and ± 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.
[f] Title 40 *Code of Federal Regulations* Part 261, "Identification and Listing of Hazardous Waste" (CFR, 2002b)
[g] EPA *Contract Laboratory Program Statement of Work for Organic Analysis* (EPA, 1988b; 1991; and 1994c)
[h] *Industrial Sites Quality Assurance Project Plan* (NNSA/NV, 2002a)
[i] EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)
[j] *Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)
[k] Normalized Difference is not RPD, it is another measure of precision used to evaluate duplicate analyses. The normalized difference 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)
[l] *Manual of Environmental Measurements Laboratory Procedures*, HASL-300 (DOE, 1997)
[m] American Society for Testing and Materials
[n] *General Radiochemistry and Routine Analytical Services Protocol (GRASP)* (EG&G Rocky Flats, 1991)
[o]USEPA Contract Laboratory Program *National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, February 1994 (EPA, 1994a)

Definitions:
mg/L = Milligrams per liter
mg/kg = Milligrams per kilogram
µg/L = Micrograms per liter
CRQL = Contract-required quantitation limits

Table 3-5
Minimum Detectable Concentrations and Preliminary Action Levels for Radionuclides in Samples Collected at CAU 214

Isotope	Soil		Liquid	
	MDC[a] (pCi/g)	PAL[b] (pCi/g)	MDC[a] (pCi/L)	PAL[b] (pCi/L)
Americium-241 (by Gamma spectroscopy)	2.0[c]	2.0	50	50
Cesium-137	0.5[c]	7	10	10
Cobalt-60	0.5[c]	0.5	10[c]	10
Europium-152	4.0[c]	4.0	75[c]	75
Europium-154	2.5[c]	2.5	65[c]	65
Europium-155	1.0[c]	1.35	20[c]	20
Strontium-90	0.5	1.17	1.0	1.0
Uranium-234	0.05	3.47	0.1	8.92
Uranium-235	0.05	0.07	0.1	0.36
Uranium-238	0.05	3.47	0.1	9.39
Plutonium-238	0.05	0.05	0.1	0.16
Plutonium-239/240	0.05	0.106	0.1	9.0

[a] MDC is the minimum detectable concentration: detection limits required for the measurement of Shaw samples.
[b] PAL is the preliminary action level and is defined as the maximum concentration listed in the literature for a sample taken from an undisturbed background location (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991; and DOE/NV, 1999b). The PAL is equal to the MDC for isotopes not reported in soil samples from undisturbed background locations or if the PAL is less than the MDC.
[c] MDC for gamma-emitting radionuclides is relative to Cs-137.

pCi/g = Picocuries per gram
pCi/L = Picocuries per liter

4.0 Field Investigation

This section contains the technical approach for the CAU 214 field investigation.

4.1 Technical Approach

The information necessary to resolve the DQO decisions will be generated for each CAU 214 CAS by collecting and analyzing samples generated during a field investigation. The presence and nature of contamination at each CAS will be evaluated by collecting samples at biased locations that are determined to be most probable to contain COCs if they are present anywhere within the CAS. These locations will be determined based on the identification of biasing factors. The absence of COCs at CASs 25-99-12 and 11-22-03 may also be established if the contaminant source material is determined not to contain COCs. Additional random samples will also be collected at CASs 25-23-01, 25-23-19, and 25-99-18 storage areas since the CAS footprints are large and biasing factors may not be present to adequately locate contamination. If while defining the nature of contamination it is determined that COCs are present at a CAS, that CAS will be further addressed by determining the extent of contamination before evaluating corrective action alternatives.

Sample locations may be changed based on site conditions, obvious debris or staining of soils, field-screening results, or professional judgement. The Site Supervisor has the discretion to modify the biased locations, but only if the modified locations meet the DQO decision needs and criteria stipulated in Appendix A.1.

Since this CAIP only addresses contamination originating from the CAU, it may be necessary to distinguish overlapping contamination originating from other sources. For example, widespread surface radiological contamination originating from atmospheric tests will not be addressed under CAU 214. To determine if contamination is from the CAU or from other sources, soil samples may be collected from background locations at selected CASs.

Modifications to the investigative strategy may be required should unexpected field conditions be encountered at any CAS. Significant modifications shall be justified and documented on a Record of Technical Change prior to implementation. If an unexpected condition indicates that conditions are significantly different than the corresponding CSM, the activity will be rescoped and the identified decision makers will be notified.

4.2 Field Activities

Activities to be conducted under this CAIP include:

- Relocation of surface debris, equipment, and the fly ash storage structure as necessary to allow access to sampling locations.
- Perform radiological surveys of the drums at CAS 11-22-03, area surveys of CASs 25-23-01 and 25-23-19, and footprint of CASs 25-34-03, 25-34-04, and 25-34-05, and cable between the bunkers and the Engine Test Stand - 1 building at CASs 25-34-03, 25-34-04, and 25-34-25.
- Perform visual surveys at all CASs to identify any staining, discoloration, disturbance of native soils, or any other indication of potential contamination.
- Perform field screening for applicable COPCs.
- Collect and analyze samples from locations as described in this section.
- Collect required QC samples.
- Collect waste management samples.
- Collect soil samples from background locations, if necessary.
- Collect and analyze bioassessment samples if appropriate (e.g., if VOC concentrations exceed field-screening levels in a pattern that suggests that a plume may be present).
- Perform radiological characterization surveys of construction materials and debris as necessary for disposal purposes.
- Stake or flag sample locations and record coordinates.

Decision I surface soil samples (0 to 0.5 ft bgs) will be collected from selected locations based on the biasing factors listed in Section 4.2.1. If biasing factors are present in soils below locations where Decision I samples were removed, subsurface Decision I soil samples will also be collected by hand augering, backhoe excavation, direct-push, or drilling techniques, as appropriate. Decision I subsurface soil samples will collected at depth intervals selected by the Site Supervisor based on biasing factors to a depth where the biasing factors are no longer present. The content of the drums in CAS 11-22-03 and the fly ash in CAS 25-99-12 will be sampled to determine if the contaminant source material contains COCs. If the source material does not contain COCs, it will be determined that the soil underlying these sources also does not contain COCs. Additional random samples will be collected at CASs 25-23-01, 25-23-19, and 25-99-18 as described in Section 4.2.1.

If COCs are suspected or confirmed, step-out sampling may be necessary to properly define the extent of contamination (i.e., contaminant boundaries). Step-out (Decision II) sampling locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected, the CSM, and other biasing factors listed in Section 4.2.1. In general, step-out sample locations will be arranged in a triangular pattern around the Decision I location at distances based on site conditions, process knowledge, and biasing factors. If COCs extend beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. At each step-out location, screening samples will be collected at the maximum depth where COCs were encountered and from two additional depth intervals. If the field-screening results are not greater than field-screening levels (FSLs), one of these samples (typically the uppermost) will be submitted to the laboratory for analysis. A minimum of one clean sample (i.e., COCs less than PALs) will be collected from each lateral and vertical direction and submitted for laboratory analysis to define the extent of COC contamination. The lateral and vertical extent of COCs will be established based on validated laboratory analytical results (not field screening). The number, location, and spacing of step-outs may be modified by the Site Supervisor, as warranted by site conditions. This sampling approach is designed to bound the COCs both vertically and horizontally.

Where sampling locations are modified by the Site Supervisor, the justification for these modifications will be documented in the field logbook. Section 3.4 provides the analytical methods and laboratory requirements (i.e., detection limits, precision, and accuracy requirements) to be used when analyzing the COPCs. The analytical program for each CAS is presented in Table 3-3. All sampling activities and quality control requirements for field and laboratory environmental sampling will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable, approved procedures.

4.2.1 Sample Location Selection

Biasing factors will be used to select the most appropriate sample locations and field screening will be used to select the most appropriate samples from a particular location for submittal to the analytical laboratory. Biasing factors to be used for selection of sampling locations will include the following:

- Documented process knowledge on source and location of release
- Visual evidence of discoloration, textural discontinuities, disturbance of native soils, or any other indication of potential contamination
- Presence of debris or equipment
- Presence of hot spots based on the results of radiological surveys
- Field-screening results
- Previous sample or screening results
- Experience and data from investigations of similar sites
- Additional samples will be collected, as necessary, for waste characterization per site supervisor and/or EC lead

As biasing factors are identified and used for selection of sampling locations, they will be documented in the appropriate field documents. The CAS-specific sampling strategy and the locations of the biased samples that were estimated for each CAS are presented in Appendix A.1.

Additionally, supplemental samples will be collected from random locations within CASs 25-23-01, 25-23-19, and 25-99-18 determined using the VSP software (PNNL, 2002). Examples of the selection of randomized sampling locations for each CAS and the use of the VSP software are described in Appendix A.3.

4.3 Bioassessment Tests

Bioassessment is a series of tests designed to evaluate the physical, chemical, and microbiological characteristics of a site. Bioassessment tests include determinants of nutrient availability, pH, microbial population density, and the ability of the microbial population to grow under enhanced conditions. This type of analysis may be required if it is determined that hydrocarbon contamination is present at a site where bioremediation is a potential corrective action. Bioassessment samples may be collected if biasing factors suggest that a fuel or solvent plume may be present.

4.4 Safety

A current version of the HASP will accompany the field documents, and a site-specific health and safety plan (SSHASP) will be prepared and approved prior to the field effort. As required by the DOE 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 will reduce or eliminate the possibility of injury, illness, or accidents, and to protect the environment during all project activities. The following safety issues will be taken into consideration when evaluating the hazards and associated control procedures for field activities discussed in the SSHASP:

- Potential hazards to site personnel and the public include, but are not limited to: radionuclides, chemicals (e.g., heavy metals, VOCs, SVOCs, and petroleum hydrocarbons), adverse and rapidly changing weather, remote location, and motor vehicle and heavy equipment operations.

- 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 use of appropriate 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 to include medical care and evacuation, decontamination, spill control measures, and appropriate notification of project management. The same principles apply to emergency communications.

- If potential asbestos containing material is identified (CFR, 2002d; NAC, 2002d), it will be inspected and/or samples collected by trained personnel.

5.0 Waste Management

Management of IDW will be based on regulatory requirements, field observations, process knowledge, and the results of laboratory analysis of CAU 214 investigation samples.

Disposable sampling equipment, PPE, and rinsate are considered potentially contaminated waste only by virtue of contact with potentially contaminated media (e.g., soil) or potentially contaminated debris (e.g., construction materials). Therefore, sampling and analysis of IDW, separate from analyses of site investigation samples, may not be necessary for all IDW. However, if associated investigation samples are found to contain contaminants above regulatory levels, direct samples of IDW may be taken to support waste characterization.

Sanitary, hazardous, radioactive, and/or mixed 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 Streams

Waste generated during the investigation activities will include the following potential waste streams:

- 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 (e.g., lead brick)
- Field screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminated by field-screening activities)

Office trash and lunch waste will be sent to the sanitary land fill by placing the waste in the dumpster. Each waste stream generated will be reviewed and segregated at the point of generation by the following waste types:

- Sanitary waste
- Hazardous waste
- Polychlorinated biphenyls
- Low-level waste
- Mixed waste

5.3 Investigation-Derived Waste Management

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 RadCon Manual (DOE/NV, 2000) 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.

5.3.1 Sanitary Waste

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 rolloff box located in Mercury, or other approved rolloff box location. The number of bags of sanitary IDW placed in the rolloff box will be counted as they are placed in the rolloff box, noted in a log, and

Table 5-1
Waste Management Regulations and Requirements

Waste Type	Federal Regulation	Additional Requirements
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. 3iii[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	NAC445A.2272[k] NTS Landfill Permit SW13.097.02[l]
Polychlorinated Biphenyls	TSCA[m]	NRS 459.400 - 459.600[g] NAC 444.940 - 444.9555[o]
Asbestos	TSCA[n]	NRS 618.750-618.801[p] NAC 444.965-444.970[q]

[a]*Nevada Revised Statutes* (NRS, 2001a)
[b]*Nevada Administrative Code* (NAC, 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* (NRS, 2001b)
[h]*Nevada Administrative Code* (NAC, 2002b)
[i]*Performance Objective for the Certification of Nonradioactive Hazardous Waste* (BN, 1995)
[j]Nevada Test Site Waste Acceptance Criteria, Revision 4 (NNSA/NV, 2002b)
[k]*Nevada Administrative Code* (NAC, 2002b)
[l]Area 6 Hydrocarbon Landfill, Nevada Division of Environmental Protection (NDEP, 1997b)
[m]*Toxic Substance Control Act* (40 CFR 761) (CFR, 2002c)
[n]*Toxic Substance Control Act* (40 CFR 763) (CFR, 2002d)
[o]*Nevada Administrative Code* (NAC, 2002c)
[p]*Nevada Revised Statutes* (NRS, 2001c)
[q]*Nevada Administrative Code* (NAC, 2002d)

NA = Not applicable
TSCA = Toxic Substance Control Act

documented in the field activity daily log. These logs will provide necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill or other approved landfill.

5.3.1.1 Special Sanitary

Hydrocarbon waste is defined as waste containing more than 100 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.

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.

5.3.2 Hazardous Waste

Corrective Action Unit 214 will have waste storage areas established according to the needs of the project. Satellite accumulation areas and hazardous waste accumulation areas will be managed consistent with the requirements of Federal and State regulation (CFR, 2002a and NAC,2002b). They 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 will be handled, inspected, and managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 265, Subpart I (CFR, 2002a). 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.

Hazardous Waste Accumulation Areas 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 (CFR, 2002a). No RCRA "listed" wastes have been identified at CAU 214. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT to a permitted treatment, storage, and disposal facility (CFR, 2002a).

5.3.2.1 Management of Personal Protective Equipment

Personal Protective Equipment 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 and equipment that is not visibly stained, discolored, or grossly contaminated and that is within radiological free-release criteria will be managed as nonhazardous sanitary waste.

5.3.2.2 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 such things as the presence of a visible sheen, 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, then 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 for the NTS as follows:

- Rinsate that is determined to be nonhazardous and contaminated to less than 5x *Safe Drinking Water Standards* (SDWS) is not restricted as to disposal. Nonhazardous rinsate which is contaminated at 5x to 10x 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 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.

5.3.2.3 Management of Soil

This waste stream consists of soil produced during soil sampling, excavation, and/or drilling. This waste stream is considered to have the same COPCs as the material remaining in the ground. The preferred method for managing this waste stream 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.

5.3.2.4 Management of Debris

This waste stream can vary depending on site conditions. Debris that requires removal for the investigation activities (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 characterized 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, or by placement in a container(s). The disposal of debris may be deferred until implementation of corrective action at the site.

5.3.2.5 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 Section 5.3.5 of this document.

5.3.3 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, 2002c). 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, 2002c) as well as State of Nevada requirements, (NAC, 2002c) guidance, and agreements with NNSA/NSO.

5.3.4 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 streams exiting a radiologically controlled area. This allows for the immediate segregation of radioactive waste from waste that may be unrestricted regarding radiological release. Removable contamination limits, as defined in Table 4-2 of the current version of the NV/YMP RadCon Manual (DOE/NV, 2000), 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 is determined to be below the values of Table 4-2, by either direct radiological survey/swipe results or through process knowledge, will not be managed as potential radioactive waste but will be managed in accordance with the appropriate section of this document. Wastes in excess of Table 4-2 values will be managed as potential radioactive waste and be managed in accordance with this section and any other applicable sections of this document.

Low-level radioactive waste, 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, 2002b). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated RMA or radiologically controlled area 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, 2002b).

5.3.5 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 if the waste meets the requirements of the NTSWAC (NNSA/NV, 2002b). 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 characterization activities described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each CAS in CAU 214. Section 6.1 and Section 6.2 discuss the collection of required QC samples in the field and QA requirements for laboratory/analytical data to achieve closure. Section 6.3 provides QA/QC requirements for radiological survey data. Unless otherwise stated in this CAIP or required by the results of the DQO process (see Appendix A.1), this investigation will adhere to the Industrial Sites QAPP (NNSA/NV, 2002a).

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 environmental sample results. The number of required QC samples depends 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 (one per sample cooler containing VOC environmental samples)
- Equipment blanks (one per sampling event for each type of decontamination procedure)
- Source blanks (one per lot of source material that contacts sampled media)
- Field duplicates (1 per 20 environmental samples or 1 per CAS per matrix, if less than 20 collected)
- Field blanks (1 per 20 environmental samples)
- Matrix spike (MS)/matrix spike duplicate (MSD) (1 per 20 environmental samples or 1 per CAS per matrix, if less than 20 collected, not required for all radionuclide measurements)

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

6.2 Laboratory/Analytical Quality Assurance

Criteria for the investigation, as stated in the DQOs (Appendix A.1) and except where noted, require laboratory analytical quality data be used for making critical decisions. Rigorous QA/QC will be implemented for all laboratory samples including documentation, data verification and validation of analytical results, and an assessment of data quality indicators (DQIs) as they relate to laboratory analysis.

6.2.1 Data Validation

Data verification and validation will be performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002a), except where otherwise stipulated in this CAIP. All nonradiological laboratory data from samples collected and analyzed will be evaluated for data quality according to *EPA Functional Guidelines* (EPA, 1994a and 1999). Radiological laboratory data from samples that are collected and analyzed will be evaluated for data quality according to company-specific procedures. The data will be reviewed to ensure that all critical samples were appropriately collected, analyzed, and the results passed data validation criteria. Validated data, including estimated data (i.e., J-qualified), will be assessed to determine if they meet the DQO requirements of the investigation and the performance criteria for the DQIs. The results of this assessment will be documented in the CADD. If the DQOs were not met, corrective actions will be evaluated, selected, and implemented (e.g., refine CSM or resample to fill data gaps).

6.2.2 Data Quality Indicators

Data quality indicators are qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of data. The principal DQIs are precision, accuracy, representativeness, comparability, and completeness. A sixth DQI, sensitivity, has also been included for the CAU 214 investigation. Data quality indicators are used to evaluate the entire measurement system and laboratory measurement processes (i.e., analytical method performance) as well as to evaluate individual analytical results (i.e., parameter performance).

Precision and accuracy are quantitative measures used to assess overall analytical method and field sampling performance as well as to assess the need to “flag” (qualify) individual parameter results when corresponding QC sample results are not within established control limits. Therefore, performance metrics have been established for both analytical methods and individual analytical results. Data qualified as estimated for reasons of precision or accuracy may be considered to meet the parameter performance criteria based on assessment of the data.

Representativeness and comparability are qualitative measures, and completeness is a combination of both quantitative and qualitative measures. Representativeness, comparability, and completeness are used to assess the measurement system performance. The DQI parameters are individually discussed in Section 6.2.3 through Section 6.2.8.

Table 6-1 provides the established analytical method/measurement system performance criteria for each of the DQIs and the potential impacts to the decision if the criteria are not met. The Industrial Sites QAPP (NNSA/NV, 2002a) documents the actions required to correct conditions that adversely affect data quality both in the field and the laboratory. All DQI performance criteria deficiencies will be evaluated for data usability and impacts to the DQO decisions. These evaluations will be discussed and documented in the data assessment section of the CADD. The following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data.

6.2.3 Precision

Precision is used to assess the variability of a population of measurements with the variability of the analysis process. The method used to calculate relative percent difference (RPD) is presented in the Industrial Sites QAPP (NNSA/NV, 2002a).

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

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 214 Data Quality Indicators

Data Quality Indicator	Performance Criteria	Potential Impact on Decision if Performance Criteria Not Met
Precision	Variations between duplicates (laboratory and field) and original sample should not exceed analytical method-specific criteria discussed in Section 6.2.3.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for precision are not met.
Accuracy	Laboratory control sample, matrix spike, and surrogate results should be within specified acceptance windows.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for accuracy are not met.
Sensitivity	Laboratory detection limits must be less than or equal to respective PALs.	Cannot determine if COCs are present or migrating at levels of concern; therefore, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.
Comparability	Equivalent samples analyzed using same analytical methods, the same units of measurement and detection limits must be used for like analyses.	Inability to combine data with data obtained from other sources and/or inability to compare data to regulatory action levels.
Representativeness	Correct analytical method performed for appropriate COPC; valid data reflects appropriate target population.	Cannot identify COC or estimate concentration of COC; therefore, cannot make decision(s) on target population.
Nature Completeness	80% of the CAS-specific noncritical analytes identified in the CAIP have valid results. 100% of critical analytes are valid.	Cannot make decision on whether COCs are present.
Extent Completeness	100% of critical analytes used to define extent of COCs are valid.	Extent of contamination cannot be determined.
Clean Closure Completeness	100% of critical analytes are valid.	Cannot determine if COCs remain in soil.

6.2.3.1 Precision for Chemical Analysis

The RPD criteria to be used for assessment of precision are the parameter-specific criteria listed in Table 3-4. No review criteria for field duplicate RPD comparability have been established; therefore, the laboratory sample duplicate criteria will be applied to the review of field duplicates.

The parameter performance criteria for precision will be compared to RPD results of duplicate samples. This will be accomplished as part of the data validation process. Precision values for organic and inorganic analyses that are within the established control criteria indicate that analytical results for associated samples are valid. The RPD values that are outside the criteria for organic analysis do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgement about the quality of the reported analytical results. Inorganic laboratory sample duplicate RPD values outside the established control criteria result in the qualification of associated analytical results as estimated; however, qualified data does not necessarily indicate that the data are not useful for the purpose intended. This qualification is an indication that data precision should be considered for the overall assessment of the data quality and potential impact on data applicability in meeting site characterization objectives.

The criteria to evaluate analytical method performance for precision will be assessed based on the analytical method-specific (e.g., VOCs) precision measurements. Each analytical method-specific precision measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.3.2 Precision for Radiochemical Analysis

The parameter performance criteria for precision will be compared to the RPD or normalized difference (ND) results of duplicate samples. The criteria for assessment of the radiochemical precision are parameter-specific criteria (see Table 3-4). This assessment will be accomplished as part of the data validation process. Precision values that are within the established control criteria indicate that analytical results for associated samples are valid. Out of control RPD or ND values do not necessarily indicate that the data are not useful for the purpose intended; however, it is an indication that data precision should be considered for the overall assessment of the data quality and the potential impact on data applicability in meeting site characterization objectives.

If the RPD or ND criteria are exceeded, samples will be qualified. Field duplicates will be evaluated, but field samples will not be qualified based on their results. The MSD results outside of the control limits may not result in qualification of the data. An assessment of the entire analytical process, including the sample matrix, will be conducted to determine if qualification is warranted.

Each analytical method-specific precision measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.4 Accuracy

Accuracy is a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. It is used to assess the performance of laboratory measurement processes as well as to evaluate individual groups of analyses (i.e., sample delivery groups).

Accuracy is determined by analyzing a reference material of known parameter concentration or by reanalyzing a sample to which a material of known concentration or amount of parameter has been added (spiked).

6.2.4.1 Accuracy for Chemical Analyses

The criteria to be used for assessment of accuracy are the parameter-specific criteria listed in Table 3-4. Accuracy for chemical analyses will be evaluated based on results from three types of spiked samples: MS, LCS, and surrogates.

For organic analyses, laboratory control limits are used for evaluation of percent recovery. The acceptable control limits for organic analyses are established in the EPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, 1994a).

The percent recovery parameter performance criteria for accuracy will be compared to percent recovery results of spiked samples. This will be accomplished as part of the data validation process. The percent recovery values that are outside the criteria do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. Factors beyond the laboratory’s control, such as sample matrix effects, can cause the measured values to be outside of the established criteria. Therefore, the entire sampling and analytical process must be evaluated when determining the quality of the analytical data provided.

The criteria to evaluate analytical method performance for accuracy will be based on the analytical method-specific (e.g., VOCs) accuracy measurements. Each analytical method-specific accuracy measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.4.2 Accuracy for Radiochemical Analysis

Accuracy for radiochemical analyses will be evaluated based on results from LCS and MS samples. The LCS sample is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS will be prepared with each batch of samples for analysis by a specific measurement.

The MS samples are analyzed to determine if the measurement accuracy is affected by the sample matrix. The MS samples are analyzed with sample batches, when requested.

The percent recovery criteria to be used for assessment of accuracy will be the control limits for radiochemical analyses listed in Table 3-4.

The criteria to evaluate analytical method performance for accuracy will be assessed based on the analytical method-specific (e.g., gamma spectrometry) accuracy measurements. Each analytical method-specific accuracy performance will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.5 Representativeness

Representativeness is the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Representativeness is assured by a carefully developed sampling strategy, collecting the specified number of samples from proper sampling locations, and analyzing them by the approved analytical methods. An evaluation of this qualitative criterion will be presented in the CADD.

6.2.6 Completeness

Completeness is a quantitative and qualitative evaluation of measurement system performance. The criterion for meeting completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. The quantitative measurement to be used to evaluate completeness is presented in Table 6-1 and is based on the percentage of measurements made that are judged to be valid. If these criteria are not achieved, the dataset will be assessed for potential impacts on meeting site characterization objectives.

The qualitative criterion for evaluation of measurement system performance is that sufficient data of the appropriate quality have been generated to satisfy the data needs identified in the DQOs. An evaluation of this qualitative criterion will be presented in the CADD.

6.2.7 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). To ensure comparability, all samples will be subjected to the same sampling, handling, preparation, analysis, reporting, and validation criteria. Approved standard methods and procedures will also be used to analyze and report the data (e.g., Contract Laboratory Program [CLP] and/or CLP-like data packages). This approach ensures that the data from this project can be compared to regulatory action levels. An evaluation of this qualitative criterion will be presented in the CADD.

6.2.8 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest (EPA, 2001a). The evaluation criteria for this parameter will be that measurement sensitivity (detection limits) will be less than or equal to the corresponding PALs. If this criterion is not achieved, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.

6.3 Radiological Survey Quality Assurance

Radiological surveys will be performed and data collected in accordance with approved standard operating procedures.

7.0 Duration and Records Availability

7.1 Duration

After the submittal of the CAIP to NDEP (FFACO milestone date of May 30, 2003), the following is a tentative schedule of activities (in calendar days):

- Day 0: Preparation for field work will begin.
- Day 76: The field work will commence. Samples will be shipped to meet laboratory holding times.
- Day 131: The field investigation will be completed.
- Day 257: The quality-assured laboratory analytical data will be available for NDEP review.
- The FFACO date for the CADD is August 31, 2004.

7.2 Records Availability

Historic information and documents referenced in this plan are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Project Manager. 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.

8.0 References

BN, see Bechtel Nevada.

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

Bechtel Nevada. 1996. *U.S. Department of Energy, Nevada Operations Office Environmental Data Report for the Nevada Test Site - 1994,* DOE/NV/11718-026. Prepared by S.C. Black and Y.E. Townsend. Las Vegas, NV.

Center for Land Use Interpretation. 1996. *The Nevada Test Site, A Guide to America's Nuclear Proving Ground*. Culver City, CA.

CFR, see *Code of Federal Regulations.*

Code of Federal Regulations. 2002a. Title 40 CFR, Parts 260-282, "Hazardous Waste Management System: General." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2002b. Title 40 CFR Part 261, "Identification and Listing of Hazardous Waste." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2002c. Title 40 CFR, Parts 761, "Polychlorinated Byphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2002d. Title 40 CFR, Part 763, "Asbestos." Washington, DC: U.S. Government Printing Office.

DASA, see Defense Atomic Support Agency.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

DRI, see Desert Research Institute.

DRI and Carey & Co., see Desert Research Institute and Carey & Co., Inc.

Defense Atomic Support Agency. 1960. *Operation Plumbbob*, 31 August. Albuquerque, NM.

Desert Research Institute. 1988. *CERCLA Preliminary Assessments of DOE's Nevada Operations Office, Nuclear Weapons Testing Areas,* April. Las Vegas, NV.

Desert Research Institute and Carey & Co., Inc. 1996. *Nevada Test Site Historic Structures Survey*, March, DOE/NV/95N11508-05. Las Vegas, NV.

EPA, see U.S. Environmental Protection Agency.

ERDA, See U.S. Energy Research and Development Administration.

EG&G Rocky Flats. 1991. *General Radiochemistry and Routine Analytical Services Protocol (GRASP),* Version 2.1, July. Golden, CO: Environmental Management Department.

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

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

Guymon, R.H., Reynolds Electrical & Engineering Co., Inc. 1995. Letter to D. Elle (DOE/NV) entitled "Investigation of the Area 25 West Yard Drums and Soil Contamination," 19 September. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 2002. CAU 214 project files. Las Vegas, NV.

Kendall, E.W., Reynolds Electrical & Engineering Co., Inc. 1995. Letter to D. Elle (DOE/NV) entitled, "Cleanup of the Area 25 West Yard," 17 October. Las Vegas, NV.

LLNL, see Lawrence Livermore National Laboratory.

Laczniak, R.J., J.C. Cole, D.A. Sawyer, and D.A. Trudeau. 1996. *Summary of Hydrogeologic Controls Ground-Water flow at the Nevada Test Site, Nye County, Nevada*. As accessed at http://water.usgs.geo/pubs/wri/wri964109/report.htm on January 28, 2002.

Lawrence Livermore National Laboratory. 1982. "The Geology of Yucca Flat." In *Energy and Technology Review,* April. Livermore, CA.

McArthur, R.D., and R.L. Miller, Jr. 1989. *Off-Site Radiation Exposure Review Project, Phase II Soil Program*, DOE/NV/10384-23. Las Vegas, NV: Desert Research Institute.

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

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

NDEP, see Nevada Division of Environmental Protection.

National Oceanic and Atmospheric Administration. 2002. "Precipitation Summary." As accessed at http://www.sord.nv.doe.gov/home_climate.htm on 13 November.

Nevada Administrative Code. 2002a. NAC 444.570 - 444.7499, "Solid Waste Disposal." Carson City, NV.

Nevada Administrative Code. 2002b. NAC 444.850 - 444.8746, "Disposal of Hazardous Waste." Carson City, NV.

Nevada Administrative Code. 2002c. NAC 444.940 - 444.9555, "Polychlorinated Biphenyl." Carson City, NV.

Nevada Administrative Code. 2002d. NAC 444.965 - 444.976, "Disposal of Asbestos." Carson City, NV.

Nevada Administrative Code. 2002e. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV.

Nevada Bureau of Mines and Geology. 1972. *Geology and Mineral Deposits of Southern Nye County, Nevada, Bulletin 77.* Prepared by H.R. Cornwall. Reno, NV: Mackay School of Mines, University of Nevada.

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

Nevada Division of Environmental Protection. 1995. *Mutual Consent Agreement between the State of Nevada and the U.S. Department of Energy for the Storage of Low-Level Land Disposal Restricted Mixed Waste.* Carson City, NV.

Nevada Division of Environmental Protection. 1997a. *Class II Solid Waste Disposal Site for Municipal and 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; UIOC, 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*, No. GNEV93001. Carson City, NV.

Nevada Revised Statutes. 2001a. NRS 444.440 - 444.620, "Collection and Disposal of Solid Waste." Carson City, NV.

Nevada Revised Statutes. 2001b. NRS 459.400 - 459.600, "Disposal of Hazardous Waste." Carson City, NV.

Nevada Revised Statutes. 2001c. NRS 618.750-618.801 "Disposal of Hazardous Waste." Carson City, NV.

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

NOAA, see National Oceanic and Atmospheric Administration.

NRS, see *Nevada Revised Statutes*.

Paar, J.G., and D.R. Porterfield. 1997. *Evaluation of Radiochemical Data Usability*, April, ES/ER/MS-5. Oak Ridge, TN: U.S. Department of Energy.

Pacific Northwest National Laboratory. 2002. *Visual Sample Plan Version 2.0 User's Guide*. September. PNNL-14002. Richland, WA.

PNNL, see Pacific Northwest National Laboratory.

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

Reynolds Electrical & Engineering Co., Inc. 1991. *Nevada Test Site Inventory of Inactive and Abandoned Facilities and Waste Sites*, Areas 11-15 Volume 3 of 5, April. Las Vegas, NV.

Shott, G.J., V. Yucel, M.J. Sully, L.E. Barker, S.E. Rawlinson, and B.A. Moore. 1997. *Performance Assessment/Composite Analysis for the Area 3 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*, Rev. 2.0. Las Vegas, NV.

Sorom, E., Reynolds Electrical & Engineering Co., Inc. 1998. Record of Telecon with C. Speer (SAIC) regarding the REECo West Storage Yard Contaminated Materials, 28 April. Las Vegas, NV: ITLV.

USGS, see U.S. Geological Survey.

United States Code. 1976. 15 USC 2601 et seq., "Toxic Substances Control Act." Enacted by Public Law No. 94-469, as amended. Washington, DC: U.S. Government Printing Office.

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

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002b. *Nevada Test Site Waste Acceptance Criteria*, DOE/NV--325, Rev. 4. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1992. *Remedial Investigation and Feasibility Study for the Plutonium Contaminated Soils at Nevada Test Site, Nellis Air Force Range and Tonopah Test Range*, April. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1994. *Project Management Plan*, Rev. 0. Las Vegas, NV.

U.S. Department of Energy, Nevada Operation Office. 1996. *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS 0243. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998. *Nevada Test Site Resource Management Plan*. DOE/NV--518, Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1999. *Underground Test Area Project Corrective Action Unit 98: Frenchman Flat*. April. DOE/NV 13052--044--V2. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000. *Safety Management System Policy*, NV P 450.4. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000. *NV/YMP Radiological Control Manual*, Rev. 4, DOE/NV/11718-079, UC-702. Prepared by A.L. Gile of Bechtel Nevada. Las Vegas, NV.

U.S. Ecology and Atlan-Tech. 1991. *Environmental Monitoring Report for the Proposed Ward Valley, California, Low Level Radioactive Waste Facility*. Rosewell, GA.

U.S. Energy Research and Development Administration. 1977. *Final Environmental Impact Statement, Nevada Test Site, Nye County Nevada*, ERDA-1551, Washington, DC.

U.S. Environmental Protection Agency. 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA 600/4-80-032. Washington, DC.

U.S. Environmental Protection Agency. 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/003. Washington, DC.

U.S. Environmental Protection Agency. 1988a. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, SOW No. 788, EPA/540/R-94/093. Washington, DC.

U.S. Environmental Protection Agency. 1988b. *Contract Laboratory Program Statement of Work for Organic Analysis*, SOW No. 2/88, EPA/540/R-94/096. Washington, DC.

U.S. Environmental Protection Agency. 1991. *Contract Laboratory Program Statement of Work for Organic Analysis*, OLMO 1.8, EPA/540/R-94/078. Washington, DC.

U.S. Environmental Protection Agency. 1994a. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA/540/R-94/013. Washington, DC.

U.S. Environmental Protection Agency. 1994b. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, ILMO 3.0, EPA/540/R-94/076. Washington, DC.

U.S. Environmental Protection Agency. 1994c. *Contract Laboratory Program Statement of Work for Organic Analysis*, OLMO 3.1, EPA/540/R-94/073. Washington, DC.

U.S. Environmental Protection Agency. 1995. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, ILMO 4.0, EPA/540/R-95/121. Washington, DC.

U.S. Environmental Protection Agency. 1996. *Test Method for Evaluating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition. Washington, DC.

U.S. Environmental Protection Agency. 1999. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA 540/R-99/008. Washington, DC.

U.S. Environmental Protection Agency. 2001a. Guidance on Data Quality Indicators, EPA QA/G-5i. Washington, DC.

U.S. Environmental Protection Agency. 2001b. *Integrated Risk Information System (IRIS) Database,* as accessed at http://www.epa.gov/iris/index.html on 11 February 2003.

U.S. Environmental Protection Agency. 2002. Memorandum from S.J. Smucker to PRG table mailing list regarding *Region IX Preliminary Remediation Goals (PRGs)*, 1 October. San Francisco, CA.

U.S. Geological Survey, 1995. *Selected Groundwater Data for Yucca Mountain Region, Southern Nevada and Eastern California,* Calendar Year 1993, USGS-OFR-95-58. Prepared by G.S. Hale and C.L. Westenburg, Denver CO.

U.S. Geological Survey. 1990 *Geologic Map of the Nevada Test Site, Southern Nevada,* USGS Map I-2046. Denver, Co.

U.S. Geological Survey. 2002. "Ground Water for Nevada: Water Levels." As accessed at http://waterdata.usgs.gov/nv/nwis/gwlevels on 9 October.

Winograd, I.J., and W. Thordarson. 1975. *Hydrology and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site*, USGS Professional Paper 712-C. Denver, CO.

Appendix A.1

Data Quality Objectives

A.1 Data Quality Objectives Process for CAU 214

The Data Quality Objectives process described in this appendix is a seven-step strategic planning approach based on the scientific method was used to plan data collection activities at CAU 214, Bunkers and Storage Areas. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend recommended corrective actions (i.e., no further action, closure in place, or clean closure). Information about the nature and extent of contamination at the CASs in CAU 214 is insufficient to evaluate and select preferred corrective actions at this time; therefore a CAI will be required.

The CAU 214 CAI will be based on the DQOs presented in this appendix as developed by representatives of the NDEP and the NNSA/NSO. The seven steps of the DQO process developed for CAU 214 and presented in Section A.1.2 through Section A.1.8 were developed based on the CAS-specific information presented in Section A.1.1 and in accordance with *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, 1998. This document identifies and references the associated EPA Quality System Document for DQOs entitled *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA, 2000) upon which the DQO process presented herein is based.

A.1.1 CAS-Specific Information

The nine CASs in CAU 214 are located in Areas 5, 11, and 25 of the NTS, as shown in Figure A.1-1. The CASs include:

- 05-99-01, Fallout Shelters
- 11-22-03, Drum
- 25-99-12, Fly Ash Storage
- 25-23-01, Contaminated Materials
- 25-23-19, Radioactive Material Storage
- 25-99-18, Storage Area
- 25-34-03, Motor Dr/Gr Assembly (Bunker)
- 25-34-04, Motor Dr/Gr Assembly (Bunker)
- 25-34-05, Motor Dr/Gr Assembly (Bunker)

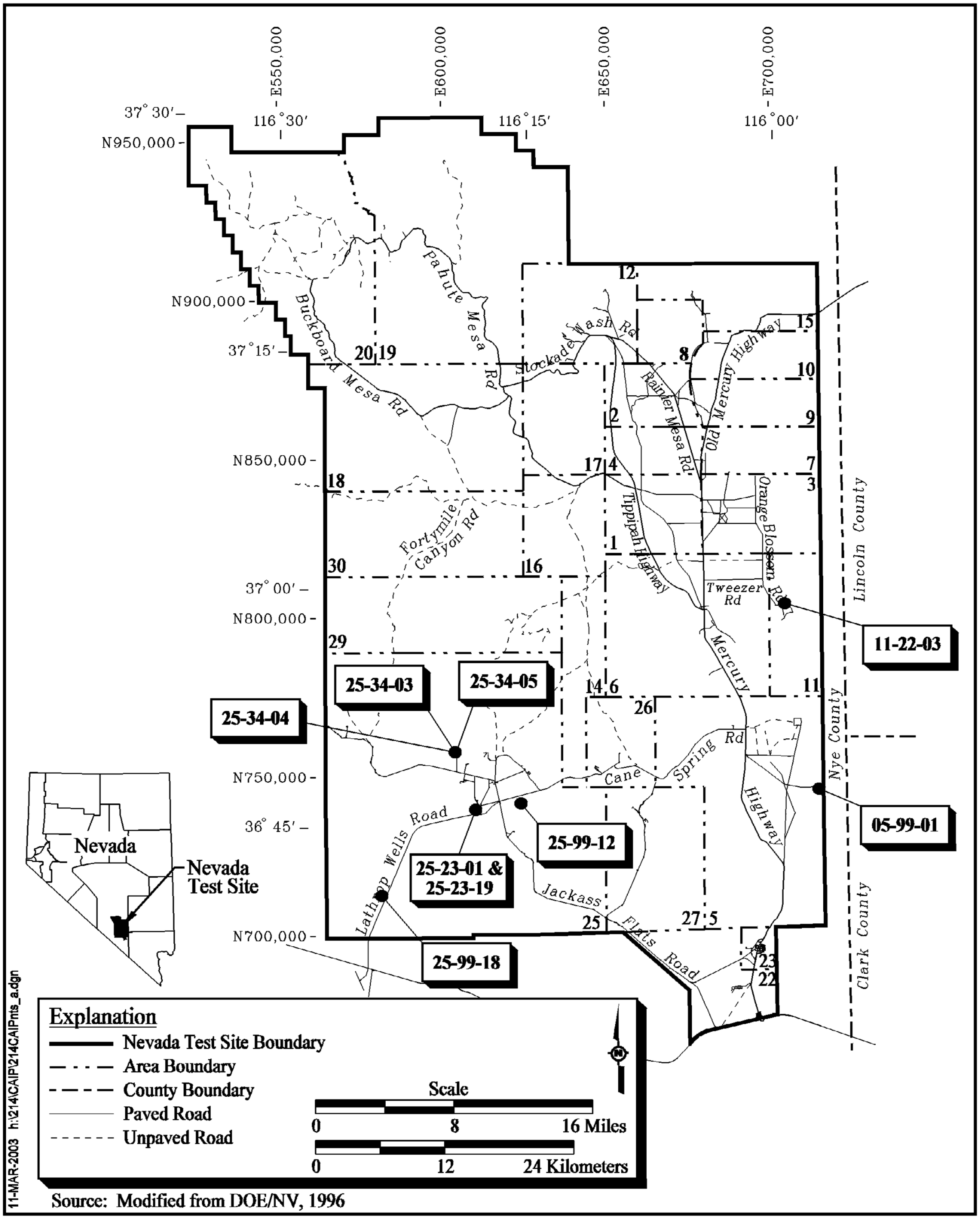


Figure A.1-1
CAU 214, CAS Location Map

Table A.1-1
CAU 214 Contaminants of Potential Concern

Corrective Action Site / COPC	05-99-01 Fallout Shelters	11-22-03 Drum	25-99-12 Fly Ash Storage[a]	25-23-01 Contaminated Materials	25-23-19 Radioactive Material Storage	25-99-18 Storage Area	25-34-03, 25-34-04, 25-34-05 Motor Dr/Gr Assembly (Bunker)
Organics							
TPH (DRO)		X		C	C	C	X
TPH (GRO)		X		X	X	C	X
PCBs	X	X	X	C	C	X	X
VOCs	X	X		X	X	X	X
SVOCs	X	X		X	X	X	
Pesticides				C, X[b]	C, X[b]		
Herbicides				X	X		
Inorganics							
Asbestos	X					X	
Metals							
RCRA Metals, Beryllium	X	X	C, X[c]	C, X[d]	C, X[e]	X	
Radionuclides							
Gamma Spectrometry	X	X	X	X	X	X	X
Strontium-90	N		N	X	X	N	N
Isotopic Uranium	N		N	X	X	N	N
Isotopic Plutonium	N	X	N	X	X	N	N

C = Critical COPC X = Noncritical COPC N = Results of gamma analysis will be used to determine if further radioanalytical analysis is warranted.

[a]In addition to COPCs listed, samples will be analyzed for pH
[b]Chlordane, heptachlor, and 4,4'-DDT are critical COPCs; remaining pesticides are noncritical COPCs
[c]Arsenic is a critical COPC; remaining RCRA metals and beryllium are noncritical COPCs
[d]Arsenic, barium, cadmium, and chromium are critical COPCs; remaining RCRA metals and beryllium are noncritical COPCs
[e]Chromium is a critical COPC; remaining RCRA metals and beryllium are noncritical COPCs

The CAS-specific COPCs are described in the following CAS descriptions and listed in Table A.1-1. Critical COPCs are defined as those contaminants that are known or reasonably suspected to be present within the CAS based on previous sampling, process knowledge, geographic setting, and/or operational site history. Noncritical COPCs are defined as those contaminants than may be present within a CAS. Analyses for noncritical COPCs assist in reducing the uncertainty concerning the history and potential release from the CAS and allow for an accurate evaluation of potential contamination.

If any 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 COC contamination.

Soil contamination originating from the fallout of atmospheric nuclear weapons testing in the vicinity of CAS 05-99-01 and CAS 11-22-03 is not considered part of this CAU. Contamination originating from these sources will not be considered for sample location selection, and/or will not be considered COCs for Decision II. If fallout contamination is detected, it will be addressed by the Soils Project.

The following sections (Section A.1.1.1 through Section A.1.1.6) provide a CAS description, physical setting and operational history, sources of potential contamination, previous investigation results, and COPCs for each CAS in CAU 214.

A.1.1.1 CAS 05-99-01, Fallout Shelters

Corrective action site 05-99-01 consists of the soil in the ramp entrance and instrument pit floor within the footprint of the fallout shelters and soil surrounding the fallout shelter structures. The structures at the CAS include two domed aluminum fallout shelters, their adjacent instrument pits and dirt mounds, and surrounding debris associated with the shelters. Figure A.1-2 shows a site sketch of the CAS.

Physical Setting and Operational History - CAS 05-99-01 is located on Frenchman Flat in Area 5. The shelter foundations are constructed of concrete and steel and the domes were coated with aluminum sheeting bonded to asbestos cloth (DASA, 1960). The shelters were built during Operation Plumbbob in 1957 and instrumented to study the effects of nuclear blasts on different construction types and structure design. Both domes were destroyed and collapsed during the tests, although the

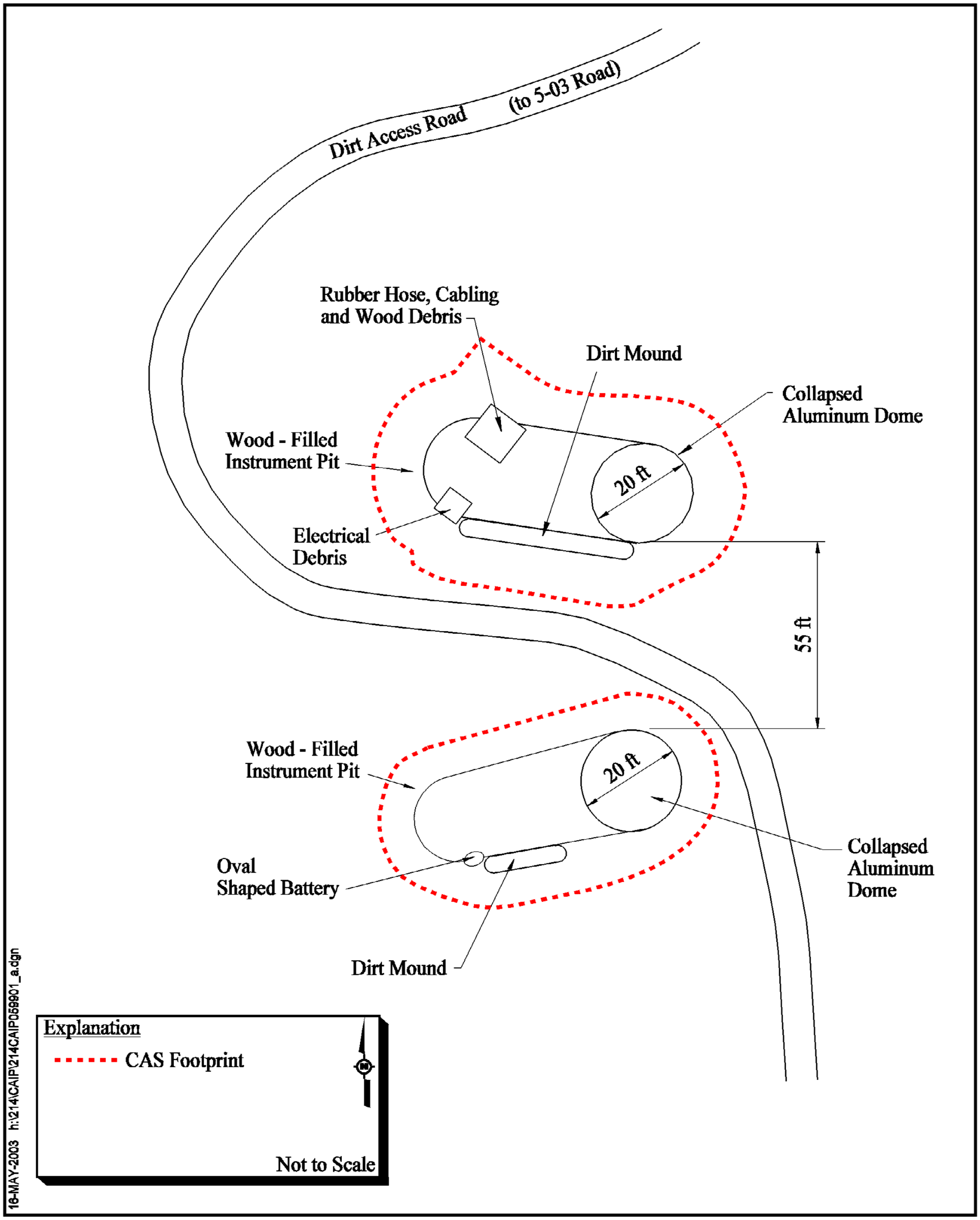


Figure A.1-2
Site Sketch of CAS 05-99-01, Fallout Shelters

foundations are still intact. The shelters have been identified as being potentially eligible for inclusion in the National Register of Historic Places in the *Nevada Test Site Historic Building Survey* (DRI and Carey & Co., 1996).

There is some debris mixed with soil in the immediate vicinity of the shelters. There is an excavated area on the downwind side of each shelter that served as an instrument pit and to provide access to shelter doors located below grade.

Sources of Potential Contamination - There is no indication that the equipment and materials inside of the fallout shelters or operations associated with the shelters are source(s) of potential contamination. There are no visible soil stains or other biasing factors at either fallout shelter, although the excavations are filled with tumbleweeds and the bottoms of the excavations cannot be fully observed. However, asbestos material is potentially present in the soil at the fallout shelters. Radioactive fallout contamination due to nuclear weapons testing is not included in this CAS.

Previous Investigation Results - No previous investigations have been identified for this CAS.

Contaminants of Potential Concern - The COPCs identified for CAS 05-99-01 are shown in Table A.1-1. There are no critical COPCs identified for this CAS. Noncritical COPCs include PCBs, VOCs, SVOCs, asbestos, RCRA metals, beryllium, and gamma-emitting radionuclides. Asbestos from the destroyed domes is potentially mixed in the soil or present on the ground surface, which will pose a health and safety consideration during the investigation of this CAS.

A.1.1.2 CAS 11-22-03, Drum

Corrective Action Site 11-22-03 consists of one 55-gallon, open-top drum with the lid in place; one 55-gallon open-top drum without a lid (cable was observed in this drum); and two piles of rusted cable (approximately 5 cubic yards). Figure A.1-3 shows a site sketch of the CAS.

Physical Setting and Operational History - CAS 11-22-03 is located in Area 11 and is within a radiologically-posted and fenced area labeled, “Danger High Contamination Area,” and “Caution Underground Radioactive Materials.” Area 11 (Plutonium Valley) was the site of four nuclear safety experiments in 1955 and 1956 (DASA, 1960). Although soil throughout this area is contaminated from the safety experiments, it is not known if contamination was released from the drums and cable

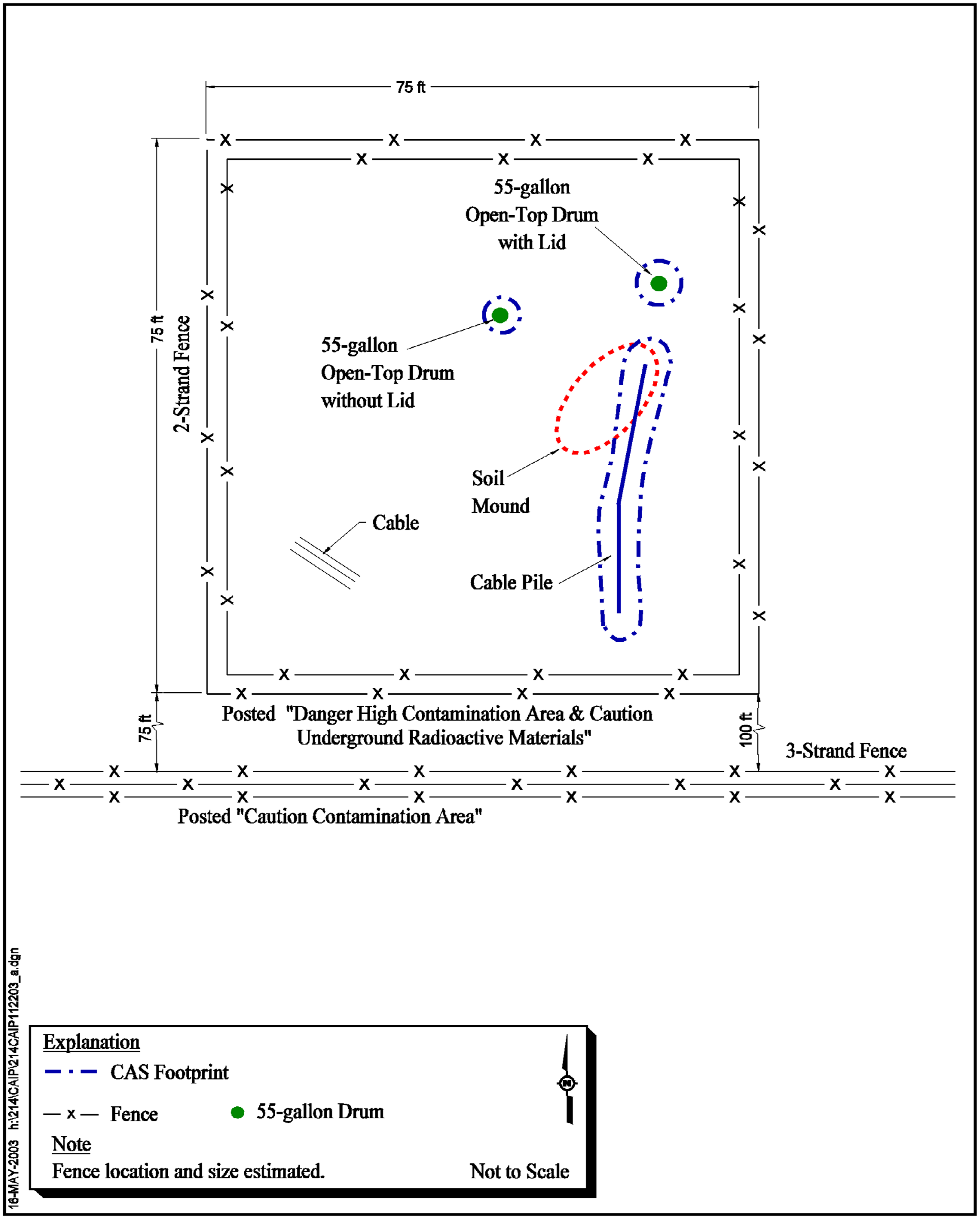


Figure A.1-3
Site Sketch of CAS 11-22-03, Drum

that constitute this CAS. It is also not known if the drums and cable pile were generated from the safety experiments. The source and contents of the drums are unknown except for the cable and metal that are visible in the open drum.

Sources of Potential Contamination - Although unlikely, sources of potential soil contamination are unknown fluids or solids leaking from the drums, or spills from the drums that may have occurred during drum transport or handling. Soil contamination associated with the drums and cable pile is not expected. Radioactive contamination resulting from the safety experiments and atmospheric nuclear testing is not considered part of this CAS.

Previous Investigation Results - No sampling of the drums or cable pile has been conducted. Four profile soil samples were collected from nearby contaminated waste dumps, created during early cleanup efforts. Analytical results show that plutonium isotopes are present in the top 2 in. of soil (DRI, 1988).

Contaminants of Potential Concern - The COPCs identified for CAS 11-22-03 are shown in Table A.1-1. No critical COPCs have been identified. Noncritical COPCs include TPH (DRO), TPH (GRO), PCBs, VOCs, SVOCs, RCRA metals, beryllium, gamma-emitting radionuclides, isotopic plutonium and daughter products.

A.1.1.3 CAS 25-99-12, Fly Ash Storage

Corrective Action Site 25-99-12 consists of a small wooden structure (i.e., shed; dimension 10 x 12 x 8 ft) and its contents (approximately 15 cubic yards of unconsolidated, lightweight, white, and powdery material believed to be fly ash). Figure A.1-4 shows a site sketch of the CAS.

Physical Setting and Operational History - CAS 25-99-12 is located near the BREN Tower in Area 25. The structure is in poor condition, exterior walls (plywood) bulging on all sides, and is held together with metal bands. Some of the contents (presumed to be fly ash) have migrated out of the structure through openings in the walls, door opening, and open windows. Fly ash is present on the ground surface around the structure.

The storage structure is located west of a one-story wooden building with oriental-style architecture, which may have been moved to the site from the Japanese village in Area 4. The exact use of either

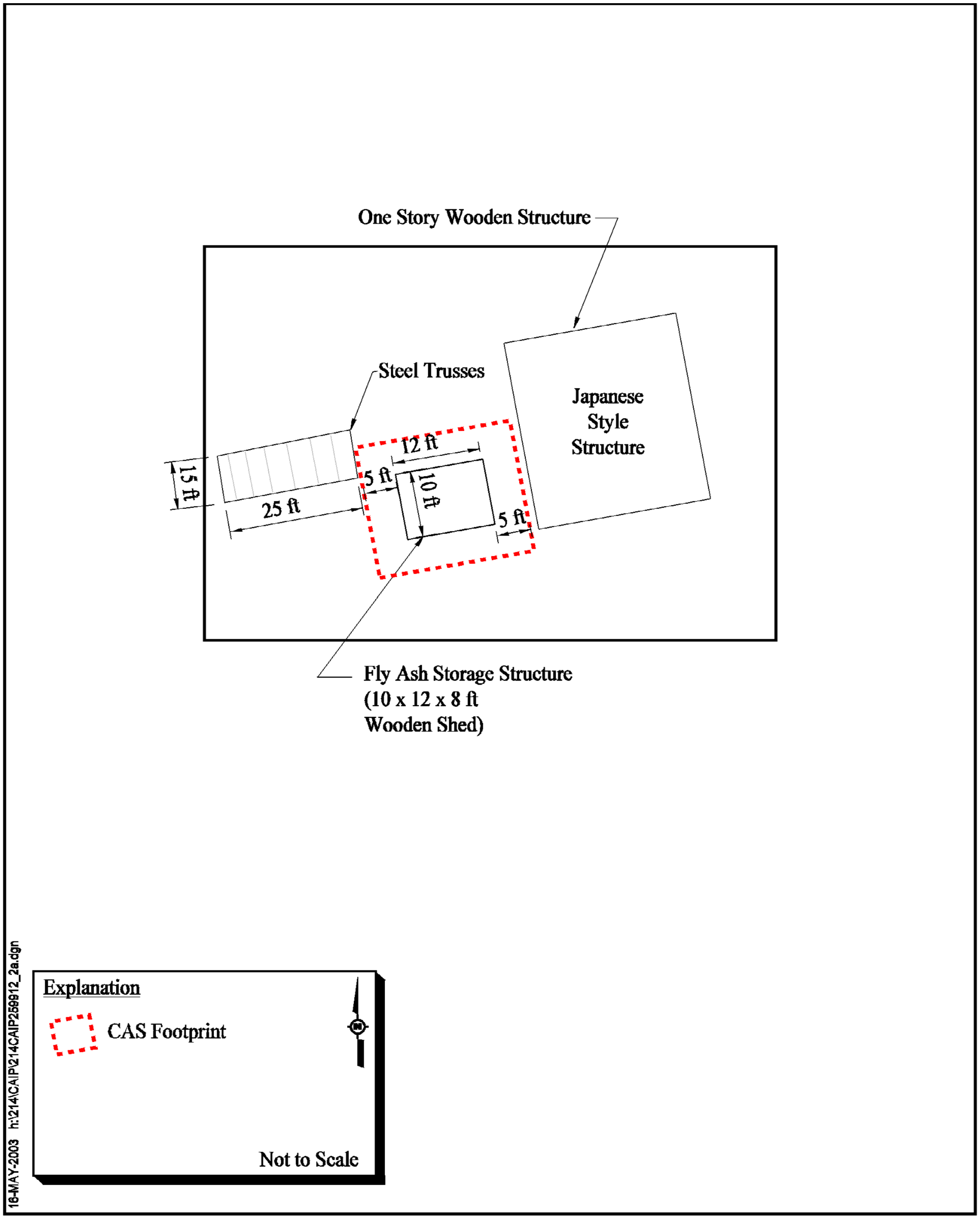


Figure A.1-4
Site Sketch of CAS 25-99-12, Fly Ash Storage

building is unknown, though they may have been used in various experiments at the BREN Tower. The source of the fly ash is unknown.

Sources of Potential Contamination - The source of potential soil contamination is fly ash migrating out of the storage structure.

Previous Investigation Results - One sample of the fly ash from the storage structure was collected during the preliminary process. This sample was analyzed for RCRA metals, TCLP RCRA metals, pH, and gamma-emitting radionuclides. The RCRA metals analysis indicated an arsenic concentration of 16 mg/kg which is above the PAL. Barium, chromium, lead, selenium, and silver were not detected above PALs. The TCLP metals analysis indicated all metals, including arsenic, were below RCRA characteristic waste levels. The pH of the soil in the stained area was reported as 12. Gamma-emitting radionuclides were not detected above PALs.

Contaminants of Potential Concern - The COPCs identified for CAS 25-99-12 are shown in Table A.1-1. The sole critical COPC is arsenic. Noncritical COPCs include PCBs, the remaining RCRA metals, beryllium, and gamma-emitting radionuclides. The fly ash itself is not considered a COPC, although a Material Safety Data Sheet for fly ash states that, depending on jurisdiction and use, it may be considered hazardous. Fly ash may also contain complex aluminosilicate glass, mullite, hematite, magnetite, spinel, and quartz. As noted above, the pH of the fly ash is basic. The health and safety implications of these characteristics will be considered during investigation planning.

A.1.1.4 CAS 25-23-01, Contaminated Materials and CAS 25-23-19, Radioactive Material Storage

Corrective action sites 25-23-01 and 25-23-19 consist of contaminant releases from materials stored in a materials storage yard. Figure A.1-5 shows a site sketch of the CASs.

Physical Setting and Operational History - CASs 25-23-01 and 25-23-19 are located west of the Yucca Mountain Project Sample Management Facility in the Area 25 support compound. Corrective Action Site 25-23-01 is the southern portion of the yard and CAS 25-23-19 is the northern third portion of the yard.

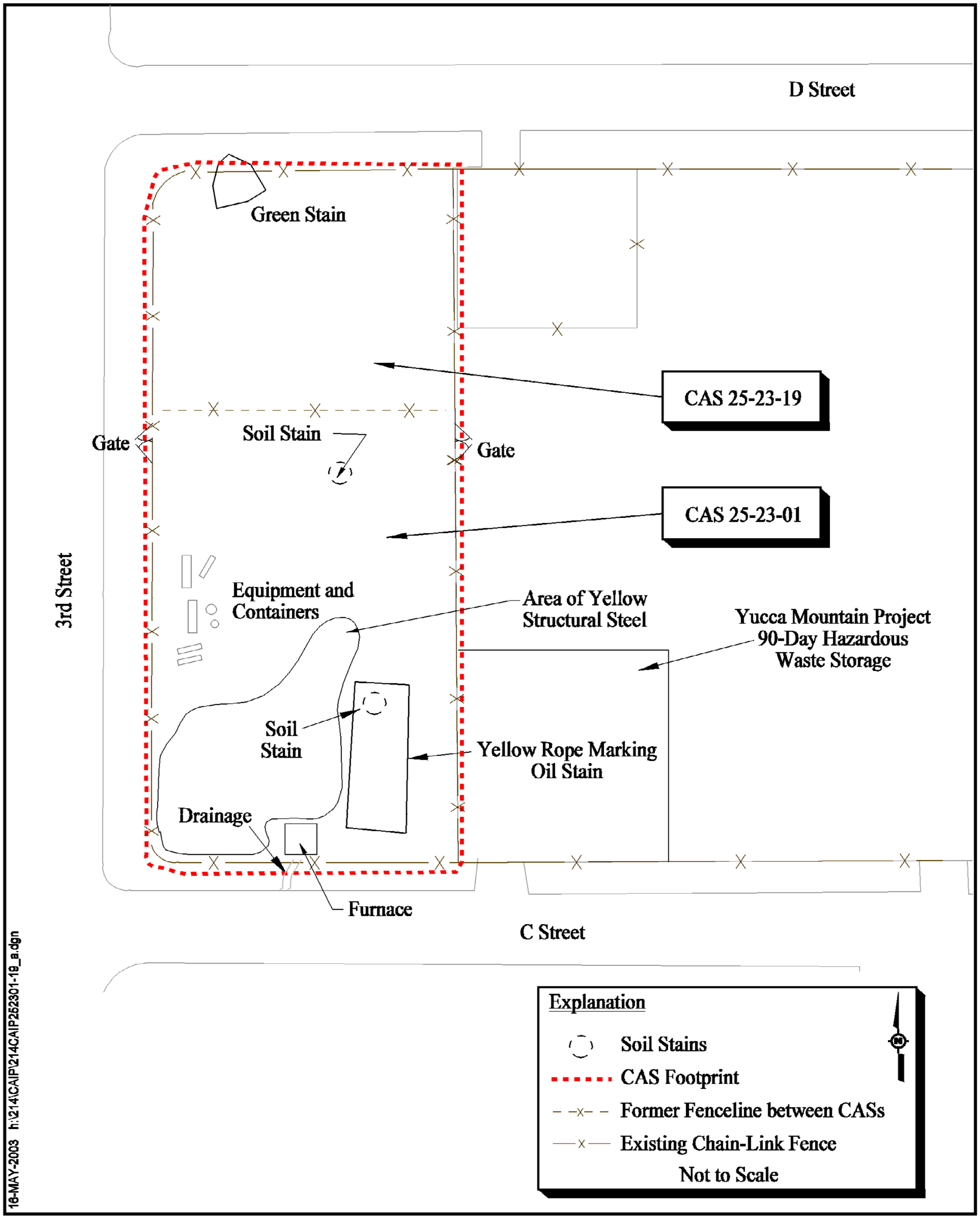


Figure A.1-5
Site Sketch of CAS 25-23-01, Contaminated Materials, and CAS 25-23-19, Radioactive Materials Storage

The yard was historically used to store radioactive equipment, hazardous waste, heavy equipment, reactor components, and drums and tanks containing unspecified material. Some of the material stored in the yard was originally generated at Test Cell A and Test Cell C (Sorom, 1998). In the mid-1990s, radiologically-contaminated material was segregated into the northern portion of the storage yard as a posted and fenced RMA. This RMA was designated as CAS 25-23-19 and the remainder of the yard was designated as CAS 25-23-01. Cleanup of the yard began in 1995 and solid waste, scrap metal, and equipment were taken to the Area 23 salvage yard. In 1995, 20,000 pounds of radioactively contaminated material and equipment from the RMA was taken to the Area 25 RMSF and the fence between the two CASs was removed (Kendall, 1995).

A recent site visit identified metal and wood debris, bottles and cans containing unknown material, heavy equipment, a furnace, and an empty drum on a pallet within the CAS 25-23-01 storage yard. No equipment or debris was observed within the CAS 25-23-19 storage yard. An area of oil staining is located in the southeast section of CAS 25-23-01. A green stain roughly 20 ft in diameter, is located in the northwest corner of CAS 25-23-19. This stain straddles the fence line and thus is partially located outside the yard.

Sources of Potential Contamination - The source of potential soil contamination is materials released or eroded from solids and/or fluids stored in the yard. In particular, a black oily liquid from a drum may have been released to the soil. Other contamination sources have largely been removed and disposed as nonhazardous (Guymon, 1995), although several containers with unknown contents are still present in CAS 25-23-01.

Previous Investigation Results - Various liquid and soil samples have been collected at the site. In 1993, three soil samples were collected from an oil-stained area and analyzed for TPH, TCLP metals, TCLP SVOCs, and gamma-emitting radionuclides. The highest detected concentration of TPH was 45,600 mg/kg. No TCLP metals were identified above RCRA characteristic waste limits and gamma-emitting radionuclides were below PALs. The TCLP SVOCs results were no longer available when requested from the laboratory.

A black oily substance in a deteriorating drum located within the oil-stained area was also sampled in 1993. The following substances were identified at the given concentration: chromium at 9.8 mg/kg; heptachlor at 23,000 mg/kg; chlordane at 24,000 mg/kg; nonachlor at 15,000 mg/kg; and PCBs at

4,900 mg/kg. A sample was collected in 1994 from the surface soil where the drum was located. This sample was analyzed for PCBs, TCLP SVOCs, TCLP metals and gamma-emitting radionuclides. No PCBs were detected; however, the detection limit was 167 micrograms per kilograms (µg/kg) as the samples were diluted due to matrix effects and the recovery of PCBs were not calculated (Latham, 1996). Gamma-emitting radionuclides were determined to be below PALs. The analytical results for the TCLP SVOC and TCLP metals analyses were not available when requested from the laboratory.

A second surface soil sample, collected from roughly the same spot, was analyzed for pesticides. Analytical results for this sample showed chlordane at 2,020 mg/kg and heptachlor at 294 mg/kg. These concentrations are above the respective PALs.

A third sample collected at roughly the same location, was analyzed for TCLP VOCs, TCLP pesticides, and PCBs. Analytical results for this sample indicated chlordane at 9.3 milligrams per liter (mg/L). Heptachlor and TCLP VOCs were not detected. The PCB results were not available when requested from the laboratory.

Two soil samples were collected from the oil-stained area during the preliminary assessment process. These samples were analyzed for VOCs, SVOCs, TPH (GRO), TPH (DRO), RCRA metals, PCBs, pesticides, herbicides, pH, and gamma-emitting radionuclides. TPH (GRO), herbicides, PCBs, VOCs and SVOCs were not detected above detection limits. TPH (DRO) was detected at up to 4,000 mg/kg. Arsenic was detected at 8.3 mg/kg, which is above the PAL but representative of background concentrations. Barium, chromium, and lead were detected at levels below PALs. The pesticides alpha-chlordane; gamma-chlordane; alpha-BHC; 4,4'-DDT; beta-BHC; and endrin aldehyde were detected at concentrations below PALs. The pH of the soil was reported as 6.7 and 7.7. No gamma-emitting radionuclides were detected above PALs.

During the PA process one soil sample was collected from the green stain in CAS 25-23-19 and analyzed for SVOCs, TPH (DRO), TPH (GRO), RCRA metals, pH, and gamma-emitting radionuclides. No SVOCs, TPH (DRO), or TPH (GRO) were detected above PALs. Arsenic was detected at 4.8 mg/kg and chromium was detected at 880 mg/kg. Both these levels are above PALs, although the arsenic concentration is considered representative of background levels. Barium, lead, and selenium were detected at levels below PALs. The pH of the soil was reported as 9.4. No gamma-emitting radionuclides were detected above PALs.

Several radiological surveys have been conducted. A 1993 demarcation survey (REECo, 1993) identified background radiation levels along the fenceline of the yard and elevated readings at several pieces of equipment. A 1998 survey of the yard (IT, 1998) indicated background beta readings, although a 1991 survey indicated elevated readings around the soil stains and the empty drum on the pallet.

Contaminants of Potential Concern - The COPCs identified for CAS 25-23-01 are shown in Table A.1-1. Critical COPCs include TPH (DRO), PCBs, chlordane, heptachlor, 4,4'-DDT, arsenic, barium, cadmium, and chromium. Noncritical COPCs include TPH (GRO), VOCs, SVOCs, the remaining pesticides, herbicides, the remaining RCRA metals, beryllium, gamma-emitting radionuclides, strontium-90, isotopic uranium, and isotopic plutonium. The COPCs identified for CAS 25-23-19 are also shown in Table A.1-1 and are the same as CAS 25-23-01 with the exception that chromium is a critical COPC. The remaining RCRA metals are noncritical COPCs.

A.1.1.5 CAS 25-99-18, Storage Area

Corrective Action Site 25-99-18 consists of contamination releases from materials stored in a large storage yard. Figure A.1-6 shows a site sketch of the CAS.

Physical Setting and Operational History - CAS 25-99-18 is located on the west side of Lathrop Wells road at the MX Missile Site. The storage yard was used to store heavy equipment and materials used during the MX Program. The site later became the storage yard for materials and scrap prior to sale as salvage. Hazardous materials such as paint, hydraulic fluid, and batteries were found during inspections but were removed prior to the 1996 auction (Center for Land Use Interpretation, 1996; Jacobs, 1986 and 2001; DOE/NV, 1996).

A recent site visit identified remaining material as a 72-ft long concrete trough, three cylindrical concrete plugs ranging from 4 to 15 ft in diameter, one lead brick, and abundant surface and partially buried wood and metal debris. Various scrap objects believed to contain asbestos are also present. There are two small depressions at the site. It is unknown why these depressions are present; however, they may be associated with the removal of hydrocarbon contaminated soil after the salvage

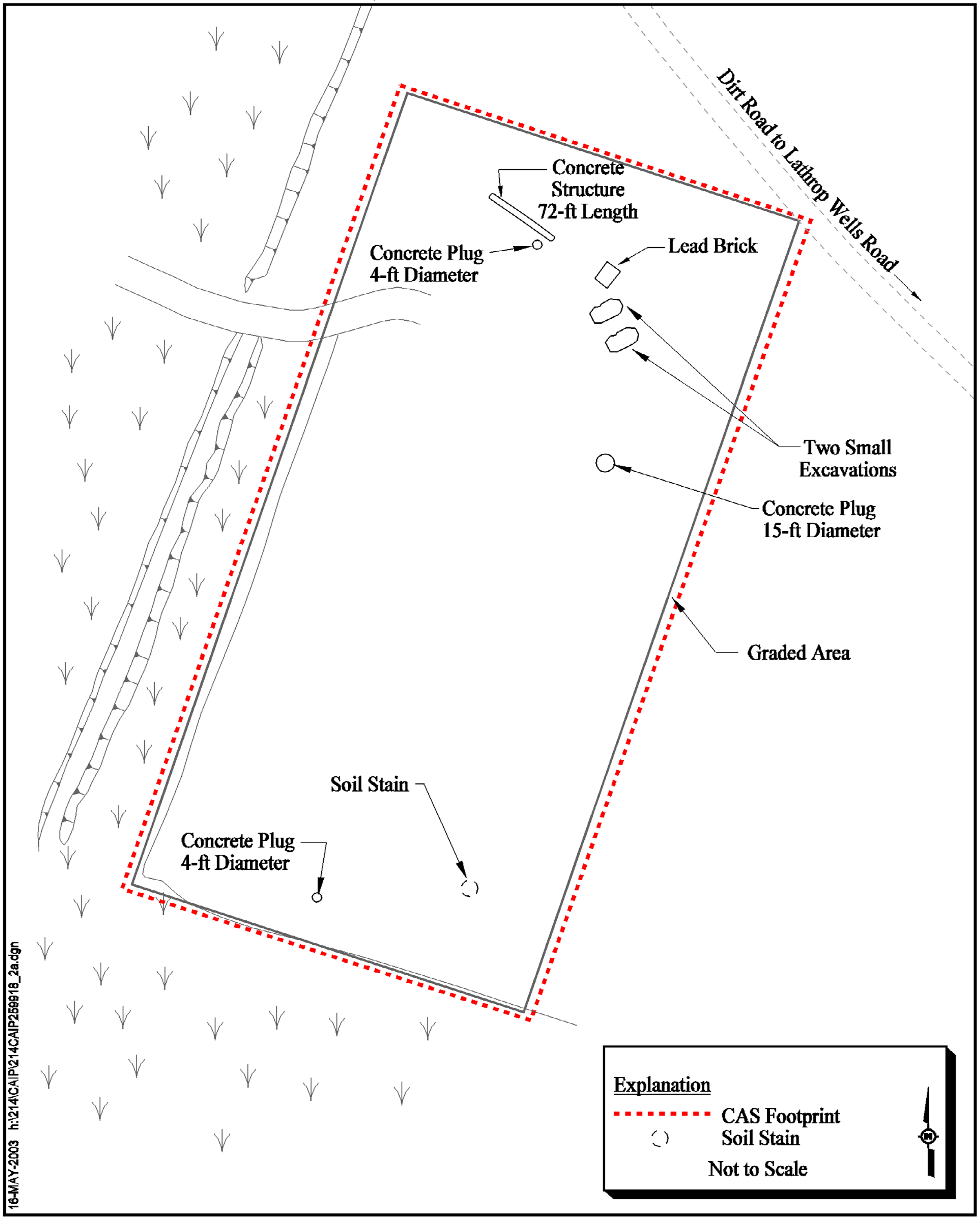


Figure A.1-6
Site Sketch of CAS 25-99-18, Storage Area

sale. A surface soil stain was observed in the southeast portion of the CAS. Two 1-gallon cans were found on site in June 1996 (BN, 2000). There is no information indicating any stains or releases from these cans and the cans are not currently present in the yard.

Sources of Potential Contamination - Sources of potential soil contamination are contaminants released or eroded from solids and/or fluids stored in the yard.

Previous Investigation Results - In June 1996, prior to the August 1996, material salvage auction, inventoried items in the yard were radiologically surveyed and were found to be free of radiation and contamination. The only known analytical results associated with CAS 25-99-18 is a sample from the contents of two 1-gallon cans that were found on site in June 1996 (BN, 2000). These results indicate that the contents of the can contained an unknown hydrocarbon at 940,000 ppm, TPH (GRO) at 30 ppm; and TPH (GRO) at 25,000 ppm. No other previous investigation results have been identified for this CAS.

Contaminants of Potential Concern - The COPCs identified for CAS 25-99-18 are shown in Table A.1-1. The critical COPCs are TPH (DRO) and TPH (GRO). Noncritical COPCs include PCBs, VOCs, SVOCs, RCRA metals, beryllium, and gamma-emitting radionuclides.

A.1.1.6 CASs 25-34-03, 25-34-04, and 25-34-05, Motor Dr/Gr Assembly (Bunker)

Corrective action sites 25-34-03, 25-34-04, and 25-34-05 consist of contamination releases from bunkers and associated cabling. Figure A.1-7, Figure A.1-8, and Figure A.1-9 show site sketches of the three CASs.

Physical Setting and Operational History - The Motor Dr/Gr Assembly Bunkers are all located at ETS-1 in Area 25. These bunkers were used to house the cable spools and motor drives used for manipulating an engine exhaust downhole cover and two radiation shields. The power source for each bunker appears to be electricity. No USTs or generator pads were observed in the vicinity.

Each CAS contains a small concrete structure (14 x 8 x 5 ft) containing the motor drive/gear (Dr/Gr) assembly, associated cable running to ETS-1, and miscellaneous surface debris (e.g., wood, concrete, and metal) in the immediate vicinity. The motor drive/gear assembly in each bunker is oil- and grease-stained, and some portions of the interior bunker floors or walls may also be stained. Small

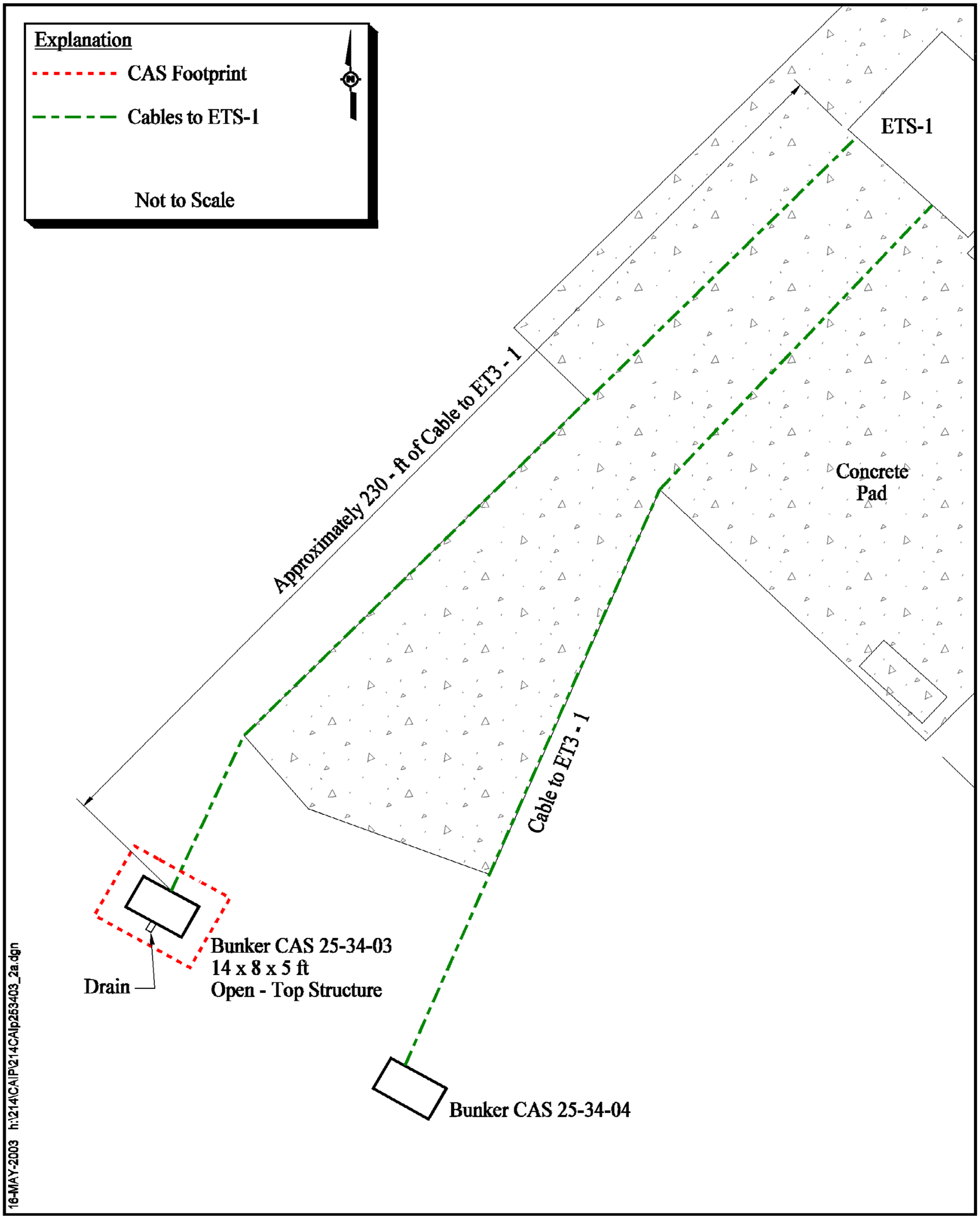


Figure A.1-7
Site Sketch of CAS 25-34-03, Motor Dr/Gr Assembly (Bunker)

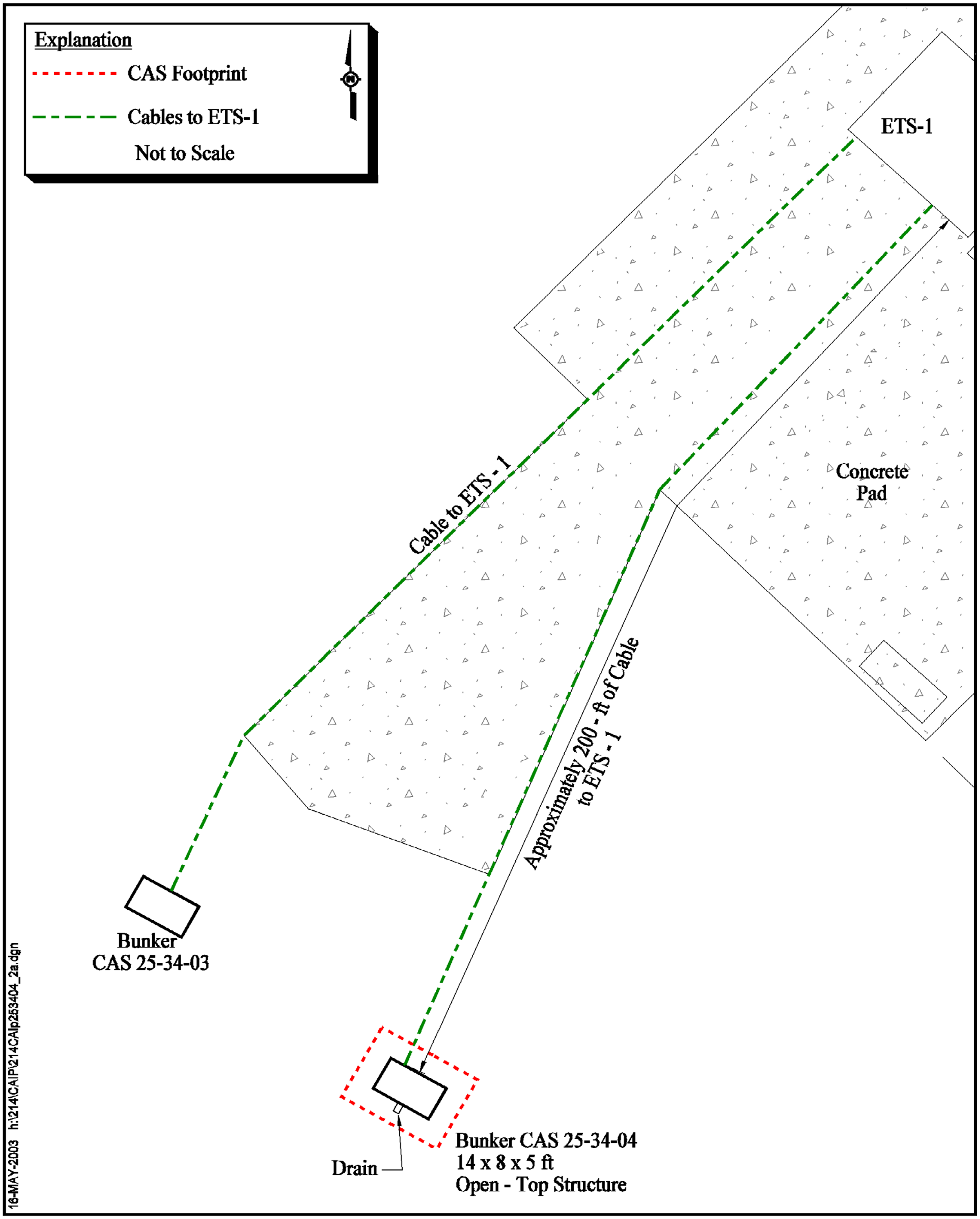


Figure A.1-8
Site Sketch of CAS 25-34-04, Motor Dr/Gr Assembly (Bunker)

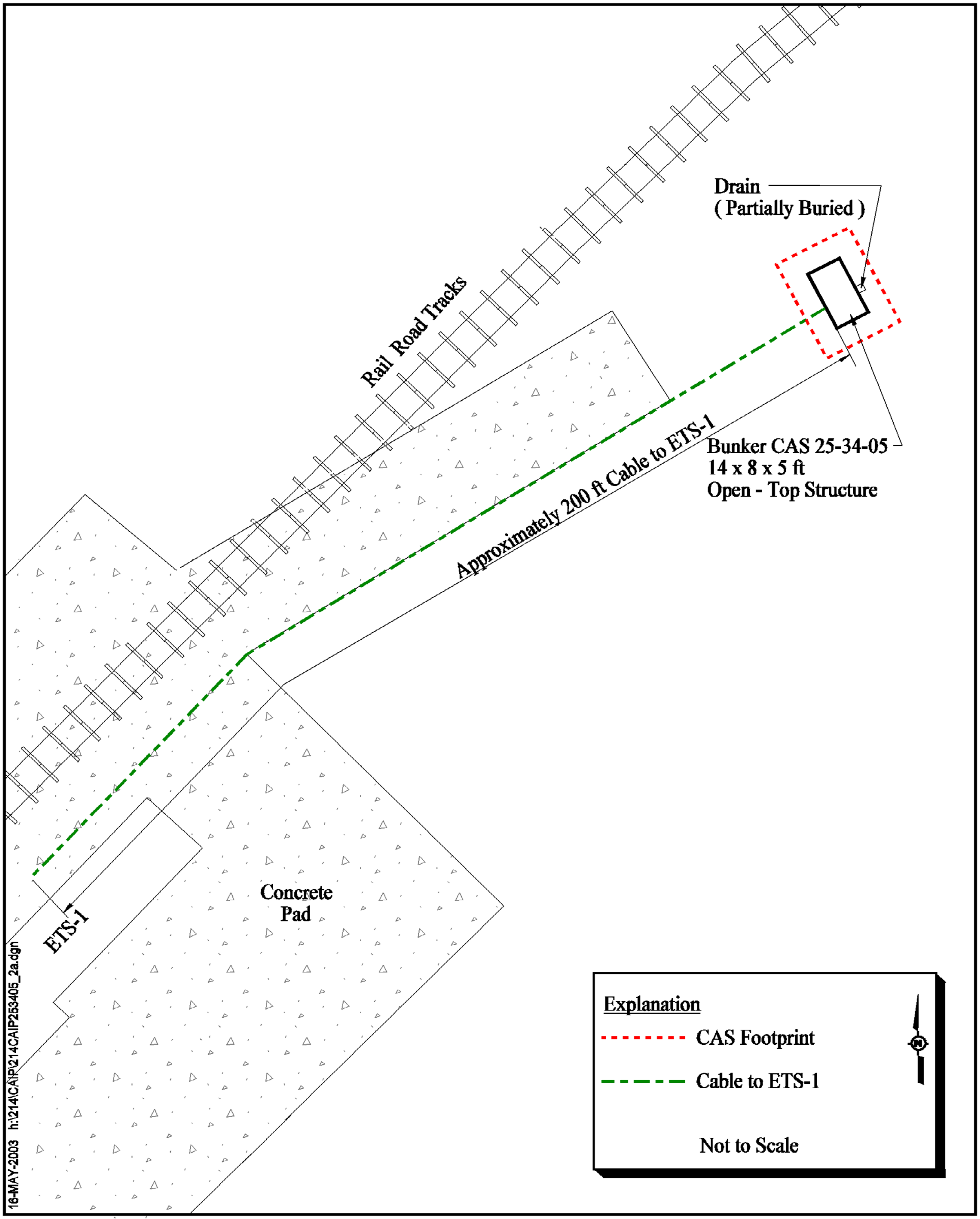


Figure A.1-9
Site Sketch of CAS 25-34-05, Motor Dr/Gr Assembly (Bunker)

piles of dirt and gravel are present in each bunker, believed to have sifted in from openings at the top and side. Any contamination inside the bunkers may have been carried out through a wall drain in each bunker. Any contamination that was transported in this fashion would be expected to be found in the soil beneath the drain outlet, although no soil stains were observed at these locations.

Sources of Potential Contamination - Sources of potential soil contamination are contaminants released or eroded from solids and/or residual amounts of fluids used for maintenance or operation of the drive gears.

Previous Investigation Results - A radiological survey was conducted at the ETS-1 after the last test but it is unknown if the survey included the three bunkers. The survey indicated there was no removable radiological contamination. No previous sampling has been identified.

Contaminants of Potential Concern - The COPCs identified for these CASs are shown in Table A.1-1. There are no critical COPCs. Noncritical COPCs include TPH (DRO), PCBs, VOCs, and gamma-emitting radionuclides.

A.1.2 Step 1 - State the Problem

This step identifies the DQO planning team members, describes the problem that has initiated the CAU 214 investigation, and presents the CSMs.

A.1.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP; NNSA/NSO; Shaw Environmental, Inc.; and Bechtel Nevada. The primary decision-makers include NDEP and NNSA/NSO representatives. Table A.1-2 lists representatives from each organization in attendance for the February 12, 2003, final DQO meeting.

A.1.2.2 Describe the Problem

Corrective Action Unit 214 is being investigated because uncontrolled releases of unknown substances may have contaminated surrounding media, particularly soil. As a result of these possible releases, hazardous and/or radioactive constituents may be present at CAU 214 at concentrations that could potentially pose a threat to human health and the environment.

Table A.1-2
Final DQO Meeting Participants
for CAU 214
February 12, 2003

Participant	Affiliation
Clemens Goewert	NDEP
Sabine Curtis	NNSA/NSO
John Davis	Shaw
Ronald (Brad) Jackson	BN
Kraig Knapp	BN
R. Lynn Kidman	Shaw
Barbara Quinn	SAIC
Georgette Dimit	SAIC

BN - Bechtel Nevada
Shaw - Shaw Environmental, Inc.
NDEP - Nevada Division of Environmental Protection
NNSA/NSO - U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
SAIC - Science Applications International Corporation

The problem statement for CAU 214 is: “Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for the CASs in CAU 214.”

A.1.2.3 Develop Conceptual Site Models

Two CSMs have been developed for CAU 214 using information from the physical setting, potential contaminant sources, knowledge from similar sites, release information, historical background information, and physical and chemical properties of the potentially affected media and COPCs. The applicability of the following CSMs to each CAS is summarized in Table A.1-3 and discussed below. Table A.1-3 provides information on additional CSM elements that will be used throughout the remaining steps of the DQO process. If additional elements are identified during the investigation that are outside the scope of the CSMs, the situation will be reviewed and a recommendation will be made as to how to proceed. In such cases, identified decision makers will be notified and given the opportunity to comment on, or concur with, the recommendation.

Table A.1-3
Conceptual Site Models
Description of Elements for Each CAS in CAU 214
(Page 1 of 2)

CSM	Materials and Equipment Storage Yards				Facilities and Associated Soil				
CAS Identifier	**25-23-01**	**25-23-19**	**25-99-18**	**11-22-03**	**25-34-03**	**25-34-04**	**25-34-05**	**05-99-01**	**25-99-12**
CAS Description	**Contaminated Materials**	**Radioactive Material Storage**	**Storage Area**	**Drum**	**Motor Dr/Gr Assembly (Bunker)**			**Fallout Shelters**	**Fly Ash Storage**
Site Status	Sites are inactive and/or abandoned								
Exposure Scenario	The potential for contamination exposure is limited to industrial and construction workers, and military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials.								
Affected Media	Surface and shallow subsurface soil; debris such as concrete, steel, and wood								
Sources of Potential Soil Contamination	Leaking containers and surface disposal of discarded equipment and materials				Lubrication and cleaning of equipment; surface disposal of discarded equipment and materials			Asbestos cloth cover over shelter domes	Fly ash migrated through openings in structure
Location of Contamination/ Release Point	Surface soil at or near location(s) of stored waste/materials			Surface soil near drums, cable pile	Surface soil below drain holes, surface soil around bunkers			Surface soil near shelters	Surface soil near structure
Transport Mechanisms	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 available soil moisture from precipitation (i.e., 3 to 10 inches) (USGS, 1995a). Surface water runoff may provide for the transportation of some contaminants within or outside of the footprints of the CASs.								
Preferential Pathways	None anticipated; lateral transport expected to dominate over vertical transport								

Table A.1-3
Conceptual Site Models
Description of Elements for Each CAS in CAU 214
(Page 2 of 2)

CSM	Materials and Equipment Storage Yards				Facilities and Associated Soil				
CAS Identifier	**25-23-01**	**25-23-19**	**25-99-18**	**11-22-03**	**25-34-03**	**25-34-04**	**25-34-05**	**05-99-01**	**25-99-12**
CAS Description	**Contaminated Materials**	**Radioactive Material Storage**	**Storage Area**	**Drum**	**Motor Dr/Gr Assembly (Bunker)**			**Fallout Shelters**	**Fly Ash Storage**
Lateral and Vertical Extent of Contamination	Unknown. Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Groundwater contamination is not expected. Depth to groundwater in Jackass Flats (Area 25) varies from 710 to 1,160 ft bgs (USGS, 1995b). Depth to groundwater in Frenchman Flat (Area 5) varies from 689 to 719 ft bgs (Trudeau, 1997; USGS/DOE, 2002). Depth to groundwater in Plutonium Valley (Area 11) was reported to be 725 meters above mean sea level in 1975 (DOE/NV, 1999). Surface migration may occur as a result of runoff.								
Amount Released	Unknown				Unknown				
Potentially Released Material	Contaminants released or eroded from solids and/or fluids from stored containers				Contaminants eroded from solids and/or residual amounts of fluids from maintenance and/or storage				
Existing Historical Data on COPCs	- Oil - PCBs - Chlordane - Heptachlor - 4,4'-DDT - Arsenic - Barium - Cadmium - Chromium	- Oil - PCBs - Chlordane - Heptachlor - 4,4'-DDT - Chromium	TPH (DRO) TPH (GRO)	No records available	No records available				Arsenic, high pH

The CSMs that are pertinent to this CAU are:

- Materials and Equipment Storage Yards
- Facilities and Associated Soil

Conceptual site models describe the most probable scenarios for current conditions at specific sites and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. They are the basis 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 those receptors. Accurate CSMs are important as they serve as the basis for all subsequent inputs and decisions throughout the DQO process.

An important element of a CSM is the expected fate and transport of contaminants, which infer how contaminants move through site media and where they can be expected in the environment. The expected fate and transport is based on distinguishing physical and chemical characteristics of the contaminants and media. Contaminant characteristics include solubility, density, and particle size. Media characteristics include permeability, saturation, sorting, chemical composition, and adsorption coefficients. In general, contaminants with low solubility and high density can be expected to be found relatively close to release points. Contaminants with high solubility and low density can be expected to be found further from release points or in area where settling may occur.

Contaminants migrating to regional aquifers is not considered as a significant pathway at CAU 214 based on the low annual average precipitation rates, high potential evapotranspiration, and low mobility of expected COPCs.

Currently, the potential for exposure to contamination at the CAU 214 CASs is limited to industrial and construction workers as well as military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials. The future land-use scenarios are provided in Table A.1-4.

Table A.1-4
Future Land-Use Scenarios

CAS	Zone	Zone Description
25-23-01	Yucca Mountain Site Characterization	
25-23-19		
25-99-18		
25-34-03	Research, Test, and Experiment	This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of material and equipment under controlled conditions. This zone includes compatible defense and nondefense research, development and testing projects and activities.
25-34-04		
25-34-05		
25-99-12		
05-99-01		
11-22-03	Reserved	This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. This zone is also used for short duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Center training and DoD land-navigation exercises and training.

Source: (DOE/NV, 1998)

A.1.2.3.1 Materials and Equipment Storage Yards CSM

The Materials and Equipment Storage Yards CSM applies to CASs 25-23-01, 25-23-19, 25-99-18, and 11-22-03. Each of these sites is a yard or storage area where materials, equipment, and/or wastes were accumulated and/or stored. The source of potential contamination is contaminants released or eroded from solids and/or fluids from stored materials. Debris such as construction material may exist at each of these CASs. Figure A.1-10 is the CSM as it applies to CASs 25-23-01, 25-23-19, and 11-22-03. Figure A.1-11 is the CSM as it applies to CAS 25-99-18.

A.1.2.3.2 Facilities and Associated Soil CSM

The Facilities and Associated Soil CSM applies to CASs 25-34-03, 25-34-04, 25-34-05, 05-99-01, and 25-99-12. At each of these sites there is a small building or structure, debris in the immediate vicinity, and potential soil contamination which is directly associated with the operation of the facility or the materials contained within the facility. Figure A.1-12 is the CSM as it applies to CASs

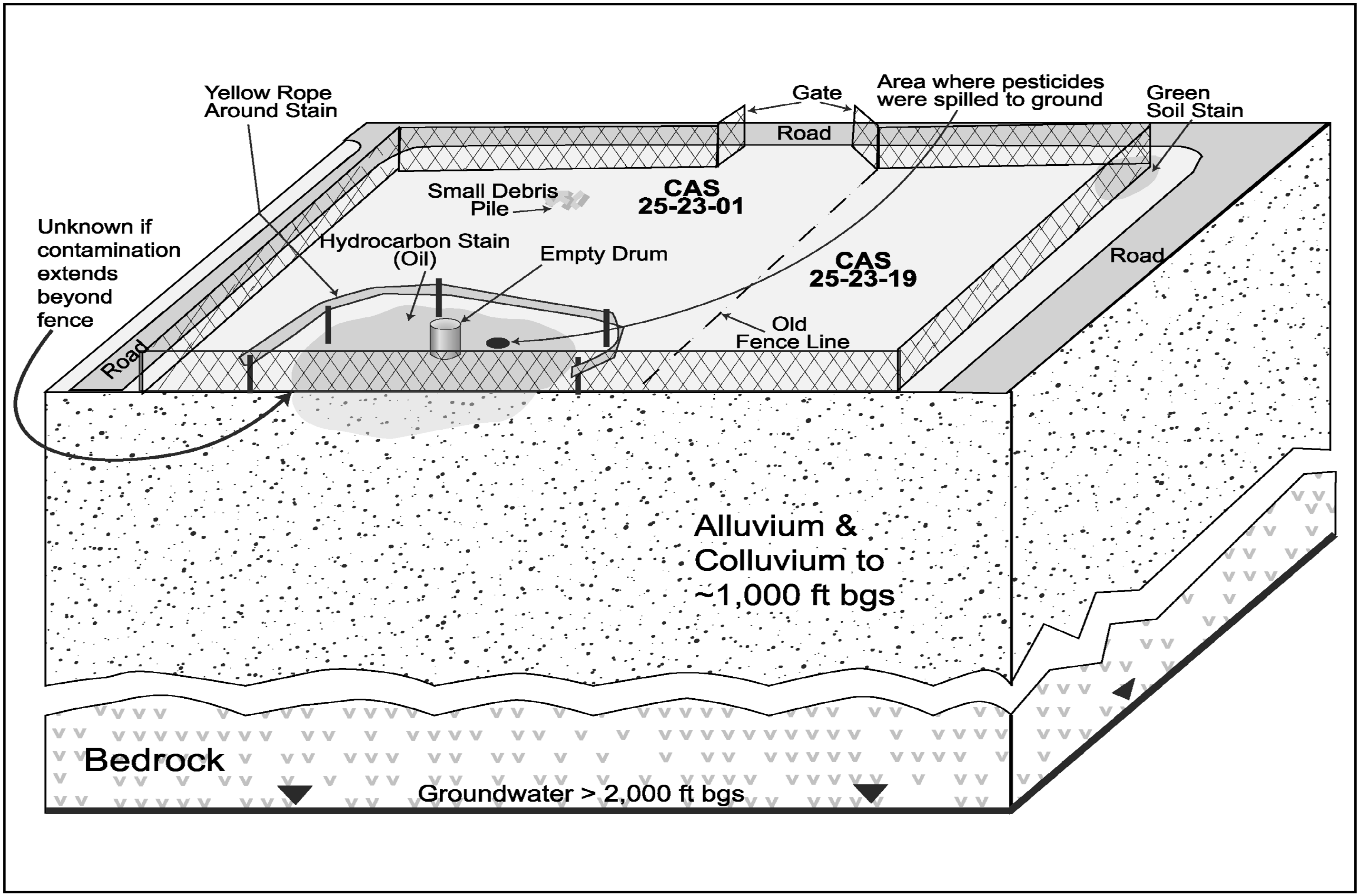


Figure A.1-10
Materials and Equipment Storage Yards CSM for
CAS 25-23-01, CAS 25-23-19, and CAS 11-22-03

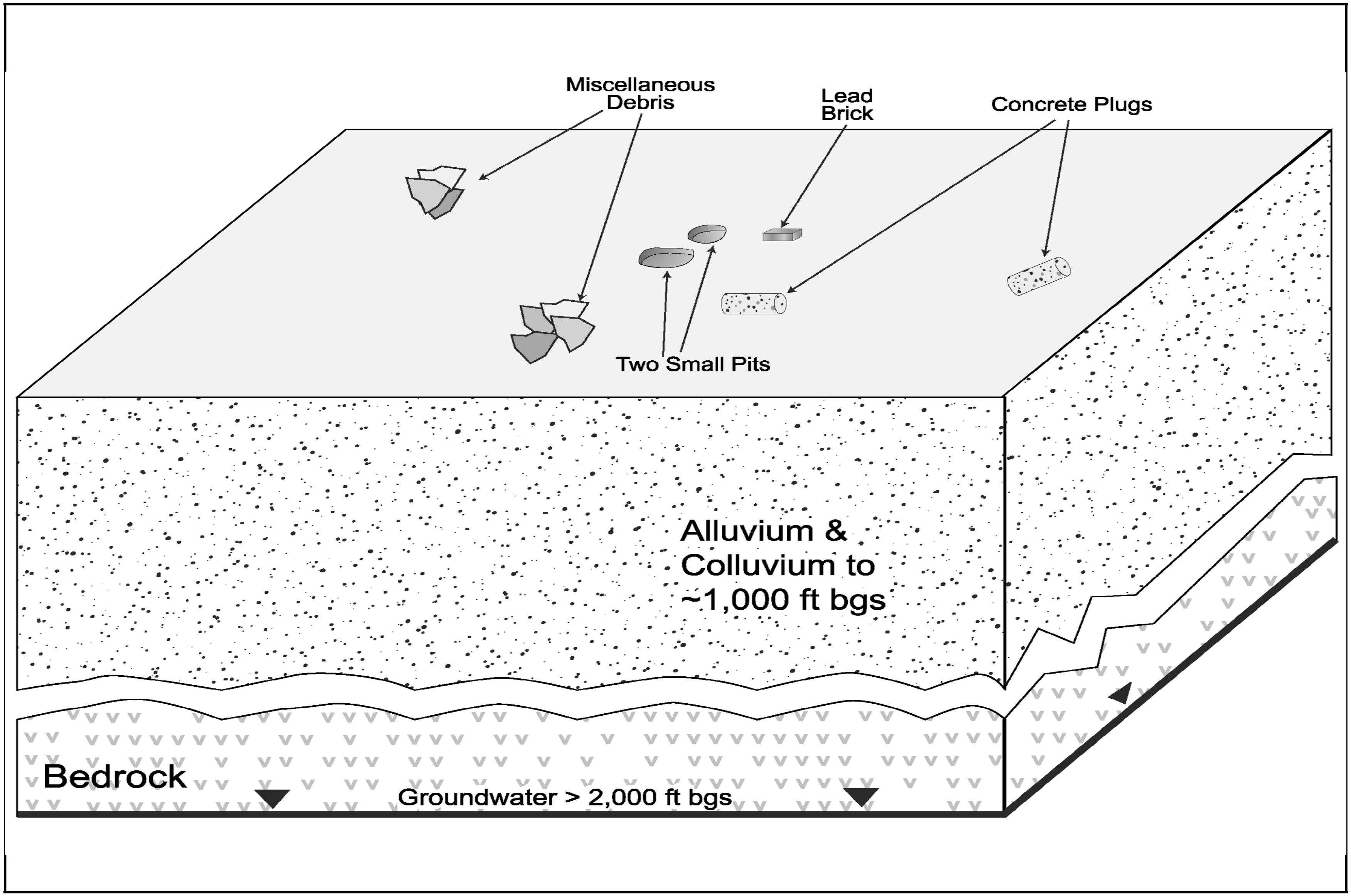


Figure A.1-11
Materials and Equipment Storage Yards CSM for CAS 25-99-18

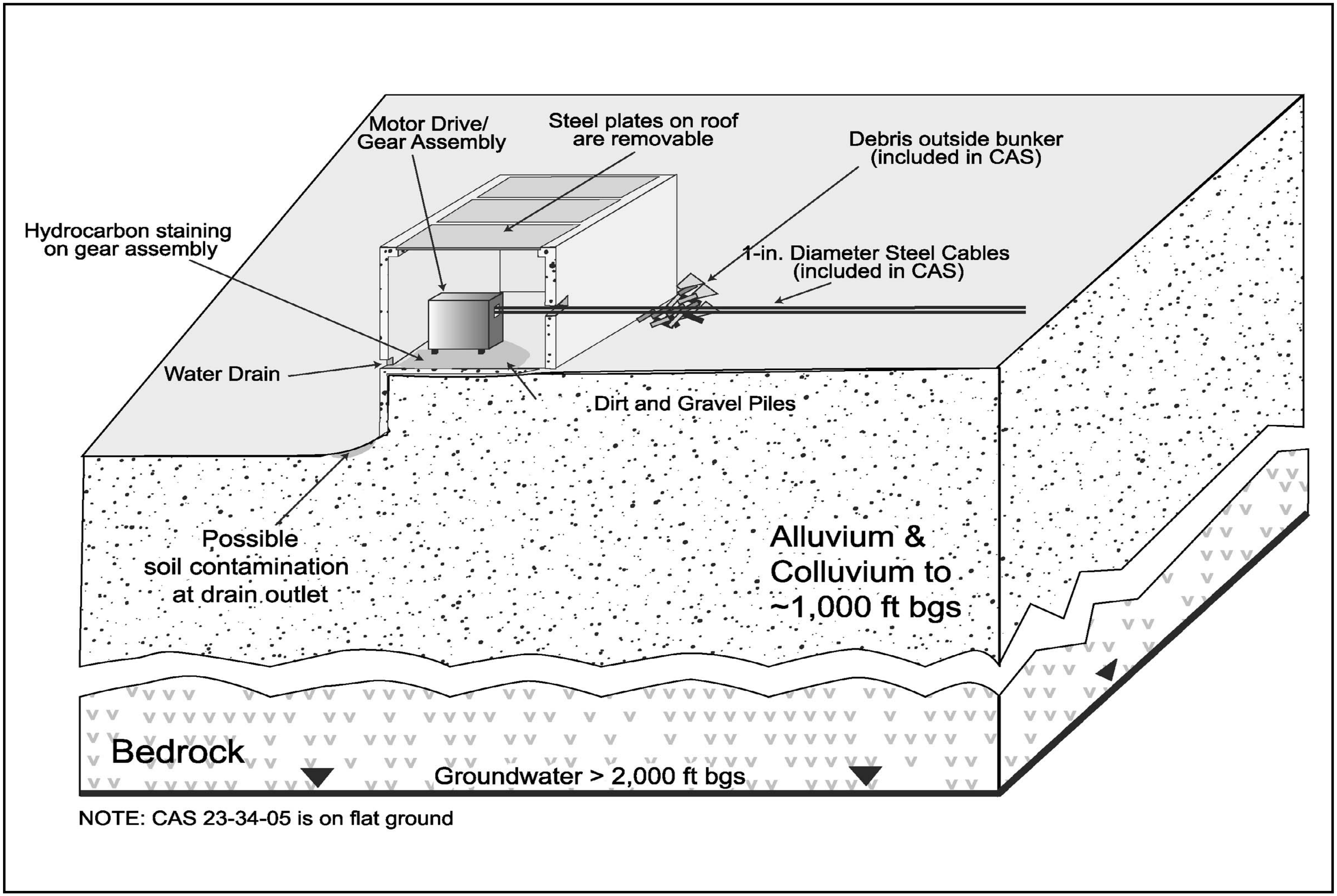


Figure A.1-12
Facilities and Associated Soil CSM for CASs 25-34-03, 25-34-04, and 25-34-05

25-34-03, 25-34-04, and 25-34-03. Figure A.1-13 is the CSM as it applies to CAS 05-99-01, and Figure A.1-14 is the CSM as it applies to CAS 25-99-12.

A.1.3 Step 2 - Identify the Decisions

This step develops a decision statement and defines alternative actions appropriate for Decision I and Decision II.

A.1.3.1 Develop a Decision Statement

The Decision I statement is: "Is a COC present in environmental media within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?"

Any site-related contaminant detected in environmental media at concentrations exceeding the corresponding PALs defined in Section A.1.4.2 will be considered a COC. The presence of a contaminant within a CAS is defined as the analytical detection of a COC. Samples used to resolve Decision I are identified as Decision I samples.

The Decision II statement is: "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?"

Sufficient information is defined as the data needs identified in this DQO Process to include the lateral and vertical extent of all COCs within each CAS. Samples used to resolve Decision II are identified as Decision II samples.

A.1.3.2 Alternative Actions to the Decision

If no COCs are present, further assessment of the CAS is not required. If COCs are present, resolve Decision II.

If the extent of COCs is defined in both the lateral and vertical directions, further assessment of the CAS is not required. If the extent of COCs is not defined, re-evaluate site conditions and collect additional samples.

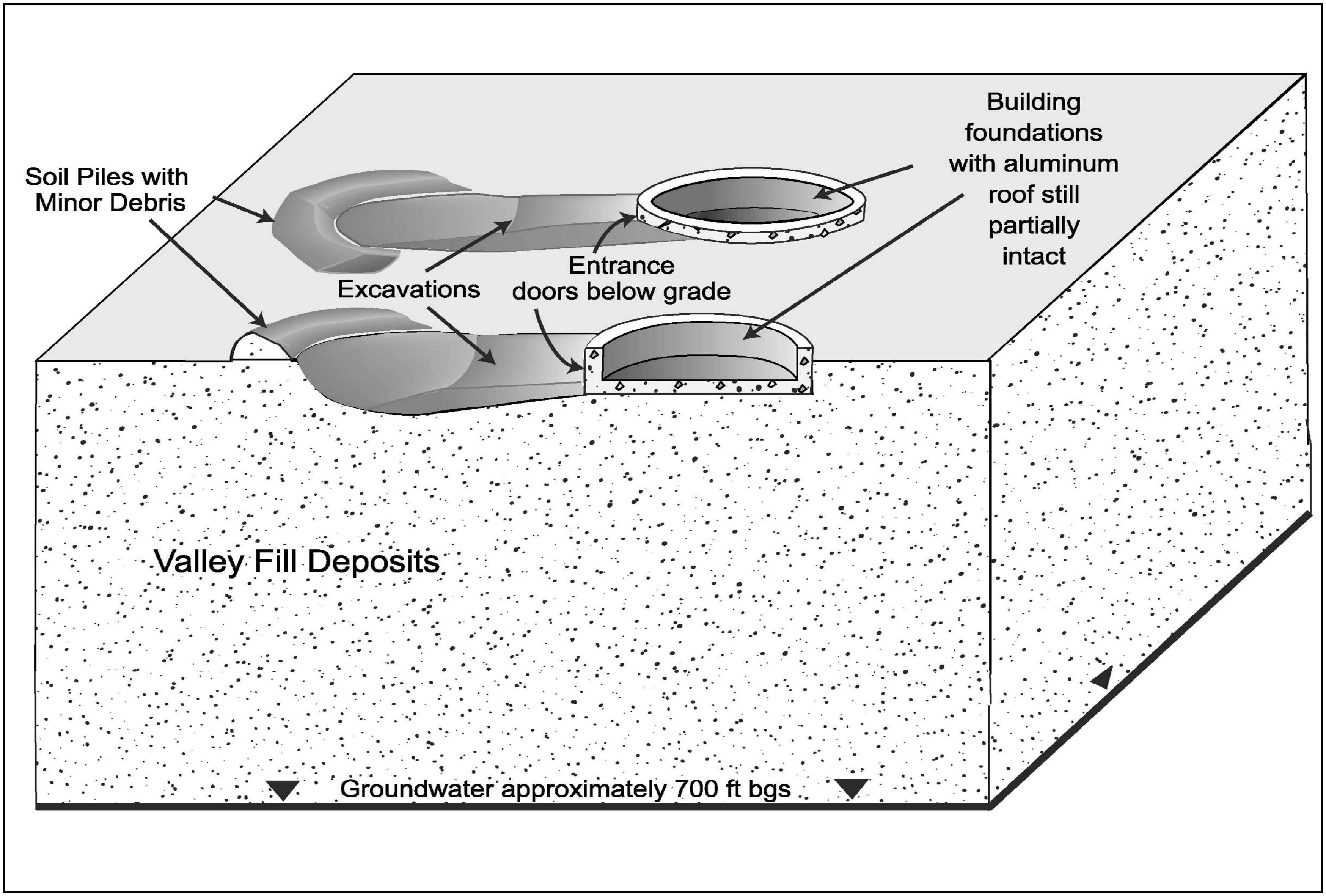


Figure A.1-13
Facilities and Associated Soil CSM for CAS 05-99-01

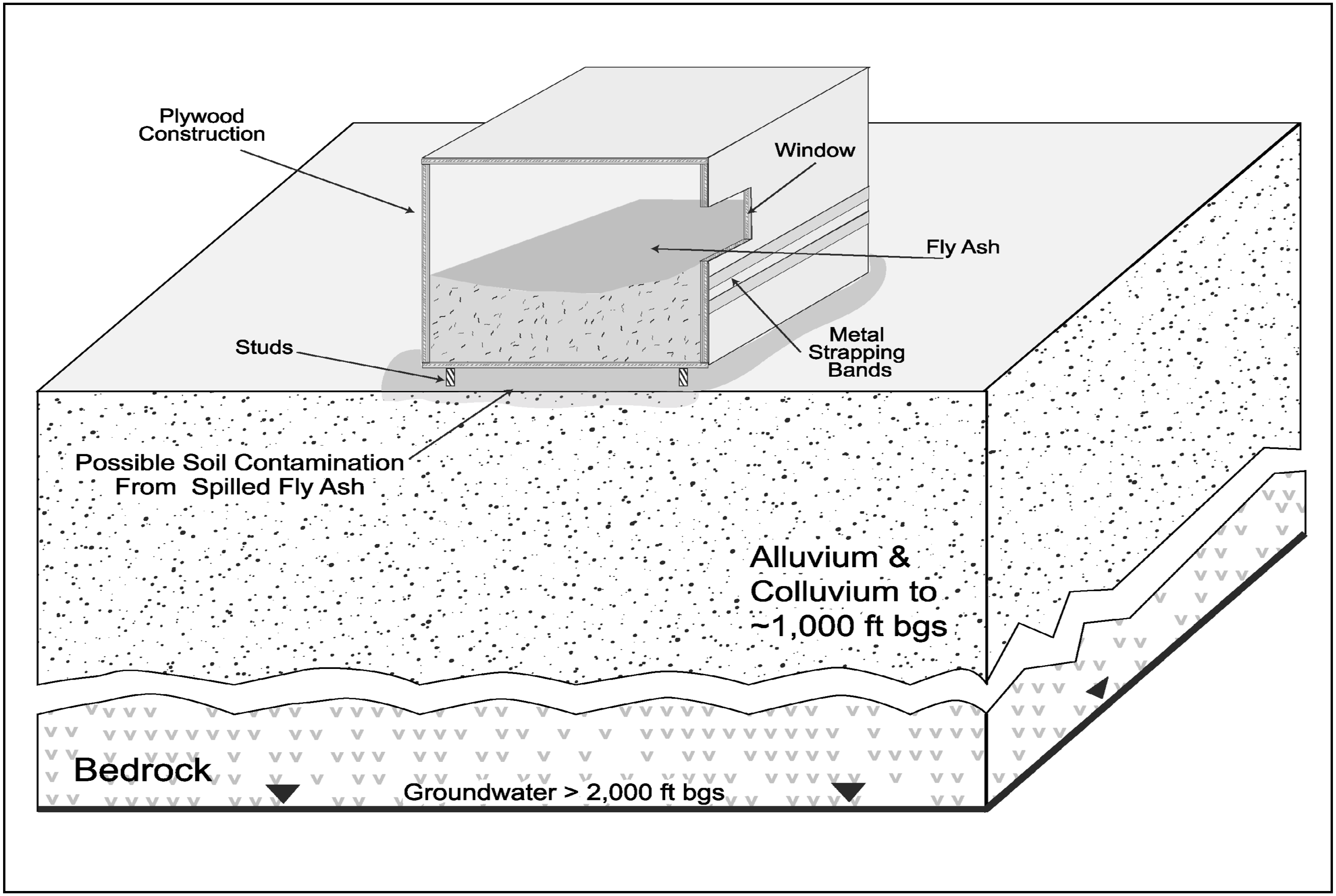


Figure A.1-14
Facilities and Associated Soil CSM for CAS 25-99-12

A.1.4 Step 3 - Identify the Inputs to the Decision

This step identifies the information needed, determines sources for information, determines the basis for establishing the action level, and identifies sampling and analysis methods that will meet the data requirements. To determine if a COC is present, each sample result is compared to the PAL (Section A.1.4.2). If any sample result or population parameter is greater than the PAL, then the CAS is advanced to Decision II 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 Information Sources

In order to determine if a COC is present at a given CAS, sample data must be collected and analyzed following these two criteria: (1) samples must be collected in areas most likely to contain a COC; and (2) the analytical suite selected must be sufficient to detect any COCs present in the samples. Biasing factors to support these criteria include:

- Documented process knowledge on source and location of release
- Visual evidence of discoloration, textural discontinuities, disturbance of native soils, or any other indication of potential contamination
- Presence of debris or equipment
- Presence of hot spots based on the results of radiological surveys
- Field-screening results
- Previous sample or screening results
- Experience and data from investigations of similar sites

Additional random samples will be collected at CAS 25-23-01, CAS 25-23-19, and CAS 25-99-18 storage areas since biasing factors may not be present to adequately indicate contamination associated with materials previously stored in these areas. The content of the drums in CAS 11-22-03 and the fly ash in CAS 25-99-12 will be sampled to determine if the contaminant source material contains COCs. If the source material does not contain COCs, it will be determined that the soil underlying these sources also does not contain COCs.

To determine the extent of a COC, Decision II sample data must be collected and analyzed at locations to bound the lateral and vertical extent of COCs. The data required to satisfy the information needed for Decision II for each COC is a sample result that is below the PAL. Step-out locations will be selected based on the CSM, biasing factors, and existing data. Biasing factors to support these information needs may include the factors previously listed plus Decision I analytical results.

Table A.1-5 lists the information needs, the source of information for each need, and the proposed methods to collect the data needed to resolve Decisions I and II. The last column addresses the QA/QC data type and associated metric. The data type is determined by the intended use of the data in decision making.

Data types are discussed in the following text. 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 sections.

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 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 is 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 or amount of a characteristic or component because a correlation has been shown to exist between results from the 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.

Table A.1-5
Information Needs to Resolve Decision I and Decision II
(Page 1 of 2)

Information Need	Information Source	Collection Method	Data Type/Metric
Decision I: Determine if a COC is present. Criteria I: Samples must be collected in areas most likely to contain a COC.			
Source and location of release points	Process knowledge compiled during the PA process and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Qualitative – CSM has not been shown to be inaccurate
	Site visit and field observations	Conduct site visits and document field observations	Qualitative - CSM has not been shown to be inaccurate
	Radiological surveys	Review and interpret radiological surveys	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Field screening	Review and interpret field-screening results	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Biased Samples	Selection of locations utilizing technical expertise	Semiquantitative - Sampling based on process knowledge
	Random Samples at CASs 25-23-01, 25-23-19, and 25-99-18	Selection of locations utilizing “Visual Sample Plan” software (PNNL, 2002) set to exclude biased sampling locations	Quantitative - Sampling based on statistical randomization technique
Decision I: Determine if a COC is present. Criteria 2: Analyses must be sufficient to detect any COCs in samples.			
Identification of all potential contaminants	Process knowledge compiled during PA process and previous investigations of similar sites	Information documented in CSM and public reports - no additional data needed	Qualitative - CSM has not been shown to be inaccurate
Analytical results	Data packages of biased samples	Appropriate sampling techniques and approved analytical methods will be used	Quantitative - Detection limits will be less than PALs
Decision II: Determine the extent of a COC			
Identification of applicable Decision II contaminants	Data packages of prior samples	Review analytical results to select Decision II COCs	Quantitative – Only COCs previously identified will be analyzed in future sampling events.

Table A.1-5
Information Needs to Resolve Decision I and Decision II
(Page 2 of 2)

Information Need	Information Source	Collection Method	Data Type/Metric
Extent of Contamination	Field observations	Document field observations	Qualitative – CSM has not been shown to be inaccurate.
	Field screening	Conduct field screening with appropriate instrumentation	Semiquantitative – field screening results will be compared to FSLs.
	Decision II analytical results	Appropriate sampling techniques and approved analytical methods will be used to bound COCs	Quantitative - Validated analytical results will be compared to PALs to determine COC extent.

Qualitative Data

Qualitative data identifies or describes the characteristics or 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.

Metrics provide a tool to determine if the collected data support decision making as intended. Metrics tend to be numerical for quantitative and semiquantitative data, and descriptive for qualitative data.

A.1.4.2 Determine the Basis for the Preliminary Action Levels

Site workers and military personnel may be exposed to contaminants through oral ingestion, inhalation, external (radiological), or dermal contact (absorption) of soil during disturbance of environmental media. Laboratory analytical results for soils will be compared to the following PALs to evaluate if COPCs are present at levels that may pose an unacceptable risk to human health and/or the environment (i.e., COCs):

- EPA *Region IX Risk-Based Preliminary Remediation Goals* for Industrial Soils (EPA, 2002).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered the mean plus

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

- TPH concentrations above the action level of 100 mg/kg per NAC 445A.2272 (NAC, 2002).
- For COPCs without established PRGs, a protocol similar to EPA Region IX will be used to establish an action level; otherwise, an established PRG from another EPA region may be chosen.
- For radiologically contaminated materials and structures, the total residual surface contamination for unrestricted release of materials and equipment to the general public allowed by DOE Order 5400.5 (DOE, 1993) and as defined in the *NV/YMP Radiological Control Manual* (DOE/NV, 2000).
- The PALs for radiological results are isotope-specific for the radionuclide identified and are 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).

A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods

The following sections describe potential sampling and other investigative techniques. Additional detail is provided in Section A.1.8.

A.1.4.3.1 Sampling

Samples will be collected by grab sampling, hand auguring, direct push, backhoe excavation, drilling, or other appropriate sampling methods. Sample collection and handling activities will follow standard procedures.

The analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) to be followed are provided in Table 3-4 and Table 3-5 of the CAIP. Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory requirements. Specific analyses required for the disposal of IDW are identified in Section 5.0 of the CAIP. To assure that laboratory analyses are sufficient to detect contamination in soil samples at concentrations exceeding the minimum reporting limit, COPC parameters of interest have been selected.

The VOC and SVOC compounds expected to be analyzed for in Decision I soil samples are listed in Table A.1-6 and Table A.1-7, respectively. The radionuclides, PCBs, and metals compounds expected to be analyzed for in Decision I soil samples are listed in Table A.1-8. The herbicide and pesticide compounds are listed in Table A.1-9.

Table A.1-6
Analytes Reported from VOC Analysis

1,1,1-Trichloroethane	4-Methyl-2-pentanone	Chloromethane
1,1,1,2-Tetrachloroethane	Acetone	Dibromochloromethane
1,1,2,2-Tetrachloroethane	Benzene	Dibromomethane
1,1,2-Trichloroethane	Bromobenzene	Dichlorodifluoromethane
1,1-Dichloroethane	Bromochloromethane	Ethylbenzene
1,1-Dichloroethene	Bromodichloromethane	Isopropylbenzene
cis-1,2-Dichloroethene	Bromoform	Methyl tertiary butyl ether
trans-1,2-Dichloroethene	Bromomethane	Methylene chloride
1,2-Dichloroethane	Carbon disulfide	N-Butylbenzene
1,2-Dichloropropane	Carbon tetrachloride	N-Propylbenzene
1,2,3-Trichloropropane	Chlorobenzene	sec-Butylbenzene
1,2,4-Trimethylbenzene	Chloroethane	Styrene
1,2-Dibromo-3-chloropropane	Chloroform	tert-Butylbenzene
1,2-Dibromoethane		Tetrachloroethene
1,3,5-Trimethylbenzene		Toluene
cis-1,3-Dichloropropene		Trichloroethene
trans-1,3-Dichloropropene		Trichlorofluoromethane
2-Butanone		Trichlorotrifluoroethane
2-Chlorotoluene		Vinyl acetate
		Vinyl chloride
		Xylene

A.1.4.3.2 Field Screening

Field screening may be conducted for TPH (DRO), VOCs, and radioactivity. Field screening techniques provide semiquantitative data that can be used to guide additional soil sampling activities. Field screening may also be used for health and safety monitoring and to assist in making certain health and safety decisions.

- TPH (DRO) - A gas chromatograph or equivalent instrument or method may be used to screen for weathered diesel or other heavier carbon chain compounds. The TPH (DRO) field-screening level (FSL) is established at 75 ppm.
- VOCs - A photoionization detector using the headspace method, or equivalent instrument or method may be used to screen for volatiles in soil. The VOC FSL is established as 20 ppm or 2.5 times background, whichever is greater.
- Radionuclides - an NE Technology Electra, or equivalent instrument or method may be used to screen for alpha- and beta/gamma-emitting radionuclides. Radionuclide FSLs are CAS-specific and will be calculated prior sample collection, based on background levels.

Table A.1-7
Analytes Reported from SVOC Analysis

1,2,4-Trichlorobenzene	Acenaphthylene	Di-n-butyl Phthalate
1,2-Dichlorobenzene	Aniline	Di-n-octyl Phthalate
1,3-Dichlorobenzene	Anthracene	Fluoranthene
1,4-Dichlorobenzene	Benzo(a)anthracene	Fluorene
2,4,5-Trichlorophenol	Benzo(a)pyrene	Hexachlorobenzene
2,4,6-Trichlorophenol	Benzo(b)fluoranthene	Hexachlorobutadiene
2,4-Dichlorophenol	Benzo(g,h,i)perylene	Hexachlorocyclopentadiene
2,4-Dimethylphenol	Benzo(k)fluoranthene	Hexachloroethane
2,4-Dinitrophenol	Benzoic Acid	Indeno(1,2,3-cd)pyrene
2,4-Dinitrotoluene	Benzyl Alcohol	Isophorone
2,6-Dinitrotoluene	Bis(2-chloroethoxy) methane	Naphthalene
2-Chloronaphthalene	Bis(2-chloroethyl)ether	Nitrobenzene
2-Chlorophenol	Bis(2-chloroisopropyl)ether	N-Nitroso-di-n-propylamine
2-Methylphenol	Bis(2-ethylhexyl) phthalate	N-Nitrosodimethylamine
2-Nitroaniline	Butyl benzyl phthalate	N-Nitrosodiphenylamine
3,3'-Dichlorobenzidine	Carbazole	Pentachlorophenol
4-Bromophenyl phenyl ether	Chrysene	Phenanthrene
4-Chloroaniline	Dibenzo(a,h)anthracene	Phenol
4-Methylphenol	Dibenzofuran	Pyrene
4-Nitrophenol	Diethyl Phthalate	Pyridine
Acenaphthene	Dimethyl Phthalate	

Table A.1-8
Analytes Reported from Radionuclides, PCB, and Metals Analyses

Radionuclides	PCB		Metals	
Gamma-emitting radionuclides	Aroclor-1016	Aroclor-1248	arsenic	lead
Strontium-90	Aroclor-1221	Aroclor-1254	barium	mercury
Isotopic uranium	Aroclor-1232	Aroclor-1260	beryllium	selenium
Isotopic plutonium	Aroclor-1242		cadmium	silver
			chromium	

A.1.4.3.3 Radiological Surveys

Radiological surveys will be conducted at appropriate CASs to determine the presence of surficial gamma and high energy beta-emitting radiological contaminants. Walkover surveys will be performed over approximately 100 percent of the CAS boundaries, as permitted by terrain and field conditions. A plastic scintillator will be used as the instrument for the surveys. Additional equipment and software used in the collection and processing of radiological data include a Trimble™ global positioning system receiver, laptop computer used to log and process the data, and Surfer™ to plot the data.

Table A.1-9
Analytes Reported from Herbicides and Pesticides Analyses

Herbicides	Pesticides	
Dalapon Dicamba MCPP MCPA Dichloroprop 2,4-D Silvex 2,4,5-T 2,4-DB Dinoseb	alpha-BHC gamma-BHC (Lindane) Heptachlor Aldrin beta-BHC delta-BHC Heptachlor Epoxide Endosulfan I gamma-chlordane alpha-chlordane 4,4'-DDE	Dieldrin Endrine 4,4'-DDD Endosulfan II 4.4'-DDT Endrin aldehyde Methoxychlor Endosulfan sulfate Endrin ketone Toxaphene

A.1.4.3.4 Radiological Scanning and Swipe Sampling

Radiological scanning and swipe sampling may be conducted on equipment and/or materials. A handheld detector such as an NE Technologies Electra or equivalent instrument, will be used to scan the item of interest. If contamination is indicated, swipe samples will be collected and counted. This technique identifies radiological conditions of the equipment and/or materials and determines their subsequent release status.

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

The purpose of this step is to define the target population of interest, specify the spatial and temporal features of the population that are pertinent for decision making, determine practical constraints on data collection, and define the scale of decision making relevant to target populations for Decision I.

A.1.5.1 Define the Target Population

Decision I target populations represent locations within the CAS that contain COCs, if present. Decision II target populations are locations adjacent to the COC plume where COC concentrations are less than PALs.

A.1.5.2 Identify the Spatial and Temporal Boundaries

Spatial boundaries are the maximum lateral and vertical extent of expected contamination at each CAS, as shown in Table A.1-10. Contamination found beyond these boundaries may indicate a flaw in the CSM and would require re-evaluation of the CSM before the investigation could continue.

Each CAS is considered geographically independent and intrusive activities are not intended to extend into the boundaries of neighboring CASs. The exception is that CASs 25-23-01 and 25-23-19 may be treated as a single investigative unit.

Table A.1-10
Spatial Boundaries of CAU 214 CASs

Corrective Action Site	Spatial Boundaries
05-99-01, Fallout Shelters	The footprint of each fallout shelter and excavated area plus a 75-ft lateral buffer; 20 ft bgs vertically.
11-22-03, Drum	The footprint of each drum and the cable piles, plus a 30-ft lateral buffer; 20 ft bgs vertically.
25-99-12, Fly Ash Storage	The footprint of the storage structure plus a 50-ft lateral buffer; 20 ft bgs vertically.
25-23-01, Contaminated Materials	Fenceline of yard plus a 75-ft lateral buffer; 20 ft bgs vertically.
25-23-19, Radioactive Material Area	
25-99-18, Storage Area	The graded area (387 ft by 816 ft) plus a 75-ft lateral buffer; 20 ft bgs vertically.
25-34-03, Motor Dr/Gr Assembly (Bunker)	The footprint of each bunker plus a 25-ft lateral buffer; 20 ft bgs vertically. Also, the steel cable between the bunker structures and ETS-1.
25-34-04, Motor Dr/Gr Assembly (Bunker)	
25-34-05, Motor Dr/Gr Assembly (Bunker)	

Temporal boundaries are those time constraints set up by weather conditions and project schedules. Significant temporal constraints due to weather conditions are not expected. Moist weather may place constraints on sampling and field screening contaminated soils because of the attenuating effect of moisture in samples (e.g., alpha-emitting radionuclides). There are no time constraints on collecting samples as environmental conditions at all sites will not significantly change in the near future and conditions would have stabilized over the years since the site was last used.

A.1.5.3 Identify Practical Constraints

Other NTS activities may affect the ability to characterize this site. Underground utilities may exist at the site, which may limit intrusive sampling locations. Other practical constraints include rough terrain and access restrictions. Access restrictions include scheduling conflicts on the NTS with other entities, areas posted as contamination areas requiring appropriate work controls, physical barriers (e.g., fences, buildings, steep slopes), and areas requiring authorized access.

A.1.5.4 Define the Scale of Decision Making

The scale of decision making in Decision I is defined as the CAS. The scale of decision making for Decision II is defined as a contiguous area contaminated with any COC originating from the CAS.

A.1.6 Step 5 - Develop a Decision Rule

This step integrates outputs from the previous step 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 Decision I data 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

Preliminary action levels are defined in Section A.1.4.2.

A.1.6.3 Measurement and Analysis Methods

The measurement and analysis methods in the Industrial Sites QAPP (NNSA/NV, 2002) are capable of achieving the expected range of values. The detection limit of the measurement method to be used is less than the PAL for each COPC, unless specified otherwise in the CAIP. See Section A.1.4.3 for additional details.

A.1.6.4 Decision Rule

The decision rule for Decision I is:

If the population parameter of any COPC in a target population exceeds the PAL for that COPC for Decision I, then that COPC is identified as a COC, and Decision II samples will be collected. If biasing factors (e.g., staining) are present, then Decision II sampling may be conducted prior to confirming contamination through analytical results. If COPC concentrations are less than the corresponding PAL, then the decision will be no further action.

The decision rule for Decision II is:

If the observed concentration of any COC in a Decision II sample exceeds the PALs, then additional samples will be collected to complete the Decision II evaluation. If all observed COC population parameters are less than PALs, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction.

If contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in Table A.1-10, then work will be suspended and the investigation strategy will be reevaluated. If contamination is consistent with the CSM and is within spatial boundaries, then the decision will be to continue sampling to define the extent.

A.1.7 Step 6 - Specify the Tolerable Limits on Decision Errors

The approach for making DQO decisions is based on the results of individual samples; therefore, statistical analysis is not appropriate. Only validated analytical results (quantitative data) will be used to determine if COCs 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 condition (i.e., null hypothesis) and alternative condition for Decision II are as follows:

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

A.1.7.1 False Rejection Decision Error

The false rejection (alpha) decision error would mean deciding that a COC is not present when it actually is (Decision I), or deciding that the extent of a COC has been defined when it has not (Decision II). In both cases the consequence is the increased risk to human health and environment.

For Decision I, a false rejection decision error (where consequences are more severe) is controlled by meeting these criteria:

- Having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS.

- Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

For Decision II, this error is reduced by:

- Having a high degree of confidence that the sample locations selected will identify the extent of COCs.

- Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

- Having a high degree of confidence that the data set is of sufficient quality and completeness.

To satisfy the first criterion, Decision I samples will be collected in areas most likely to be contaminated by COCs (supplemented by random samples where appropriate). Decision II data collection will sample areas that represent the lateral and vertical extent of contamination. The following characteristics are considered for both decisions to accomplish the first criterion:

- Source and location of release
- Chemical nature and fate properties
- Physical transport pathways and properties
- Hydrologic drivers

These characteristics were considered during the development of the CSMs and selection of sampling locations. The biasing factors listed in Section A.1.4.1 will be used to further ensure that these criteria are met.

To satisfy the second criterion, all Decision I samples will be analyzed for the chemical and radiological parameters listed in Section A.1.4.3. Decision II samples will be analyzed for those chemical and radiological parameters that identified unbounded COCs.

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

A.1.7.2 False Acceptance Decision Error

The false acceptance (beta) decision error would mean deciding that a COC is present when it is not, or a COC is unbounded when it is not, resulting in increased costs for unnecessary sampling and analysis.

The false acceptance decision error is controlled by protecting against false positive analytical results. False positive results are typically attributed to laboratory 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. Other measures include proper decontamination of sampling equipment and using certified clean sample containers to avoid cross contamination.

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 and approved procedures.

Quality control samples will be collected as required by established procedures. The required QC samples include the following, but additional QC samples may be submitted based on site conditions.

- 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 source lot per sampling event)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples)
- Field blanks (minimum of 1 per 20 environmental samples, to best exemplify field conditions)

- Laboratory QC samples (minimum of 1 per matrix 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, not required for all radionuclide measurements)

A.1.8 Step 7 - Optimize the Design for Obtaining Data

Intrusive sampling for field-screening and laboratory analysis will be the primary investigative technique at CAU 214. Grab sampling, hand auguring, drilling, direct-push, excavation, or other appropriate sample collection techniques will be used to collect samples. A biased sampling strategy will be used for Decision I to target areas with the highest potential for contamination, if it is present anywhere in the CAS. Sample locations will be determined based on the biasing factors listed in Section A.1.4.1, and are discussed in the following subsections. If biasing factors are present in soils below locations where Decision I samples were removed, subsurface Decision I soil samples will also be collected by hand augering, backhoe excavation, direct-push, or drilling techniques, as appropriate. Decision I subsurface soil samples will collected at depth intervals selected by the Site Supervisor based on biasing factors to a depth where the biasing factors are no longer present.

Additionally, supplemental random samples will be collected within the storage areas of CAS 25-23-01, CAS 25-23-19, and CAS 25-99-18. The Site Supervisor has the discretion to modify the sample locations, but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.4 for the biased sample and the criteria stipulated in Appendix A.3 for the randomized samples.

Step-out (Decision II) sampling locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected, the CSM, and other biasing factors listed in Section A.1.4.1. In general, sample locations will be arranged in a triangular pattern around the Decision I location at distances based on site conditions, process knowledge, and biasing factors. If COCs extend beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. Initial step-outs will be at least as deep as the vertical extent of contamination defined at the Decision I location and the depth of the incremental step-outs will be based on the deepest contamination observed at all locations. A minimum of one clean sample (i.e., COCs less than PALs) will be collected from each step-out to define vertical extent of contamination. The number, location, and spacing of step-outs may be modified by the Site Supervisor, as warranted by site conditions.

The following sections discuss CAS-specific investigation activities, including proposed sample locations.

A.1.8.1 CAS 05-99-01, Fallout Shelters

Prior to Decision I sample collection, miscellaneous surface debris will be collected and staged for waste disposal, as needed. Tumbleweeds will be removed from the excavation at each fallout shelter. A minimum of two soil samples will be collected from each shelter at locations based on biasing factors.

Decision II step-out samples may be collected, as described in the introduction to Section A.1.8. The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples. Proposed sampling locations at CAS 05-99-01 are shown in Figure A.1-15.

As discussed in Section A.1.1, radiological soil contamination at this site originating from nuclear testing is specifically excluded from this investigation. If such contamination exists, it will be addressed by the Soils Program.

A.1.8.2 CAS 11-22-03, Drum

Each drum will be visually inspected for rust, leaks, spills, or other signs of contamination release(s). The material in the drums and the cable piles will be sampled using appropriate methodology (if sufficient nature and quantity of media is present) for waste characterization. If source material (cable pile and drum contents) contamination concentrations are less than PALs, it will not be necessary to sample the underlying soil. Otherwise, the drums and the cable piles will be moved and staged for waste disposal prior to sampling the underlying soil. If necessary, a minimum of one soil sample will be collected from the footprint of each drum, and a minimum of two soil samples will be collected from the footprint of the cable piles.

Decision II step-out samples may be collected, as described in the introduction to Section A.1.8. The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples. Proposed sampling locations at CAS 11-22-03 are shown in Figure A.1-16.

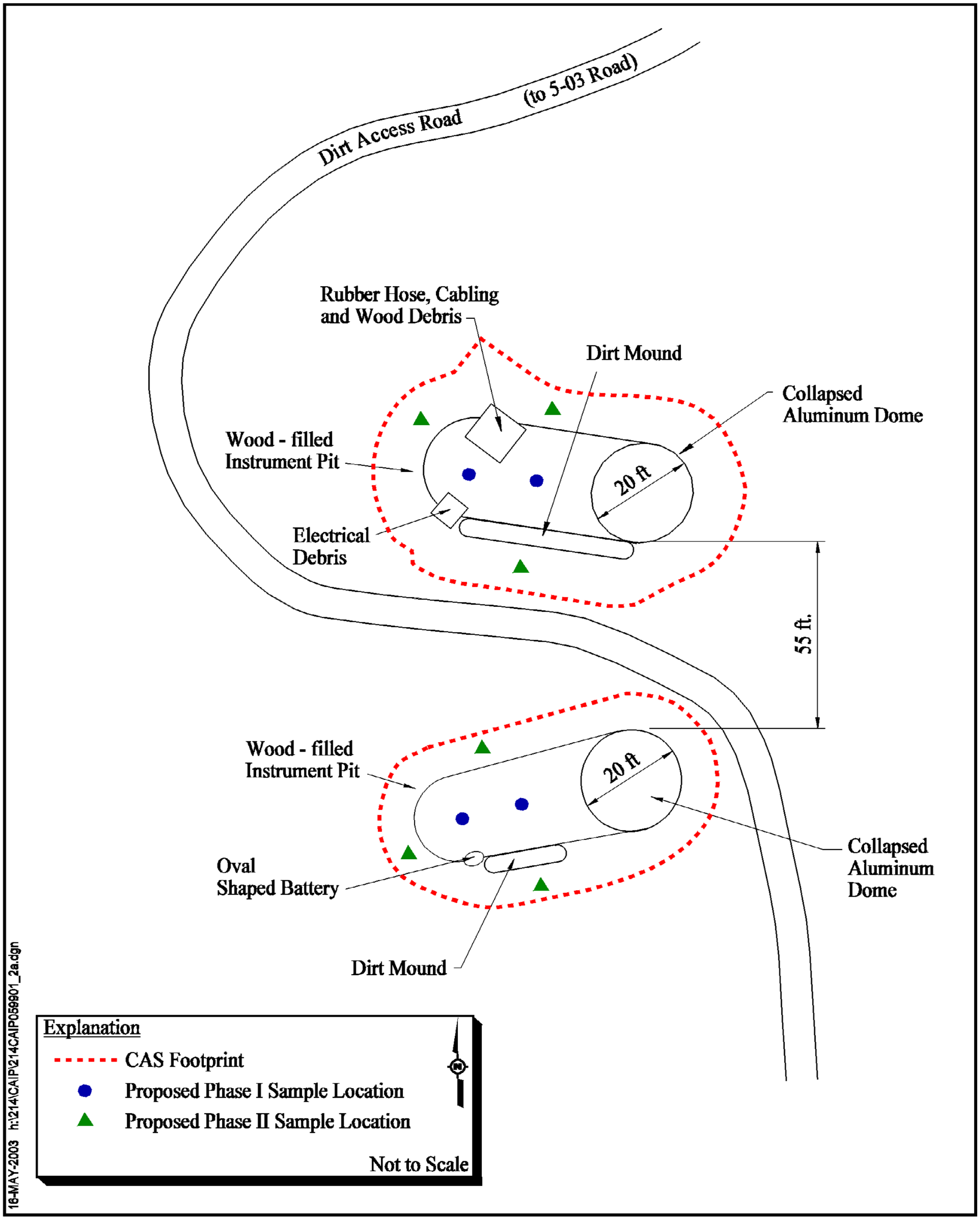


Figure A.1-15
Proposed Sampling Locations at CAS 05-99-01, Fallout Shelters

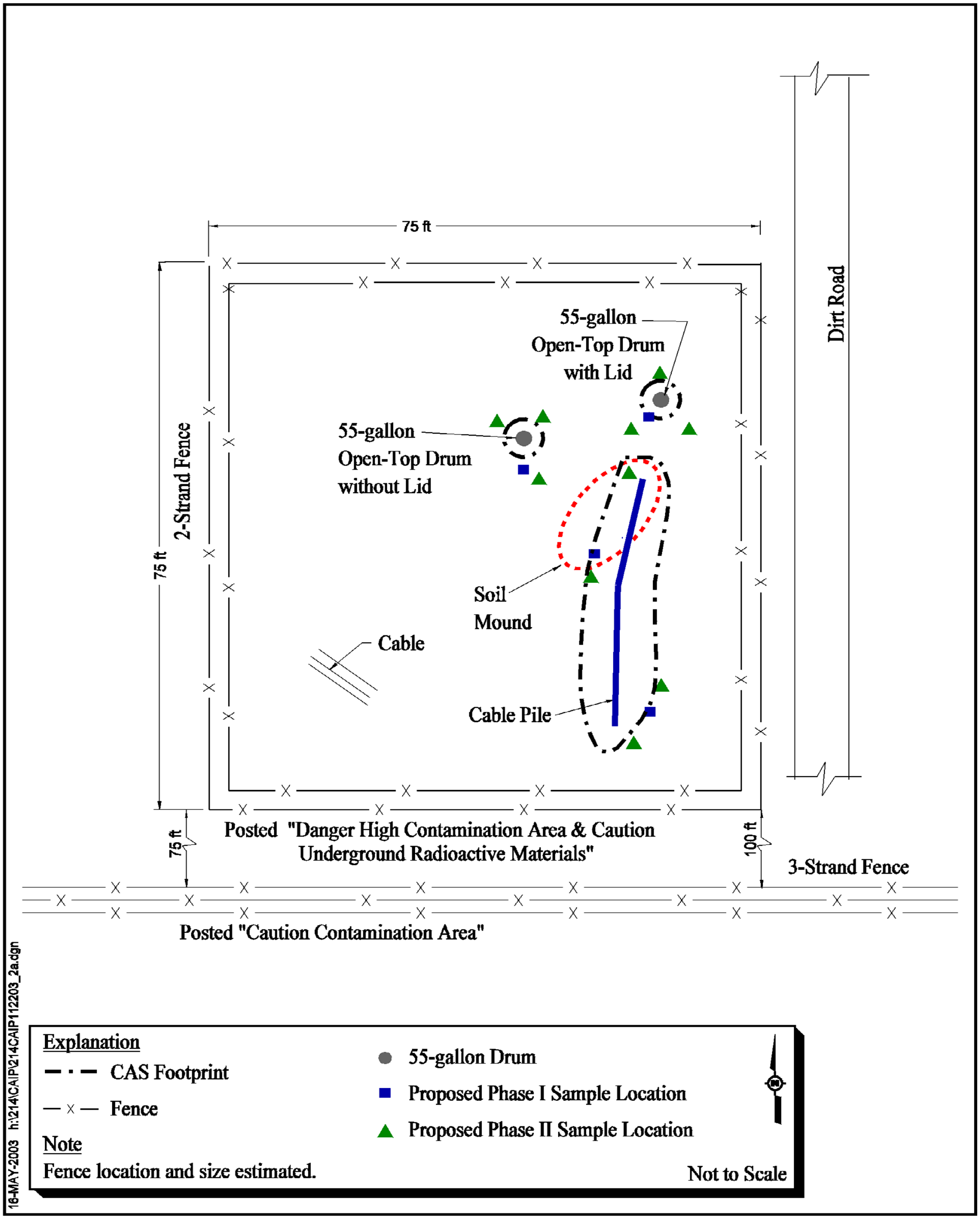


Figure A.1-16
Proposed Sampling Locations at CAS 11-22-03, Drum

As discussed in Section A.1.1, radiological soil contamination at this site originating from nuclear testing is specifically excluded from this investigation. If such contamination exists, it will be addressed by the Soils Program.

A.1.8.3 CAS 25-99-12, Fly Ash Storage

The material in the storage structure will be sampled using appropriate methodology for waste characterization. If source material (fly ash) contamination concentrations are less than PALs, it will not be necessary to sample the underlying soil. Otherwise, the storage structure and fly ash will be moved and staged for waste disposal prior to sampling the underlying soil. If necessary, a minimum of two soil samples will be collected from the footprint of the storage structure.

Decision II step-out samples may be collected, as described in the introduction to Section A.1.8. The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples. Proposed sampling locations at CAS 25-99-12 are shown in Figure A.1-17.

A.1.8.4 CAS 25-23-01, Contaminated Materials and CAS 25-23-19, Radioactive Materials Storage

A walkover radiological survey will be performed at accessible portions of the storage yard and will be conducted as described in Section A.1.4.3.3. A minimum of one soil sample will be collected from any area, hotspot, or group of hotspots with a localized gamma emission rate statistically exceeding background as determined by the post-processed contour plot of the radiological survey data.

Transects of the yard, spaced no more than 40 ft apart, will walked to ensure that the whole yard is examined for potential biasing factors. If biasing factors reveal soil stains or other indications of contamination (other than the soil stains discussed below), the location will be marked with a pinflag or other appropriate methods, and a minimum of one soil sample will be collected per contamination feature or group of features.

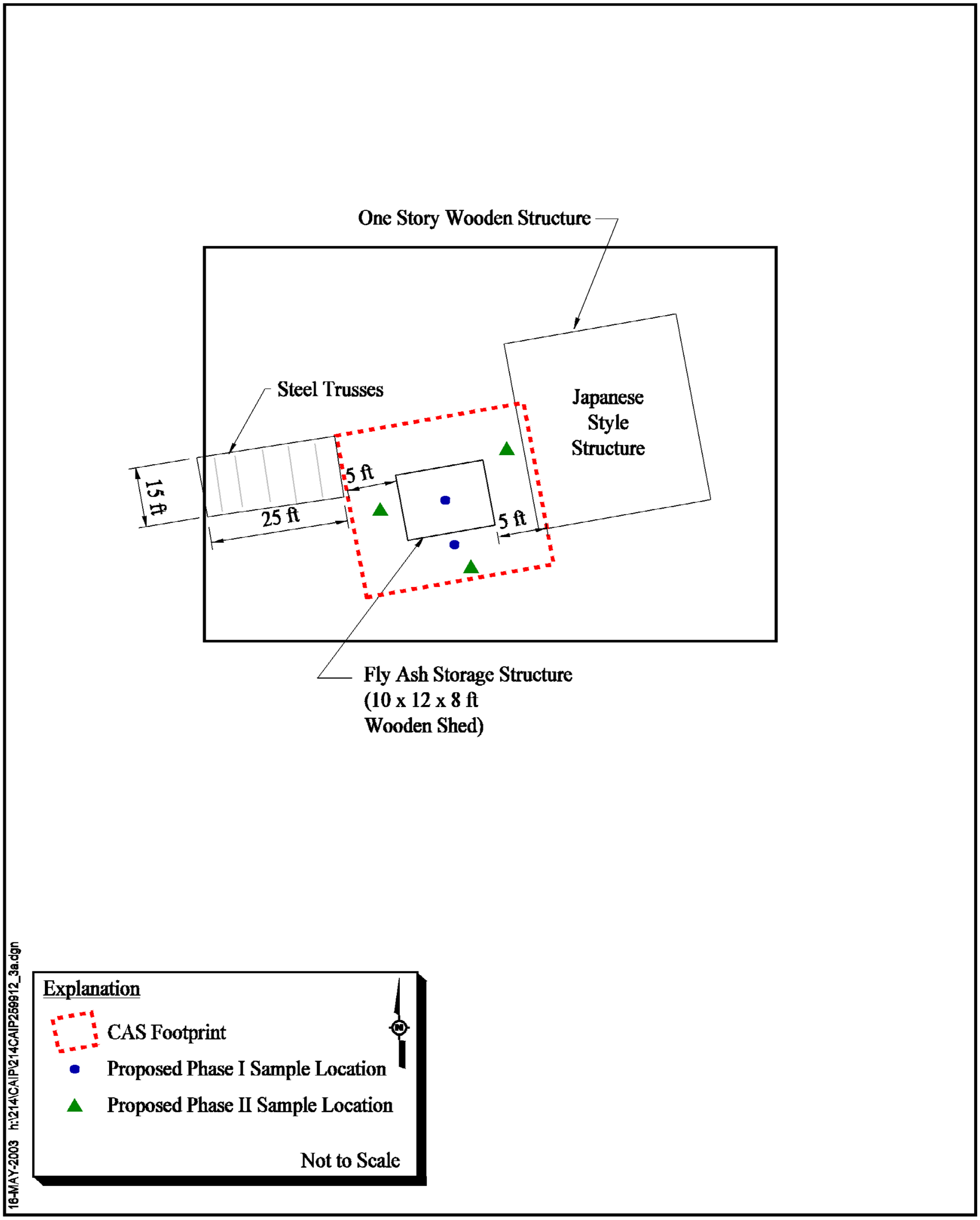


Figure A.1-17
Proposed Sampling Locations at CAS 25-99-12, Fly Ash Storage

Three surface soil stains have been identified to date at CASs 25-23-01 (two) and 25-23-19 (one); a green stain in the northwest corner of the yard (CAS 25-23-19), a stained area in the central portion of the yard, and a stained area in the southeast section of the yard (which includes the footprint of the pesticide-containing drum, since removed). A minimum of one soil sample will be collected from each soil stain and from where the pesticide drum was located. In addition, a minimum of two samples will be collected from the small drainage that exits the south side of the yard.

Additionally, supplemental samples will be collected from the locations identified by the Visual Sampling Plan software (PNNL, 2002). This software will randomize sample locations excluding areas from which biased samples were collected. Therefore, the exact number and location of the samples will be determined by re-running the software (following determination of the biased sample locations) using the parameters listed in the documented example for each CAS in Appendix A.3.

Decision II step-out samples may be collected, as described in the introduction to Section A.1.8. The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples. Proposed sampling locations at CAS 25-23-01 and CAS 25-23-19 are shown in Figure A.1-18.

A.1.8.5 CAS 25-99-18, Storage Area

A minimum of one soil sample will be collected from the bottom of each of the two shallow depressions and a minimum of one soil sample will be collected from the footprint of the lead brick after the brick is moved. Transects of the graded area, spaced no more than 40 ft apart, will walked to ensure that the whole yard is examined for potential biasing factors. If biasing factors reveal soil stains or other indications of contamination, the location will be marked with a pinflag or other appropriate methods, and a minimum of one soil sample will be collected per contamination feature or group of features.

Additionally, supplemental samples will be collected from the locations identified by the Visual Sampling Plan software (PNNL, 2002). This software will randomize sample locations excluding areas from which biased samples were collected. Therefore, the exact number and location of the samples will be determined by re-running the software (following determination of the biased

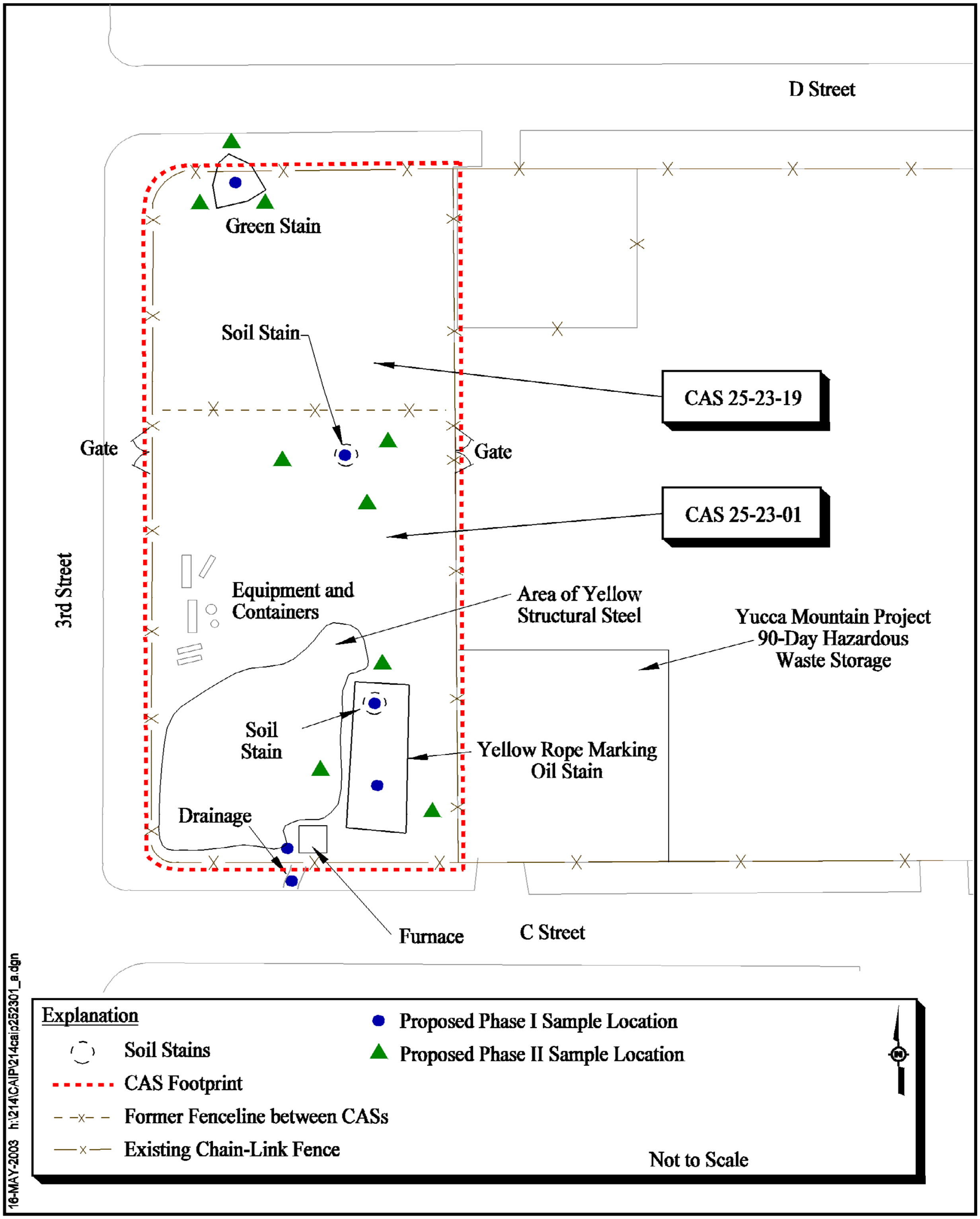


Figure A.1-18
Proposed Sampling Locations at CAS 25-23-01, Contaminated Materials, and CAS 25-23-19, Radioactive Material Storage

sampling locations) using the parameters listed in the documented example for this CAS in Appendix A.3.

Decision II step-out samples may be collected, as described in the introduction to Section A.1.8. The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples. Proposed sampling locations at CAS 25-99-18 are shown in Figure A.1-19.

A.1.8.6 CASs 25-34-03, 25-34-04, and 25-34-05, Motor Dr/Gr Assembly (Bunker)

A walkover radiological survey covering 100 percent of the CAS footprint will be conducted as described in Section A.1.4.3.3. A minimum of use soil sample will be collected from any area, hotspot, or group of hotspots with a localized gamma emission rate statistically exceeding background as determined by the post-processed contour plot of the radiological survey data. In addition, radiological survey will be performed on accessible portions of the 1-in. steel cable between the CAS bunkers and the ETS-1 Building. Hotspots will be flagged and GPS coordinates will be obtained.

Prior to Decision I sample collection, miscellaneous surface debris will be moved and staged for waste disposal. A minimum of one sample will be collected from the soil below the drain hole at each of the bunkers.

Each bunker and its contained equipment will be evaluated as significant potential source(s) of contamination using appropriate methodology (e.g., photography, visual inspection). If significant potential contamination source(s) are identified, the source(s) may be sampled, as appropriate.

Decision II step-out samples may be collected, as described in the introduction to Section A.1.8. The Site Supervisor will determine if Decision II sampling is appropriate based on biasing factors, primarily field screening of Decision I samples. Proposed sampling locations are shown in Figure A.1-20 (CAS 25-34-03), Figure A.1-21 (CAS 25-34-04), and Figure A.1-22 (CAS 25-34-05).

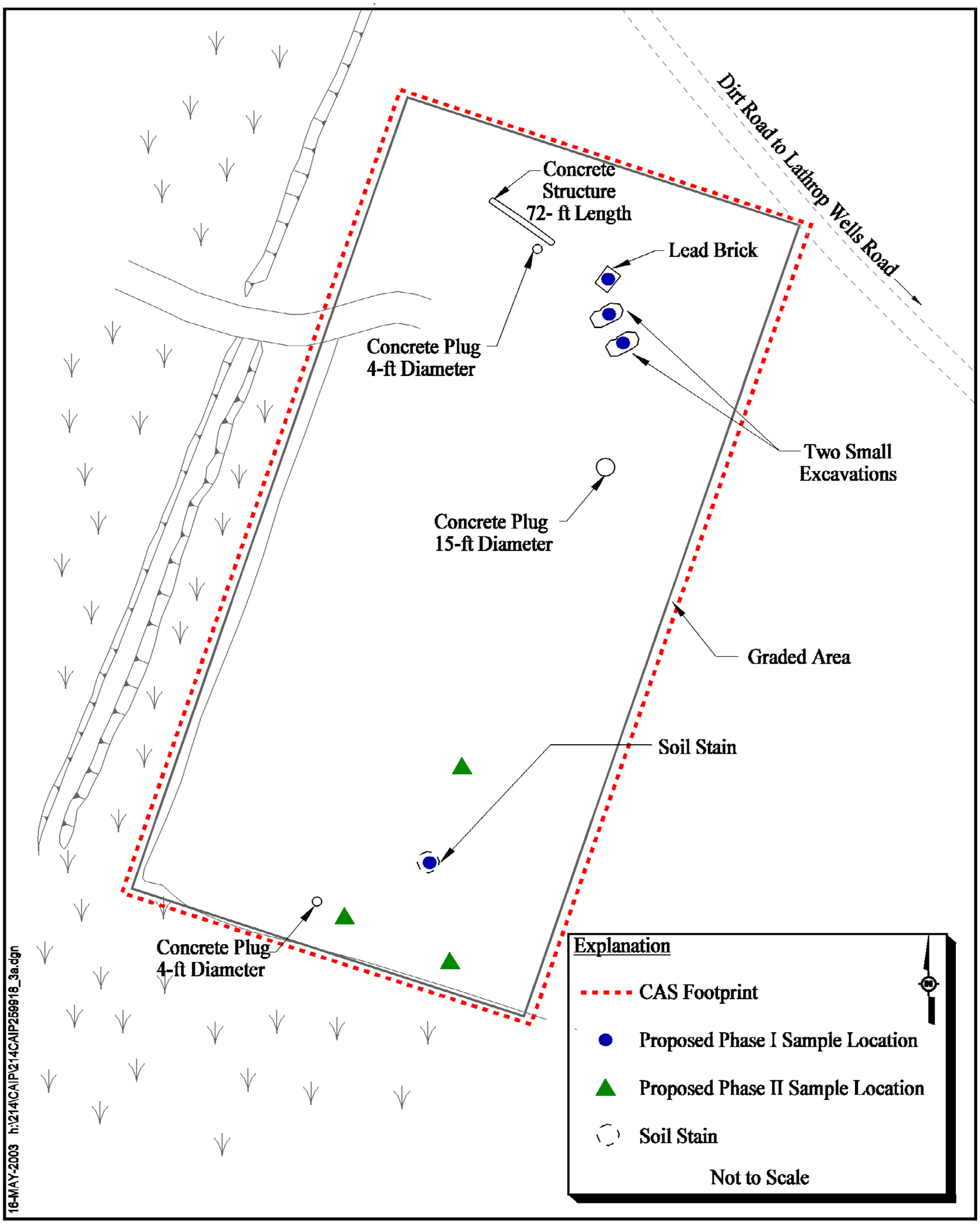


Figure A.1-19
Proposed Sampling Locations at CAS 25-99-18, Storage Area

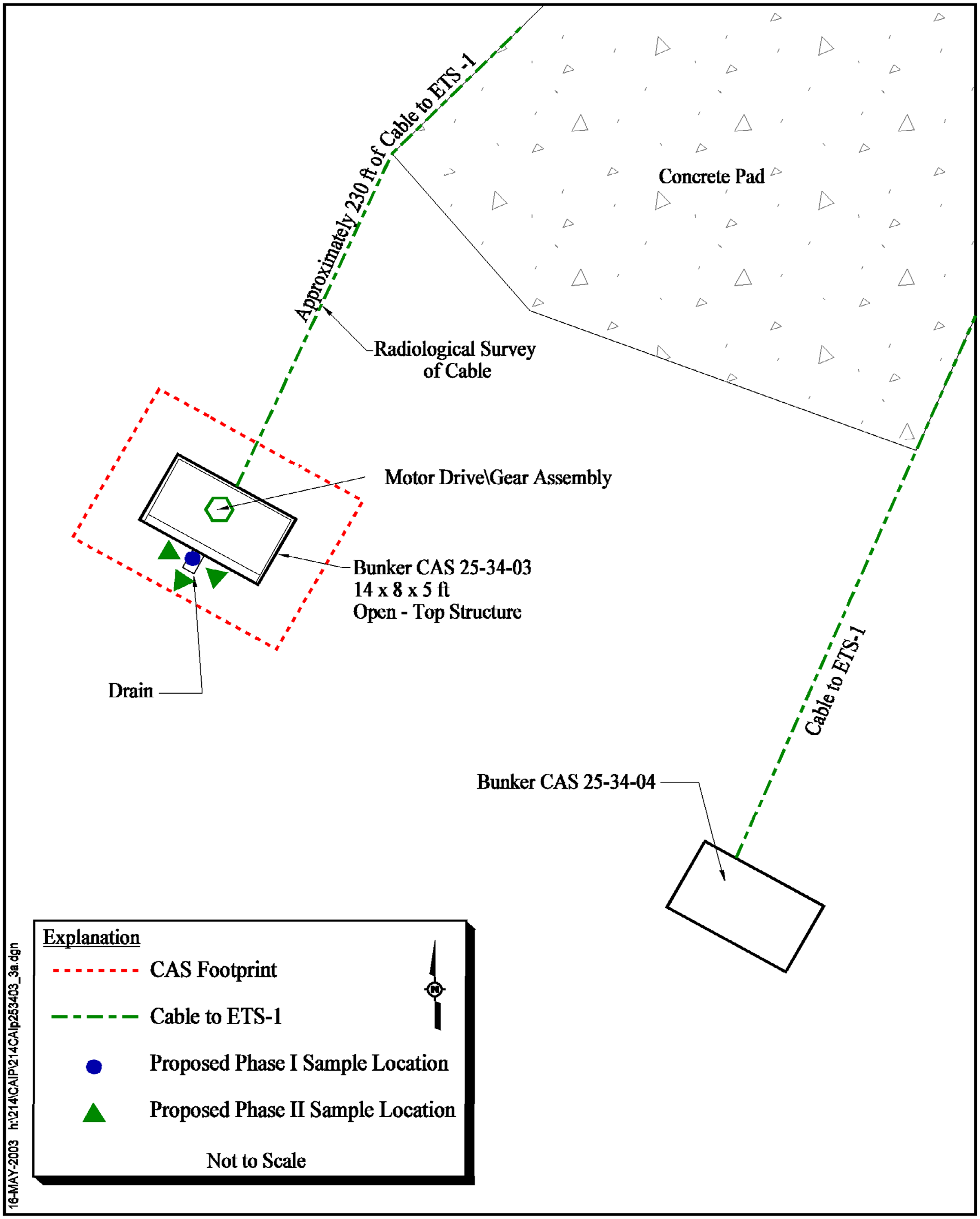


Figure A.1-20
Proposed Sampling Locations at CAS 25-34-03, Motor Dr/Gr Assembly (Bunker)

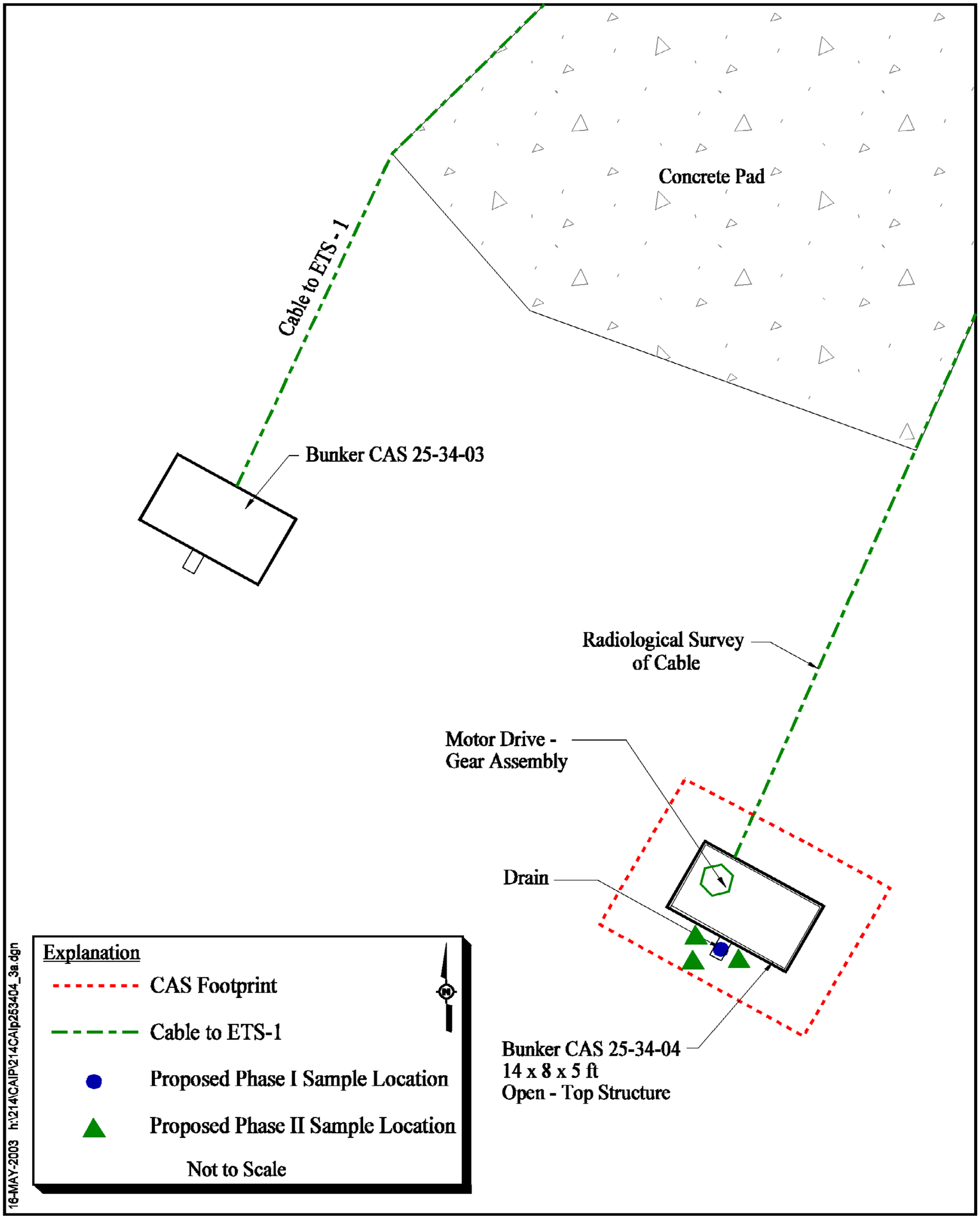


Figure A.1-21
Proposed Sampling Locations at CAS 25-34-04, Motor Dr/Gr Assembly (Bunker)

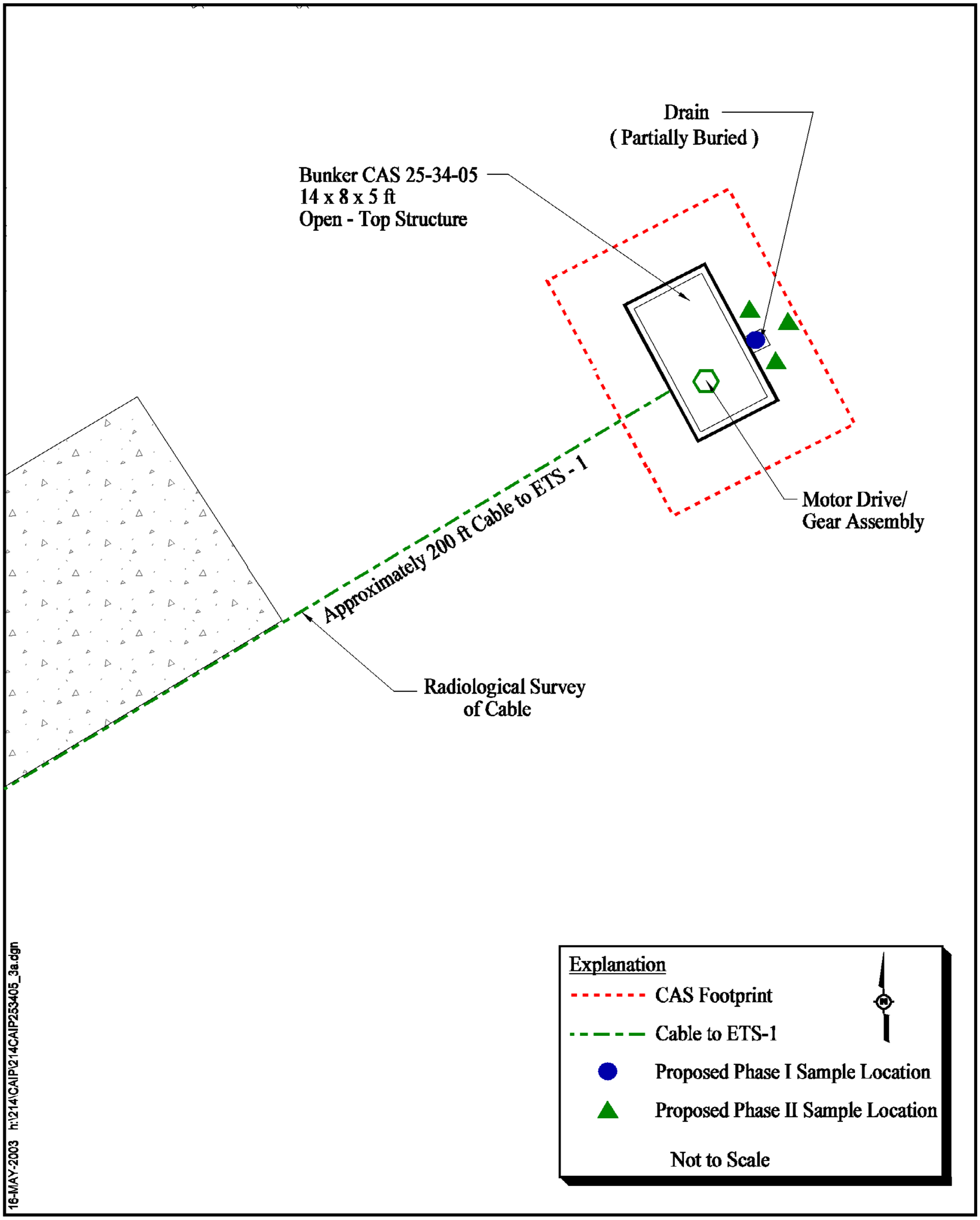


Figure A.1-22
Proposed Sampling Locations at CAS 25-34-05, Motor Dr/Gr Assembly (Bunker)

A.1.9 References

BN, see Bechtel Nevada.

Bechtel Nevada. 2000. Sample results for sample number 96MWL0708-2, 19 April. Las Vegas, NV.

Center for Land Use Interpretation. 1996. The Nevada Test Site A Guide to America's Nuclear Proving Ground, Culver City, CA.

DASA, see Defense Atomic Support Agency.

Defense Atomic Support Agency. 1960. *Operation Plumbbob*, 31 August. Albuquerque, NM.

Desert Research Institute. 1988. *CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas*, April. Las Vegas, NV.

Desert Research Institute and Carey & Co. 1996. *Nevada Test Site Historic Building Survey,* November. Las Vegas, NV.

DASA, see Defense Atomic Support Agency.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

DRI, see Desert Research Institute.

DRI and Carey & Co., see Desert Research Institute and Carey & Co., Inc.

Defense Atomic Support Agency. 1960. *Operation Plumbbob*, 31 August. Albuquerque, NM.

EPA, see U.S. Environmental Protection Agency.

Guymon, R.H., Reynolds Electrical & Engineering Co., Inc. 1995. Letter to D. Elle (DOE/NV) entitled "Investigation of the Area 25 West Yard Drums and Soil Contamination," 19 September. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 1998. *Field Activity Daily Log for CAS 25-03-01 and CAS 25-23-19.* Las Vegas, NV.

Jacobs, W.R., U.S. Air Force. 1986. Letter to V.F. Witherill (DOE/NV) entitled, "Restoration of Facilities," 13 June. Mercury, NV.

Jacobs, W.R., Science Applications International Corporation. 2001. Record of Telecon with J. Markowsky (SAIC) regarding CAU 214, CAS 25-99-18, 2 February. Las Vegas, NV.

Kendall, E.W., Reynolds Electrical and Engineering Co., Inc. 1995. Letter to D. Elle (DOE/NV) entitled, "Cleanup of the Area 25 West Yard," 17 October. Las Vegas, NV.

Latham, A.R., Bechtel Nevada. 1996. Memorandum entitled: "Sample Analytical Results," 10 January. Las Vegas, NV.

McArthur, R.D., and F.L. Miller, Jr. 1989. *Off-Site Radiation Exposure Review Project, Phase II Soil Program*, DOE/NV/10384-23. Las Vegas, NV: Desert Research Institute.

NAC, see Nevada Administrative Code.

NBMG, see Nevada Bureau of Mines and Geology.

Nevada Administrative Code. 2002. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV.

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

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

Pacific Northwest National Laboratory. 2002. *Visual Sample Plan Version 2.0 User's Guide*. September. PNNL-14002. Richland, WA.

PNNL, see Pacific Northwest National Laboratory.

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

Reynolds Electrical & Engineering Co., Inc. 1993. *Site Demarcation Survey, Radioactive Storage Yard Behind Bldg. 4320, Area 25*. Las Vegas, NV.

Sorom, E., Reynolds Electrical and Engineering Co., Inc. 1998. Record of Telecon with C. Speer (SAIC) regarding the REECo West Storage Yard Contaminated Materials, 28 April. Las Vegas, NV: ITLV.

Trudeau, D.A., U.S. Geological Survey. 1997. Letter to R. Bangerter (NNSA/NV) entitled, "Milestone Completion Letter," 31 January. Las Vegas, NV.

U.S. Department of Energy. 1993. *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, chg.2. Washington, DC: U.S. Government Printing Office.

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

U.S. Department of Energy, Nevada Operations Office. 1996. *Sealed Bid Auction Notice*, 6 August. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998. *Nevada Test Site Resource Management Plan*, DOE/NV-518. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1999. *Underground Test Area Project Corrective Action Unit 98: Frenchman Flat*, DOE/NV 13052--044--V2. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000. *NV/YMP Radiological Control Manual*, Rev. 4, DOE/NV/11718-079. Prepared by Bechtel Nevada. Las Vegas, NV.

US Ecology and Atlan-Tech. 1991. *Environmental Monitoring Report for the Proposed Ward Valley, California Low Level Radioactive Waste (LLRW) Facility.* Roswell, GA.

U.S. Environmental Protection Agency. 2000. *Data Quality Objectives Process for Hazardous Waste Site Investigations*. EPA QA/G-4HW. *Washington, DC.*

U.S. Environmental Protection Agency. 2002. *Region IX Preliminary Remediation Goals (PRGs)*. Prepared by S.J. Smucker. San Francisco, CA.

USGS, see U.S. Geological Survey.

USGS/DOE, see U.S. Geological Survey and U.S. Department of Energy.

U.S. Geological Survey. 1995a. *Precipitation Data for Water Years 1992 and 1993 from a Network on Nonrecording Gauges at Yucca Mountain, Nevada*. USGS-OFR-95-146. Prepared by D.S. Ambos and A.L. Flint, and J.A. Hevesi for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV.

U.S. Geological Survey. 1995b. *Selected Ground-Water Data for Yucca Mountain Region, Southern Nevada and Eastern California, Calendar Year 1993*. USGS-OFR-158. Prepared by G.S. Hale and C.L. Westenburg. Denver, CO.

U.S. Geological Survey and U.S. Department of Energy. 2002. "USGS/DOE Nevada Water Use Wells," as accessed at http://nevada.usgs.gove/doe_nv/area5.asp on December 20, 2002.

Appendix A.2

Project Organization

A.2 Project Organization

The NNSA/NSO Project Manager is Janet Appenzeller-Wing. She can be contacted at (702) 295-0461. The NNSA/NSO Task Manager is Sabine Curtis. She can be contacted at (702) 295-0542.

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 NNSA/NSO Project Manager be contacted for further information.

Appendix A.3

Determination of the Number and Location of Random Samples

A.3 Determination of the Number and Location of Random Samples

A.3.1 Purpose

During the DQO Meeting on February 12, 2003, it was proposed that additional randomly-located samples be collected in the CAU 214 storage yards (CAS 25-23-01, CAS 25-23-19, and CAS 25-99-18). These additional samples were needed to verify that unsampled areas of the storage yards (areas with no biasing factors upon which to base the selection of a sampling location) do not pose an unacceptable risk to human health and the environment. The Visual Sample Plan software (PNNL, 2002) was used to determine the number and location of samples for each of these CASs. This software was developed by Pacific Northwest National Laboratory for the U.S. Department of Energy and the U.S. Environmental Protection Agency.

Although the stated DQO decision rule at this site is to compare the result of each analyte from each sample to a corresponding PAL concentration, use of the VSP software assumes that the mean value of each analyte from all samples taken from each CAS will be compared to the corresponding PAL. This apparent discrepancy adds and additional measure of conservatism to the DQO decision.

The VSP software allows the user to exclude areas from consideration for selection of random sample locations. Following selection of biased sample locations at each of the storage areas, the areas represented by the biased samples will be excluded from the area VSP will consider for random sample selection and the software will be re-run. Therefore, the sampling locations presented herein are intended to be used as examples only. These locations will be re-generated following the biased sampling and presented in the CAU 214 Corrective Action Decision Document.

The following information was extracted from the *Visual Sample Plan Version 2.0 User's Guide* (PNNL, 2002).

The purpose of VSP is to provide simple, defensible tools for defining an optimal, technically defensible sampling scheme for characterization. VSP is applicable for any two-dimensional sampling plan including surface soil, building surfaces, water bodies, or other similar applications. VSP is tailored to the environmental professional who values cost effectiveness, simplicity, accuracy, and defensible methods. This professional wants to solve real-world environmental contamination problems using state-of-the-art statistical methods, but does not have time to master new complex software tools. It is no simple matter to collect and analyze environmental data to reach conclusions that are statistically defensible while minimizing costs. VSP can help scientists and engineers solve the following problems:

- How many samples are needed?
  The algorithms involved in determining the number of samples needed can be quite involved and intimidating to the non-expert. VSP can quickly calculate the number of samples needed for various scenarios at different costs.

- Where should the samples be taken?
  Sample placement based on personal judgment is prone to bias. VSP instantly provides random or gridded sampling locations overlaid on a user-input site map.

A.3.2 VSP Results

The following information was extracted from reports generated by individual runs of VSP for CAS 25-23-01, CAS 25-23-19, and CAS 25-99-18. The software was run based on the selection of random sampling locations to be used for comparing a mean with a fixed threshold (nonparametric).

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples.

Table A.3-1 summarizes the sampling design used. Figures A.3-1, A.3-2, and A.3-3 show example field sampling locations and Table A.3-2 lists example field sampling location coordinates.

A.3.3 Primary Sampling Objective

Visual Sample Plan assumes that the primary purpose of sampling at this site is to compare a mean value with a fixed threshold. The working hypothesis (or “null” hypothesis) is that the mean value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the mean value is less than the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Table A.3-1
Summary of Sampling Design

Primary Objective of Design	Compare a site mean to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The mean value at the site exceeds the threshold
Formula for calculating number of sampling locations	Wilcoxon signed ranks test
Calculated total number of samples	12
Number of samples on map[a]	12
Number of selected sample areas[b]	1
Sampling area of CAS 25-99-18[c]	29,773.36 square meters (m^2)
Sampling area CAS 25-23-01[c]	4,519.01 m^2
Sampling area CAS 25-23-19[c]	2,367.31 m^2

[a]This number may differ from the calculated number because of (1) grid edge effects, (2) adding judgment samples, or (3) selecting or unselecting sample areas.
[b]Number of selected sample areas is the number of colored areas which contain sampling location on the map.
[c]Sampling area is the surface area of the selected sample areas.

A.3.4 Selected Sampling Approach

A nonparametric random sampling approach was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

Locating the sample points randomly provides data that are separated by many distances, whereas systematic samples are all equidistant apart. Therefore, random sampling provides more information about the spatial structure of the potential contamination than systematic sampling. As with systematic sampling, random sampling also provides information regarding the mean value, but there is the possibility that areas of the site will not be represented with the same frequency as if uniform grid sampling were performed.

A.3.5 Number of Total Samples: Calculation Equation and Inputs

The equation used to calculate the number of samples is based on a Wilcoxon Signed Ranks test. For this site, the null hypothesis is rejected in favor of the alternative one if the sample mean is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = 1.16\left[\frac{\left(S_{sample}^2 + \frac{S_{analytical}^2}{r}\right)}{\Delta^2}(Z_{1-\alpha} + Z_{1-\beta}) + 0.5\, Z_{1-\alpha}^2\right]$$

where:

n = the number of samples
S = the estimated standard deviation of the measured values including analytical error
Δ = the width of the gray region
α = the acceptable probability of incorrectly concluding the site mean is less than the threshold
β = the acceptable probability of incorrectly concluding the site mean exceeds the threshold
$Z_{1-\alpha}$ = the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is 1-α
Z_{1-b} = the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is 1-β

The values of these inputs that result in the calculated number of sampling locations are shown in Table A.3-3.

Figure A.3-4 is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA, 2000). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of

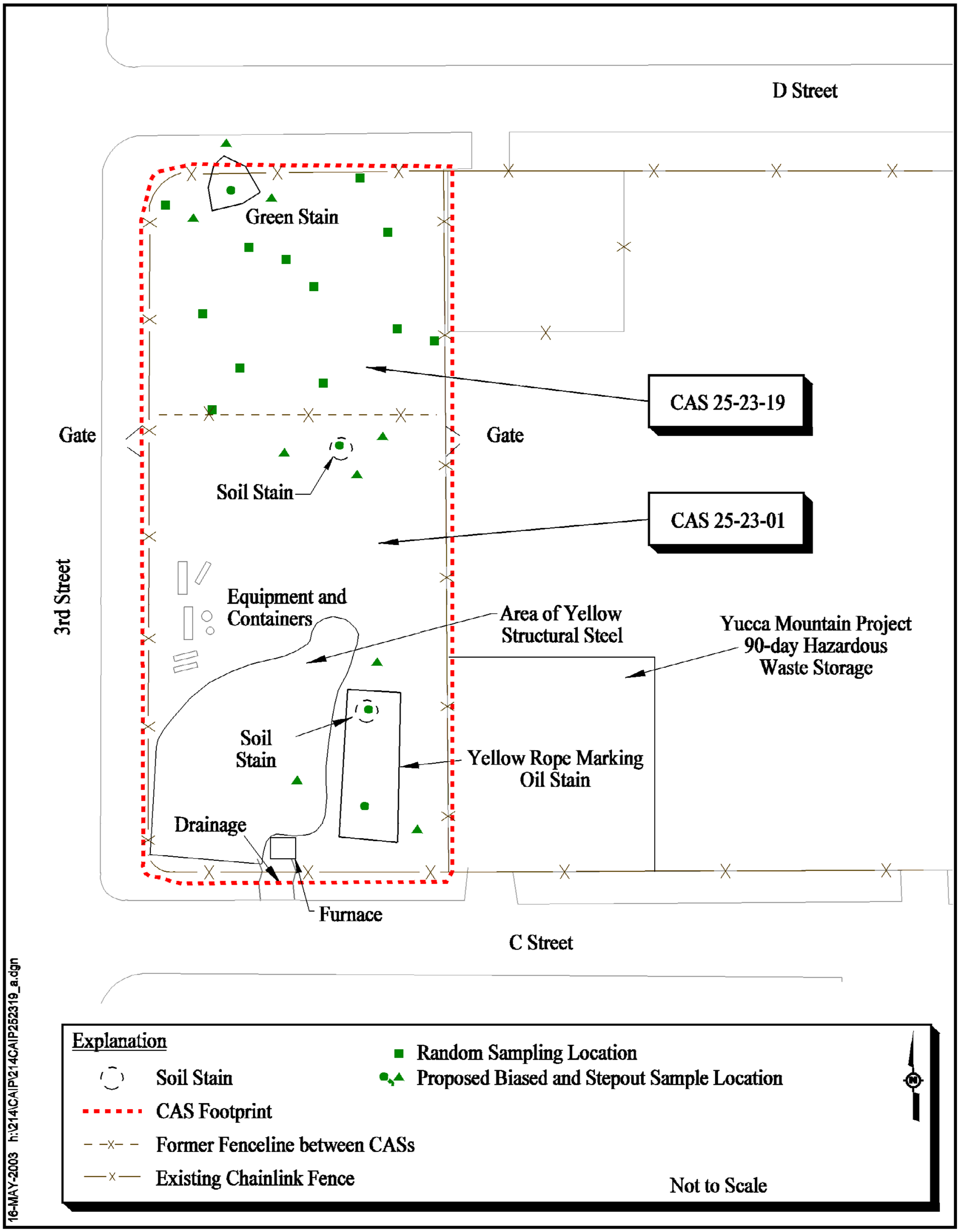


Figure A.3-1
Example Random Sampling Locations for CAS 25-23-19

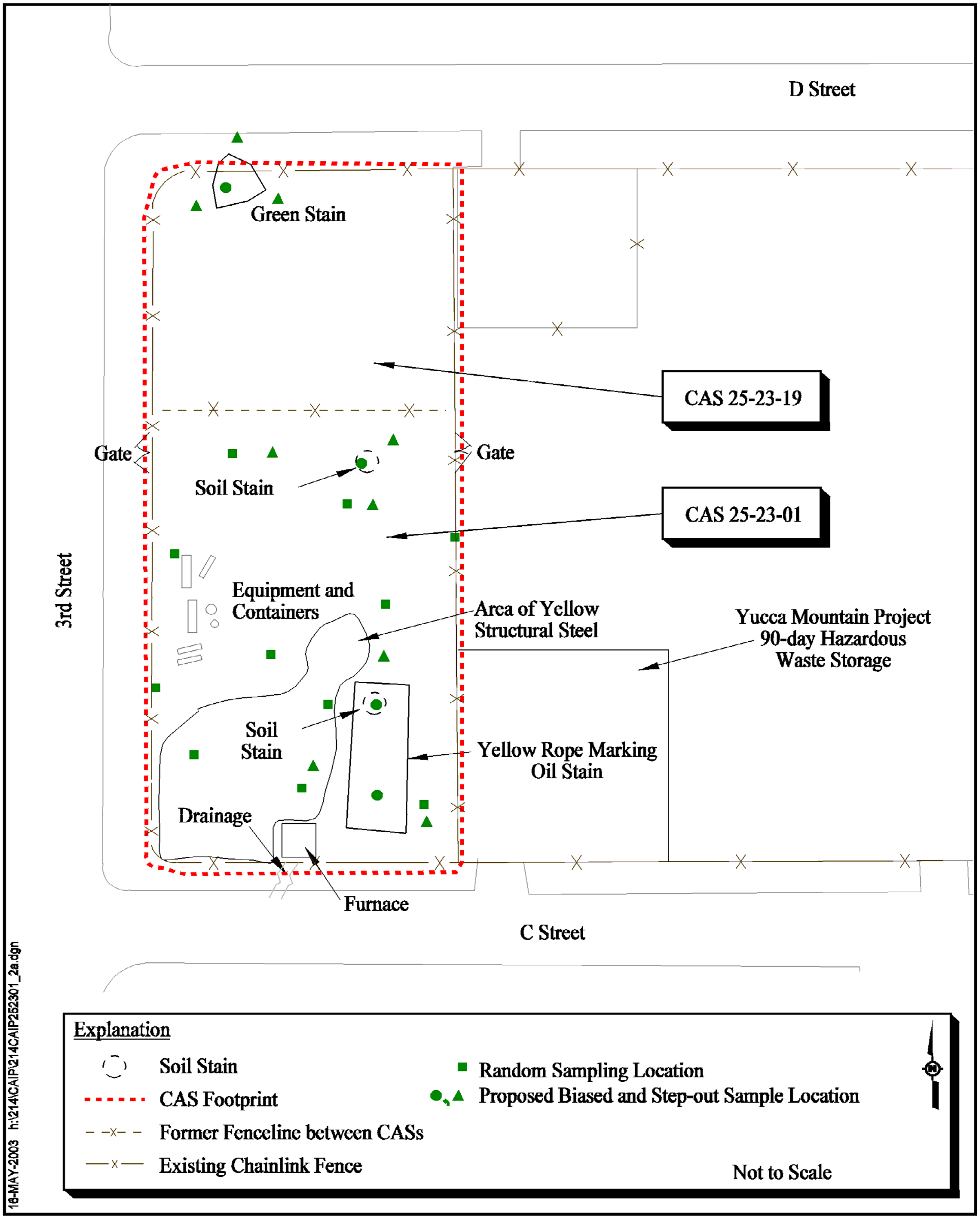


Figure A.3-2
Example Random Sampling Locations for CAS 25-23-01

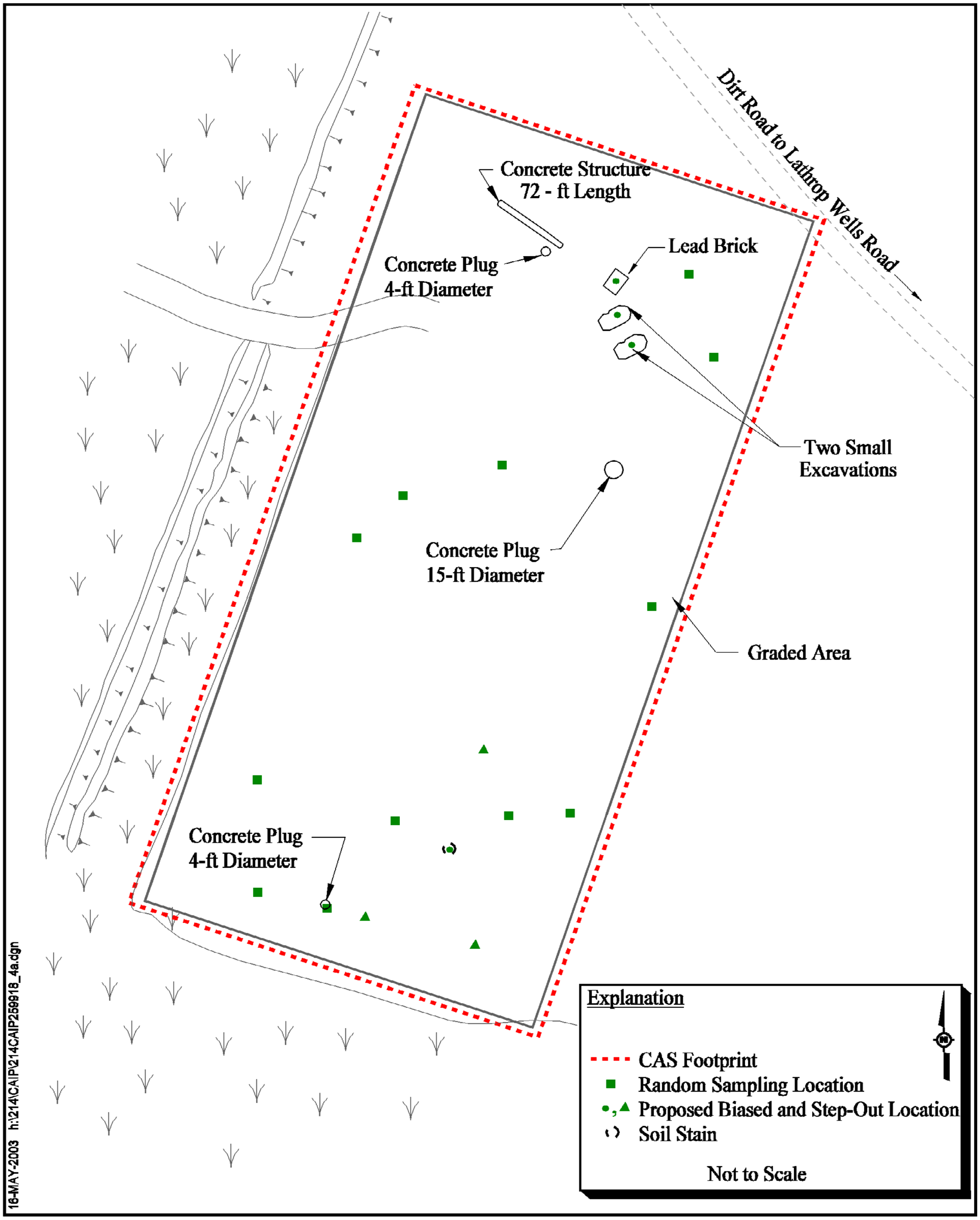


Figure A.3-3
Example Random Sampling Locations for CAS 25-99-18

Table A.3-2
Example Field Sampling Location Coordinates

Sampling Location Coordinates, CAS 25-99-18	
X Coordinate	Y Coordinate
550430.6301	4043558.2391
550318.4993	4043393.4272
550423.3785	4043583.1511
550340.5103	4043516.9083
550412.7193	4043483.6867
550298.3904	4043398.2236
550389.0280	4043421.8198
550327.1472	4043504.2483
550298.2626	4043431.8437
550371.1256	4043421.0295
550338.2622	4043419.5846
550369.2367	4043526.0530
Sampling Location Coordinates, CAS 25-23-01	
X Coordinate	**Y Coordinate**
563259.1895	4070560.9402
563286.6010	4070607.1995
563233.0629	4070579.4439
563260.4744	4070551.6883
563246.7687	4070622.6193
563274.1802	4070594.8637
563239.9158	4070567.1081
563267.3273	4070613.3674
563253.6216	4070585.6118
563281.0331	4070557.8562
563236.4894	4070604.1155
563263.9009	4070576.3599
Sampling Location Coordinates, CAS 25-23-19	
X Coordinate	**Y Coordinate**
563264.2302	4070636.4332
563250.7115	4070661.1848
563277.7488	4070646.3338
563243.9522	4070631.4829
563270.9895	4070673.8356
563257.4708	4070658.9846
563284.5081	4070644.1337
563235.5030	4070668.8853
563262.5403	4070654.0343
563249.0217	4070639.1834
563276.0590	4070663.9349
563242.2623	4070649.0840

Table A.3-3
Input Values for VSP

Parameter	Value
S	10
Δ	10
α	5%
β	10%
$Z_{1-\alpha}$	1.64485[a]
$Z_{1-\beta}$	1.28155[b]

[a]This value is automatically calculated by VSP based upon the user defined value of α.
[b]This value is automatically calculated by VSP based upon the user defined value of β.

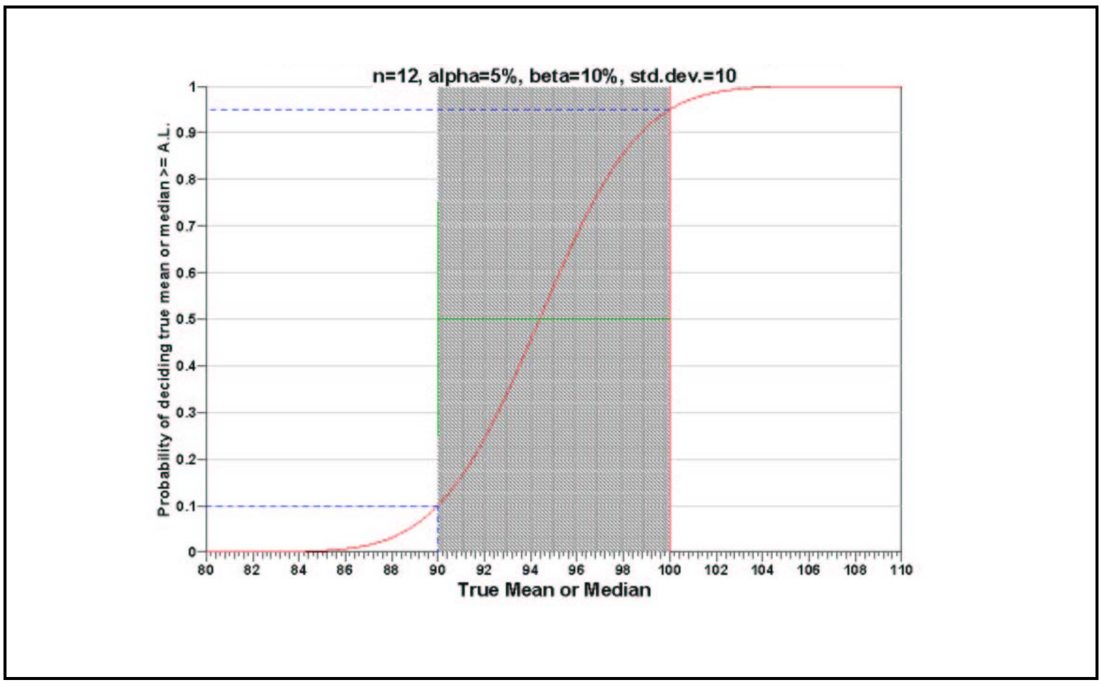


Figure A.3-4
Wilcoxon Signed Rank (One-Sample) Test

possible true mean values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

A vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the shaded area is equal to Δ; the upper horizontal dashed line is positioned at $1-\alpha$ on the vertical axis; the lower horizontal dashed line is positioned at β on the vertical axis. The vertical line is positioned at one standard deviation below the threshold. The shape of the curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at β and the upper bound of Δ at 1-α. If any of the inputs change, the number of samples that result in the correct curve changes.

Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. The data originate from a symmetric (but not necessarily normal) population
2. The variance estimate, S^2, is reasonable and representative of the population being sampled
3. The population values are not spatially or temporally correlated
4. The sampling locations will be selected randomly

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the sample locations were selected using a random process.

Table A.3-4
Sensitivity Analysis

Number of Samples							
AL=100		α=5		α=10		α=15	
		S=20	S=10	S=20	S=10	S=20	S=10
LBGR=90	β=5	52	15	41	11	34	9
	β=10	42	12	32	9	26	7
	β=15	35	10	26	8	21	6
LBGR=80	β=5	15	5	11	4	9	3
	β=10	12	5	9	3	7	3
	β=15	10	4	8	3	6	2
LBGR=70	β=5	8	3	6	3	5	2
	β=10	6	3	5	2	4	2
	β=15	6	3	4	2	3	2

S = Standard Deviation
LBGR = Lower Bound of Gray Region (% of Action Level)
β = Beta (%), Probability of mistakenly concluding that? > action level
α = Alpha (%), Probability of mistakenly concluding that? < action level
AL = Action Level (Threshold)

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying S, LBGR, β and α and examining the resulting changes in the number of samples. Table A.3-4 shows the results of this analysis.

A.3.6 References

Pacific Northwest National Laboratory. 2002. *Visual Sampling Plan Version 2.0, User's Guide* PNNL-14002. Richland, WA.

U.S. Environmental Protection Agency. 2000. *Data Quality Objectives Process for Hazardous Waste Site Investigations*. EPA QA/G-4HW.

Appendix A.4

Technical Memoradum Regarding the Use of Visual Sample Plan

Shaw
Shaw E & I, Inc.

Memorandum

To: L. Kidman

Date: April 24, 2003

From: Syl Hersh

Project No.: 840224.03080035

Subject: RESPONSE TO NDEP COMMENT ON THE USE OF VISUAL SAMPLE PLAN (VSP) FOR DETERMINING RANDOM SAMPLING LOCATIONS FOR CAU 214

(Reference April 21, 2003 Letter from D. Elle to R. Wycoff)

NDEP has requested further information regarding the use of Visual Sample Plan (VSP) for determining random sampling locations in the storage yards that are parts of this CAU. Specifically, in comment 2 of the referenced letter, NDEP states that

> "Prior to acceptance of its use in the final CAIP, NNSA/NSO must also provide additional information on the use and acceptance of this model. In addition, the *Industrial Sites Quality Assurance Project Plan* (QAPP) establishes Quality Standards for use of the computer software and models. The CAIP must address QAPP standards and describe the quality practices for the use of the software."

This memorandum will address that comment.

<u>Documentation/Verification of Visual Sample Plan</u>

Visual Sample Plan was developed by the U.S. Environmental Protection Agency under a Related Services Agreement with the U.S. Department of Energy under Contract DE-AC06-76RL01830. The activity was conducted at Pacific Northwest National Laboratory, Richland, WA 99352. Version 1 of the software was released in 2002.

Documentation of the models and code verification for version 1 of VSP was published in 2001 (Gilbert, R.O. and J.R. Davidson, Jr., J.E. Wilson and B.A. Pulsipher. February 2001. *Visual Sample Plan (VSP) Models and Code Verification*, PNNL-13450, Pacific Northwest National Laboratory, Richland, WA.). An electronic copy of that document is on file on the Shaw Environmental, Inc., Intranet and is available upon request.

Complete documentation of the models and code verification for Version 2.0, the current version of VSP, can be found in the updated document (Gilbert, R.O. et al., 2002. *Version 2.0 Visual Sample Plan (VSP) Models and Code Verification*, PNNL-13391, Pacific Northwest National Laboratory, Richland, WA.), which may be reviewed online at http://dqo.pnl.gov/vsp/document.htm. This document is an expansion of the earlier document and includes the QA procedures and testing that were conducted to assure the validity of the added features in the new version.

Both documents are retained on file both electronically and in print copy in the Shaw Environmental, Inc., office in Las Vegas and are available upon request.

Both documents take similar approaches. They begin with a presentation of the technical basis of the sample-size equations and algorithms for each of the sampling goals included in the program, referencing peer-reviewed scientifi papers and books. They then proceed to verify the computations and both statistical and nonstatistical outputs of the program. There is a section of documentation of the algorithms used to place sampling locations on the site map as well as those used to generate the random numbers required for statistically-based sampling. Finally, the computations and output of the program are verified by a comparison of sample sixes computed by VSP with those generated by hand calculations and by reference statistical software (S-PLUS, published by the Insightful Corporation, Seattle, Washington). This comparison was conducted both by the Pacific Northwest Laboratory (the developer of VSP) and by a third-party reviewer, the Research Triangle Institute.

User Acceptance and Utilization of Visual Sample Plan

At my request, the developers of VSP at PNL provided me the following breakdown of organizations that had downloaded VSP as of a year ago:

Number of downloads	Organization
82	DOE or DOE labs
404	Contractors (.com email address)
41	Army
52	Navy
9	Air Force
49	EPA
97	States
42	Universities

The current total is over 1200. Additional detail is available upon request from

Brent Pulsipher (email: brent.pulsipher@pnl.gov)
Pacific Northwest National Labs
P.O. Box 999
Richland, WA 99352

Implementation of IS QAPP Software Verification Requirements

The Industrial Sites QAPP requires that software be evaluated for use based on its ability to provide acceptable results for the intended application (Sec. 5.2.2). This standard was applied to the use of the Visual Sample Plan software via a thorough review of the documentation cited above. Particular attention was paid to the assumptions made in considering which sampling goal to use, and to the comparison of VSP calculations with hand calculations and with the calculations of the S-PLUS reference software for the sample number calculation for the chosen goal

The assumptions stated in the CAU 214 CAIP meet the requirements for the selected sampling goal: comparing a site mean to a fixed threshold, assuming simple random sampling, a non-normal contaminant distribution, and a "site is dirty" null hypothesis.

A review of the sample size calculation comparisons shows perfect agreement among the one hundred thirty-five VSP and S-PLUS results conducted in common, and among the twenty-seven hand, VSP and S-PLUS calculations performed in common.

Conclusion

Based upon an exhaustive review of the code verification and comparison sample calculations presented in the cited literature, Visual Sample Plan is deemed usable for calculating sample numbers and random placement locations for CAIP 214.

cc C. Prince

Appendix A.5

NDEP Comment Responses

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action Unit 214: Bunkers and Storage Areas, Nevada Test Site, Nevada	2. Document Date: March 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: April 18, 2003
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No.: Clem Goewert, NDEP, 486-2865	9. Reviewer's Signature:

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1) CAS 11-22-03 Sections 4.3 and A.1.4.3.1		CAS 11-22-03 Drum contains 2 drums. It is not known whether these drums contain any hazardous waste. Sections 4.3 and A.1.4.3.1 Sampling does not provide any information on how these drums will be investigated and/or sampled. The CAIP must provide investigation options for these drums.	Section 4.2.1, added 8th bullet, "Additional samples will be collected as necessary for waste characterization per site supervisor and EC lead." Section 4.2 states Shaw will perform a radiological survey of the drums at CAS 11-22-03, and Section A.1.8.2 provides additional details and description of how the drums will be investigated and/or sampled.	Yes
2) General		The CAIP describes how the VSP software will be used to establish random sample locations in the storage yards. NDEP is not familiar with this program. Prior to acceptance of its use in the final CAIP, NNSA/NSO must also provide additional information on the use and acceptance of this model. In addition, the Industrial Sites Quality Assurance Project Plan (QAPP) establishes Quality Standards for use of the computer software and models. The CAIP must address QAPP standards and describe the quality practices for the use of the software.	The Visual Sample Plan (VSP) software was developed by the U.S. Environmental Protection Agency under a Related Services Agreement with the U.S. Department of Energy under Contract DE-AC06-76RL01830.	Yes

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action Unit 214: Bunkers and Storage Areas, Nevada Test Site, Nevada

Revision No: 0

Reviewer/Organization: Clem Goewert, NDEP 486-2865

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
2) General (cont'd)			The Industrial Sites QAPP requires that software be evaluated for use based on its ability to provide acceptable results for the intended application (QAPP Section 5.2.2.2). This standard was applied to the use of the Visual Sample Plan software via a thorough review of the documentation of the model and code verification which can be viewed online at http://dpo.pnl.gov/vsp/document.htm. Based upon the review of the code verification and comparison sample calculations presented in the cited literature, Visual Sample Plan is deemed usable for calculating sample numbers and random placement locations for CAU 214. A technical memorandum providing additional information regarding the use of VSP will be provided in Appendix 3.4. In addition, the use of VSP software was previously used for the selection of randomized sampling as presented in CAUs 262 and 271.	Yes
3) General		A lead brick is suppose to be picked up in CAS 25-99-18 Storage Area. The CAIP does not address the disposition or management of the lead brick after collection. If it becomes a waste, Section 5.0, Waste Management, must address this.	Section 5.2, 4th bullet modified "surface debris in investigation area (e.g., lead brick)," and Section 5.7.2.4 provides details regarding management of debris.	Yes

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action Unit 214: Bunkers and Storage Areas, Nevada Test Site, Nevada

Revision No: 0

Reviewer/Organization: Clem Goewert, NDEP 486-2865

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
4) General		In addition to the above comments, a field trip to CAU 214 Corrective Action Sites was conducted on 4/15/03. The field trip included NDEP and NNSA/NSO staff, and NNSA/NSO subcontractors. During this trip, numerous field observations were made to clarify and enhance this CAIP. Include these observations and details in this CAIP.	Observations during the field visit on 4/15/03 have been incorporated into the CAIP. Example, access to the storage yard at CAS 25-23-01 is expected to be limited due to the presence of stored materials (i.e., structural steel, furnace and miscellaneous building materials). As discussed during the site visit, performance of a radiological survey and collection of soil samples will be limited to accessible portions of the storage yard. Materials stored in the yard area will not be moved or relocated as part of the investigation.	Yes

[a] Comment Types: M = Mandatory, S = Suggested.
Return Document Review Sheets to NNSA/NV Environmental Restoration Division, Attn: QAC, M/S 505.

Distribution

*Provide a copy in distribution of Rev. 0, and subsequent revisions if applicable. Copies of only the NDEP-approved document will be distributed to others.

	Copies
Paul J. Liebendorfer State of Nevada Bureau of Federal Facilities Division of Environmental Protection 333 W. Nye Lane, Room 138 Carson City, NV 89706-0851	1 (Controlled)*
D.R. Elle State of Nevada Bureau of Federal Facilities Division of Environmental Protection 1771 E. Flamingo Rd., Suite 121-A Las Vegas, NV 89119	1 (Controlled)*
Sabrina Lawrence Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Controlled)*
Janet Appenzeller-Wing Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)*

Sabine Curtis Environmental Restoration Division U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)*
Jeffrey L. Smith Bechtel Nevada P.O. Box 98521, M/S NTS306 Las Vegas, NV 89193-8521	1 (Uncontrolled)*
Brad Jackson Bechtel Nevada P.O. Box 98521, M/S NTS306 Las Vegas, NV 89193-8521	1 (Uncontrolled)*
George W. Petersen, Jr. Shaw Environmental, Inc. P.O. Box 93838 Las Vegas, NV 89193	1 (Controlled)*
Georgette Dimit Shaw Environmental, Inc. P.O. Box 93838 Las Vegas, NV 89193	1 (Controlled)*
Shaw Environmental, Inc. Central Files P.O. Box 93838 Las Vegas, NV 89193	 1 (Uncontrolled)*
FFACO Support Office Shaw Environmental, Inc. P.O. Box 93838 Las Vegas, NV 89193	1 (Controlled)
Manager, Southern Nevada FFACO Public Reading Room Facility P.O. Box 98521, M/S NLV040 Las Vegas, NV 89193-8521	1 (Controlled) 1 (Uncontrolled)

Manager, Northern Nevada FFACO Public Reading Facility c/o Nevada State Library & Archives Carson City, NV 89701-4285	1 (Uncontrolled)
Technical Information Resource Center U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)
U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831	1 (Uncontrolled, electronic copy)