

RECORD OF TECHNICAL CHANGE

Technical Change No. 1

Page 1 of 3

Project/Job No. IS04 - 070

Date 3/10/04

Project/Job Name Corrective Action Investigation Plan for CAU 204: Storage Bunkers

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

Al Wickline
(Name)

Task Manager
(Title)

Description of Change

1. Section 3.3 Preliminary Action Levels. Change the 4th bullet in the section to the following:

- "The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The PALs for the CAU 204 Corrective Action Investigation (CAI) are listed in Table 3-5."
- Replace Table 3-5 with the new Table 3-5 attached.

2. Section 3.4 DQO Process Discussion. Change the last two sentences in the section to the following:

- "The Minimum Detectable Concentrations (MDCs) for radiological analytes have been developed considering the PALs. The MDC for each radiological analyte is less than or equal to the corresponding PAL."

3. Section A.1.3.2 Determine the Basis for the Preliminary Action Levels. Change the 4th bullet to the following:

- "The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The PALs for the CAU 204 CAI are listed in Table 3-5."

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

4. 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 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 1.3×10^{10} years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, foods, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration.

There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

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

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

Applicable Project-Specific Document(s): Corrective Action Investigation Plan for Corrective Action Unit 204:
Storage Bunkers, Nevada Test Site, Nevada, Revision 0, December 2002.

CC:

Approved By:

Kevin Cabbie
Kevin Cabbie, Acting Project Manager
Industrial Sites Project

Date 3-15-04

J. Appenzeller-Wing
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

Date 3/15/04

NDEP Concurrence Yes___ No___ Date_____

NDEP Signature _____

Contract Change Order Required Yes___ No___

Contract Change Order No. _____

There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

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

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

Applicable Project-Specific Document(s): Corrective Action Investigation Plan for Corrective Action Unit 204:
Storage Bunkers, Nevada Test Site, Nevada, Revision 0, December 2002.

CC:

Approved By:

Kevin Cabbic
Kevin Cabbic, Acting Project Manager
Industrial Sites Project

Date 3-15-04

J. J. [Signature]
J. J. [Signature], Acting Division Director
Environmental Restoration Division

Date 3/15/04

NDEP Concurrence Yes X No Date 3/19/04

NDEP Signature [Signature]

Contract Change Order Required Yes No

Contract Change Order No.

Table 3-5
Preliminary Action Levels for Radionuclides in Samples Collected at CAU 204

Radionuclide	PAL (pCi/g)^a	Radionuclide	PAL (pCi/g)
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 ^c
Throium-232 ^d	5/15 ^c	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, 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.

^c The 5/15 pCi/g concentrations represent the PALs for these radionuclides in the surface soil (0-0.5 ft) and the subsurface soil (> 0.5 ft), respectively.

^d Thorium-232 and it's daughters Radium-228, Actinium-228, Thorium-228, Radium-224, Radon-220, Polonium-216, Polonium-212, Lead-212, Bismuth-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.

Nevada
Environmental
Restoration
Project

DOE/NV--866



Corrective Action Investigation Plan for Corrective Action Unit 204: Storage Bunkers, Nevada Test Site, Nevada

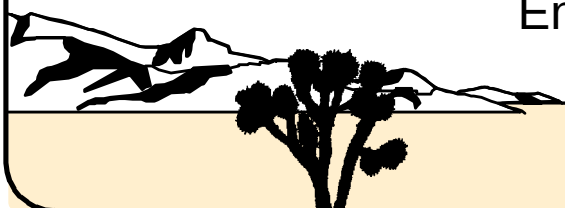
Controlled Copy No.: ____

Revision No.: 0

December 2002

Approved for public release; further dissemination is unlimited.

Environmental Restoration
Division



U.S. Department of Energy
National Nuclear Security Administration
Nevada Operations 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

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.



**CORRECTIVE ACTION INVESTIGATION PLAN
FOR CORRECTIVE ACTION UNIT 204:
STORAGE BUNKERS,
NEVADA TEST SITE, NEVADA**

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

Controlled Copy No.: ____

Revision No.: 0

December 2002

Approved for public release; further dissemination is unlimited.

**CORRECTIVE ACTION INVESTIGATION PLAN
FOR CORRECTIVE ACTION UNIT 204: STORAGE BUNKERS,
NEVADA TEST SITE, NEVADA**

Approved by: _____ Date: _____

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: _____ Date: _____

Runore C. Wycoff, Division Director
Environmental Restoration Project

Table of Contents

List of Figures.....	v
List of Tables.....	vii
List of Acronyms and Abbreviations	ix
Executive Summary	ES-1
1.0 Introduction.....	1
1.1 Purpose	1
1.1.1 CAS 01-34-01, Underground Instrument House Bunker	4
1.1.2 CAS 02-34-01, Instrument Bunker	5
1.1.3 CAS 03-34-01, Underground Bunker	5
1.1.4 CAS 05-18-02, Chemical Explosives Storage	5
1.1.5 CAS 05-33-01, Kay Blockhouse.....	5
1.1.6 CAS 05-99-02, Explosives Storage Bunker	6
1.2 Scope.....	6
1.3 CAIP Contents	6
2.0 Facility Description.....	8
2.1 Physical Setting.....	8
2.1.1 Yucca Flat Hydrogeologic Area	8
2.1.1.1 CAS 01-34-01, Underground Instrument House Bunker	9
2.1.1.2 CAS 02-34-01, Instrument Bunker	9
2.1.1.3 CAS 03-34-01, Underground Bunker	10
2.1.2 Frenchman Flat Hydrogeologic Area	10
2.1.2.1 CAS 05-18-02, Chemical Explosives Bunker	12
2.1.2.2 CAS 05-33-01, Kay Blockhouse	12
2.1.2.3 CAS 05-99-02, Explosives Storage Bunker	12
2.2 Operational History.....	12
2.2.1 CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker.....	13
2.2.2 CAS 05-18-02, Chemical Explosives Storage	13
2.2.3 CAS 05-33-01, Kay Blockhouse.....	18
2.2.4 CAS 05-99-02, Explosives Storage Bunker	19
2.3 Waste Inventory	19
2.4 Release Information	22
2.5 Investigative Background.....	23
2.5.1 CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker.....	24
2.5.2 CAS 05-18-02, Chemical Explosives Storage	24
2.5.3 CAS 05-33-01, Kay Blockhouse.....	25

Table of Contents *(Continued)*

2.5.4	CAS 05-99-02, Explosives Storage Bunker	27
2.5.5	National Environmental Policy Act	27
3.0	Objectives	28
3.1	Conceptual Site Models	28
3.1.1	Future Land Use	32
3.1.2	Contaminant Sources	32
3.1.3	Release Mechanisms	33
3.1.4	Migration Pathways	33
3.1.5	Exposure Points	34
3.1.6	Exposure Routes	34
3.1.7	Additional Information	35
3.2	Contaminants of Potential Concern	35
3.3	Preliminary Action Levels	41
3.4	DQO Process Discussion	42
4.0	Field Investigation	45
4.1	Technical Approach	45
4.2	Field Activities	45
4.2.1	CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker	46
4.2.2	CAS 05-18-02, Chemical Explosives Storage	47
4.2.3	CAS 05-33-01, Kay Blockhouse	53
4.2.4	CAS 05-99-01, Explosives Storage Bunker	56
4.3	Field-Screening Levels	58
4.4	Additional Sampling to Define Extent of Contamination	58
4.5	Geotechnical/Hydrological Analysis and Bioassessment Tests	59
4.6	Safety	60
5.0	Waste Management	62
5.1	Waste Minimization	62
5.2	Potential Waste Streams	64
5.3	Investigation-Derived Waste Management	64
5.3.1	Sanitary Waste	65
5.3.2	Hydrocarbon Waste	65
5.3.3	Hazardous Waste	65
5.3.3.1	PPE/Equipment	66
5.3.3.2	Rinsate	66
5.3.3.3	Field-Screening Waste	67
5.3.3.4	Soil	67

Table of Contents *(Continued)*

5.3.4	Low-Level Waste	67
5.3.5	Mixed Wastes	68
5.3.6	PCB and Radioactive PCB Wastes	69
6.0	Quality Assurance/Quality Control	70
6.1	Quality Control Field Sampling Activities	70
6.2	Laboratory/Analytical Quality Assurance	71
6.2.1	Data Validation	71
6.2.2	Data Quality Indicators	71
6.2.3	Precision	72
6.2.3.1	Precision for Chemical Analysis	74
6.2.3.2	Precision for Radiochemical Analysis	75
6.2.4	Accuracy	76
6.2.4.1	Accuracy for Chemical Analyses	76
6.2.4.2	Accuracy for Radiochemical Analysis	77
6.2.5	Representativeness	78
6.2.6	Completeness	78
6.2.7	Comparability	79
6.2.8	Sensitivity	79
6.3	Radiological Survey Quality Assurance	79
7.0	Duration and Records Availability	80
7.1	Duration	80
7.2	Records Availability	80
8.0	References	81
Appendix A.1 - Data Quality Objectives		A-1
A.1	Seven-Step DQO Process for CAU 204 Investigations	A-2
A.1.1	Step 1 - State the Problem	A-4
A.1.1.1	Planning Team Members	A-4
A.1.1.2	Describe the Problem	A-4
A.1.1.3	Develop Conceptual Site Model	A-5
A.1.1.3.1	Conceptual Site Models for CAU 204	A-6
A.1.1.3.2	Contaminants of Potential Concern and Suspected Contaminants	A-15
A.1.2	Step 2 - Identify the Decision	A-16
A.1.2.1	Develop Decision Statements	A-16
A.1.2.2	Alternative Actions to the Decisions	A-17

Table of Contents *(Continued)*

A.1.3	Step 3 - Identify the Inputs to the Decisions.	A-17
A.1.3.1	Information Needs and Information Sources	A-17
A.1.3.2	Determine the Basis for the Preliminary Action Levels	A-23
A.1.3.3	Potential Sampling Techniques and Appropriate Analytical Methods	A-24
A.1.4	Step 4 - Define the Boundaries of the Study	A-27
A.1.4.1	Define the Target Population	A-27
A.1.4.2	Identify the Spatial and Temporal Boundaries	A-27
A.1.4.3	Identify Practical Constraints	A-28
A.1.4.4	Define the Scale of Decision Making	A-29
A.1.5	Step 5 - Develop a Decision Rule.	A-29
A.1.5.1	Specify the Population Parameter	A-29
A.1.5.2	Choose an Action Level	A-29
A.1.5.3	Measurement and Analysis Methods	A-29
A.1.5.4	Decision Rule	A-30
A.1.6	Step 6 - Specify the Tolerable Limits on Decision Errors	A-30
A.1.6.1	False Negative Decision Error	A-31
A.1.6.2	False Positive Decision Error	A-32
A.1.6.3	Quality Assurance/Quality Control.	A-32
A.1.7	Step 7 - Optimize the Design for Obtaining Data.	A-33
A.1.7.1	General Investigation Strategy	A-33
A.1.7.1.1	Investigation Strategy for CSM #1	A-34
A.1.7.1.2	Investigation Strategy for CSM #2	A-35
A.1.7.1.3	Investigation Strategy for CSM #3	A-35
A.1.7.2	Site-Specific Sampling Strategy	A-36
A.1.8	References.	A-39
Appendix A.2 - Project Organization		A-41
A.2	Project Organization	A-42
Appendix A.3 - NDEP Comment Responses		A-43

List of Figures

Number	Title	Page
1-1	Nevada Test Site Location Map	2
1-2	CAU 204, CAS Location Map	3
2-1	CAS 01-34-01, Underground Instrument House Bunker Site Layout	14
2-2	CAS 02-34-01, Instrument Bunker Site Layout	15
2-3	CAS 03-34-01, Underground Bunker Site Layout	16
2-4	CAS 05-18-02, Chemical Explosives Storage Site Layout	17
2-5	CAS 05-33-01, Kay Blockhouse Site Layout	20
2-6	CAS 05-99-02, Explosives Storage Bunker Site Layout	21
3-1	CAU 204, Conceptual Site Model #1 Bunker Interiors and Potential Migration	29
3-2	CAU 204, Conceptual Site Model #2 Surface Debris/Burn Area	30
3-3	CAU 204, Conceptual Site Model #3 Subsurface Debris/Burn Area	31
4-1	CAS 01-34-01, Potential Sampling Locations	48
4-2	CAS 02-34-01, Potential Sampling Locations	49
4-3	CAS 03-34-01, Potential Sampling Locations	50
4-4	CAS 05-18-02, Potential Sampling Locations	52
4-5	CAS 05-33-01, Potential Sampling Locations	55
4-6	CAS 05-99-02, Potential Sampling Locations	57
A.1-1	CAU 204, Conceptual Site Model #1, Bunker Interiors and Potential Migration	A-7

List of Figures (Continued)

<i>Number</i>	<i>Title</i>	<i>Page</i>
A.1-2	CAU 204, Conceptual Site Model #2, Surface Debris/Burn Area	A-8
A.1-3	CAU 204, Conceptual Site Model #3, Subsurface Debris/Burn Area	A-9

List of Tables

<i>Number</i>	<i>Title</i>	<i>Page</i>
3-1	CSMs and Associated CASs	28
3-2	Suspect Contaminants and Critical Analytes for CAU 204 Nature of Contamination Sampling.	36
3-3	Analytical Program and Contaminants of Potential Concern (Includes Site and Waste Characterization Analyses).	37
3-4	Analytical Requirements for CAU 204	38
3-5	Minimum Detectable Concentrations, Preliminary Action Levels, and Minimum Reporting Limits for Radionuclides in Samples Collected at CAU 204	43
4-1	General Geotechnical and Hydrological Analysis.	60
5-1	Waste Management Regulations and Requirements	63
6-1	Laboratory and Analytical Performance Criteria for CAU 204 Data Quality Indicators	73
A.1-1	DQO Meeting Participants.	A-5
A.1-2	CSMs and Associated CASs	A-6
A.1-3	Future Land-Use Scenarios for CASs Within CAU 204.	A-12
A.1-4	Information Needs to Resolve Decision I	A-19
A.1-5	Information Needs to Resolve Decision II	A-22
A.1-6	Analytical Program (Includes Site and Waste Characterization Analyses).	A-25
A.1-7	Critical Analytes for Nature of Contamination (Decision I) Sampling.	A-26
A.1-8	Spatial Boundaries Investigation	A-28

List of Tables (Continued)

<i>Number</i>	<i>Title</i>	<i>Page</i>
A.1-9	Practical Constraints Identified for CAU 204	A-28
A.1-10	Planned Sampling Strategy	A-36

List of Acronyms and Abbreviations

ACM	Asbestos-containing material
Am	Americium
Be	Beryllium
bgs	Below ground surface
BN	Bechtel Nevada
CADD	Corrective Action Decision Document
CAI	Corrective action investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	<i>Code of Federal Regulations</i>
CLP	Contract Laboratory Program
cm ²	Square centimeter(s)
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
CRDL	Contract-Required Detection Limit
Cs	Cesium
CSM	Conceptual site model
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
dpm	Disintegration(s) per minute
DQI	Data quality indicator

List of Acronyms and Abbreviations (Continued)

DQO	Data quality objective
DRO	Diesel-range organics
DU	Depleted uranium
EG&G/EM	EG&G Energy Measurements
EOD	Explosives ordnance disposal
EPA	U.S. Environmental Protection Agency
Eu	Europium
FFACO	<i>Federal Facility Agreement and Consent Order</i>
FSL	Field-screening level
ft	Foot (feet)
ft ²	Square feet
HASP	Health and Safety Plan
HE	High explosives
HWAA	Hazardous Waste Accumulation Area
IDW	Investigation-derived waste
in.	Inch(es)
IRIS	Integrated Risk Information System
ISMS	Integrated Safety Management System
ITLV	IT Corporation, Las Vegas
LANL	Los Alamos National Laboratory
LCS	Laboratory control sample
LLNL	Lawrence Livermore National Laboratory
LLW	Low-level radioactive waste
MDA	Minimum detectable activity

List of Acronyms and Abbreviations (Continued)

MDC	Minimum detectable concentration
MDL	Minimum detection limit
mi	Mile(s)
mg/kg	Milligram per kilogram
mRad/hr	Millirad per hour
MRL	Minimum reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
NAC	<i>Nevada Administrative Code</i>
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NEPA	<i>National Environmental Policy Act</i>
NNSA/NV	U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office
NRS	<i>Nevada Revised Statutes</i>
NTS	Nevada Test Site
NTSWAC	<i>Nevada Test Site Waste Acceptance Criteria</i>
PAL	Preliminary action level
PCB	Polychlorinated biphenyl
PPE	Personal protective equipment
ppm	Part(s) per million
PRG	Preliminary remediation goal
Pu	Plutonium
QA	Quality assurance

List of Acronyms and Abbreviations (Continued)

QAPP	Quality Assurance Project Plan
QC	Quality control
RCRA	<i>Resource Conservation and Recovery Act</i>
REEC _o	Reynolds Electric & Engineering Co., Inc.
RMA	Radioactive materials area
ROTC	Record of Technical Change
RPD	Relative percent difference
SAA	Satellite accumulation area
SDWS	<i>Safe Drinking Water Standard</i>
Sr	Strontium
SSHASP	Site-specific health and safety plan
SVOC	Semivolatile organic compound
TPH	Total petroleum hydrocarbon
TSCA	<i>Toxic Substances Control Act</i>
U	Uranium
VOC	Volatile organic compound
WSI	Wackenhut Services, Incorporated
%R	Percent recovery

Executive Summary

This Corrective Action Investigation Plan for Corrective Action Unit 204: Storage Bunkers, Nevada Test Site, Nevada, has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the U.S. Department of Energy, the State of Nevada, and the U.S. Department of Defense. The general purpose of the investigation is to ensure that adequate data are collected to provide sufficient and reliable information to identify, evaluate, and technically defend potentially viable corrective actions.

Corrective Action Unit 204 is comprised of the following six Corrective Action Sites in Nevada Test Site Areas 1, 2, 3, and 5:

- 01-34-01, Underground Instrument House Bunker
- 02-34-01, Instrument Bunker
- 03-34-01, Underground Bunker
- 05-18-02, Chemical Explosives Storage
- 05-33-01, Kay Blockhouse
- 05-99-02, Explosive Storage Bunker

This Corrective Action Investigation Plan provides investigative details for Corrective Action Unit 204, whereas programmatic aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994). General field and laboratory quality assurance and quality control issues are presented in the *Industrial Sites Quality Assurance Project Plan* (NNSA/NV, 2002a). Health and safety aspects of the project are documented in the IT Corporation, Las Vegas Office, *Health and Safety Plan* (IT, 2001) and will be supplemented with a site-specific health and safety plan.

Corrective Action Sites 01-34-01, 02-34-01, and 03-34-01 each consist of a bunker, its interior, and the exterior directly above the bunker footprint. Bunker Station 2-63 is attached to the Corrective Action Site 02-34-01 and is accessible from the exterior. Each respective bunker was used as an instrumentation location to measure blast, heat, and neutron and/or gamma radiation. They were also used to take photographs during the T-1, T-2, and T-3 series atmospheric nuclear tests (Holmes & Narver, 1990; AEC, 1953). Each bunker is approximately 3,000 feet from the zero point of the respective atmospheric nuclear tests that were conducted in the 1950s (LANL, 1984).

Corrective Action Site 05-18-02 is a bunker location commonly referred to as Sugar Bunker. The site consists of the Sugar Bunker, attached small bunker, and two cellar units which are attached to the Sugar Bunker. The Sugar Bunker was used for various experiments conducted during the voluntary nuclear testing moratorium (DOE/NV, 2001).

Corrective Action Site 05-33-01 is a bunker location consisting of the Kay Blockhouse and the discrete associated test areas surrounding the Kay Blockhouse (IT, 2002b). The Kay Blockhouse was originally used during Operation Ranger, a series of five air drops (atmospheric nuclear tests) conducted in 1951. These tests were detonated over Frenchman Flat, and the reaction history, fireball, neutron, and gamma-ray measurements were recorded at Kay Blockhouse (LANL, 1984).

Corrective Action Site 05-99-02 was identified as an explosives magazine/storage bunker and is commonly referred to as Bunker 803. Limited data on the use of CAS 05-99-02 are available. However, various historical documents identify the site as a location used for conventional explosives and ammunition storage by the U.S. Department of Energy/Test Operation Division. Later the bunker was operated by Wackenhut Services, Incorporated as an explosives storage facility during the "Helicopter Program" (Jones, 2002).

Based on site history, process knowledge, and previous field efforts, contaminants of potential concern for Corrective Action Unit 204 collectively include radionuclides, beryllium, high explosives, lead, polychlorinated biphenyls, total petroleum hydrocarbons, silver, warfarin, and zinc phosphide.

The general technical approach for investigation of Corrective Action Unit 204 consists of, but is not limited to, the following activities:

- Perform radiological land area surveys at CASs 01-34-01, 02-34-01, 03-34-01, 05-18-02, and 05-33-01 (surveys at CASs 05-18-02 and 05-33-01 have been completed).
- Perform geophysical survey at CAS 05-33-01 to identify any subsurface metallic and nonmetallic debris (completed).
- Collect and analyze samples from biased locations.
- Perform field screening for applicable contaminants of potential concern.

- Collect required quality control samples.
- Collect additional samples, as necessary, to estimate potential corrective action waste streams.
- Collect soil samples from background locations, if necessary.
- Collect samples from native soils and analyze for geotechnical/hydrologic parameters, if necessary.
- Collect and analyze bioassessment samples, if appropriate (e.g., if volatile organic compound concentrations exceed field-screening levels in a pattern that suggests that a plume may be present).
- Perform radiological characterization surveys of construction material debris identified during the investigation.
- Stake or flag sample locations and record coordinates.

Under the *Federal Facility Agreement and Consent Order*, the Corrective Action Investigation Plan will be submitted to the Nevada Division of Environmental Protection for approval. Field work will be conducted following approval of the plan. The results of the field investigation will support a defensible evaluation of corrective action alternatives in the Corrective Action Decision Document.

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) 204: Storage Bunkers, 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 U.S. Department of Energy (DOE), the State of Nevada, and the U.S. Department of Defense (DoD).

The NTS is approximately 65 miles (mi) northwest of Las Vegas, Nevada ([Figure 1-1](#)). Corrective Action Unit 204 is comprised of the six Corrective Action Sites (CASs) shown on [Figure 1-2](#) and listed below:

- 01-34-01, Underground Instrument House Bunker
- 02-34-01, Instrument Bunker
- 03-34-01, Underground Bunker
- 05-18-02, Chemical Explosives Storage
- 05-33-01, Kay Blockhouse
- 05-99-02, Explosive Storage Bunker

Corrective Action Unit 204 is being investigated because existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for the six CASs. Therefore, 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 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 204 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.

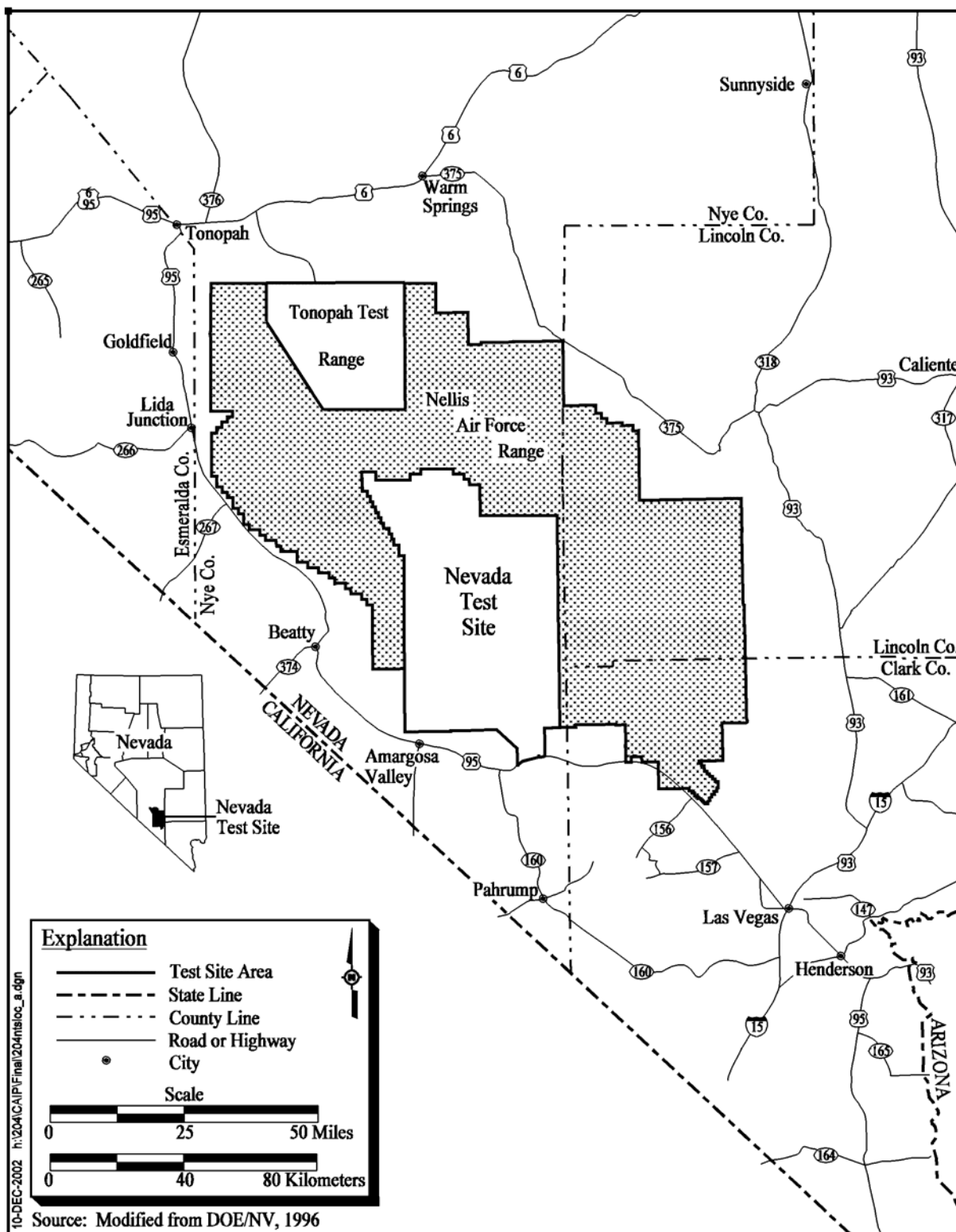


Figure 1-1
Nevada Test Site Location Map

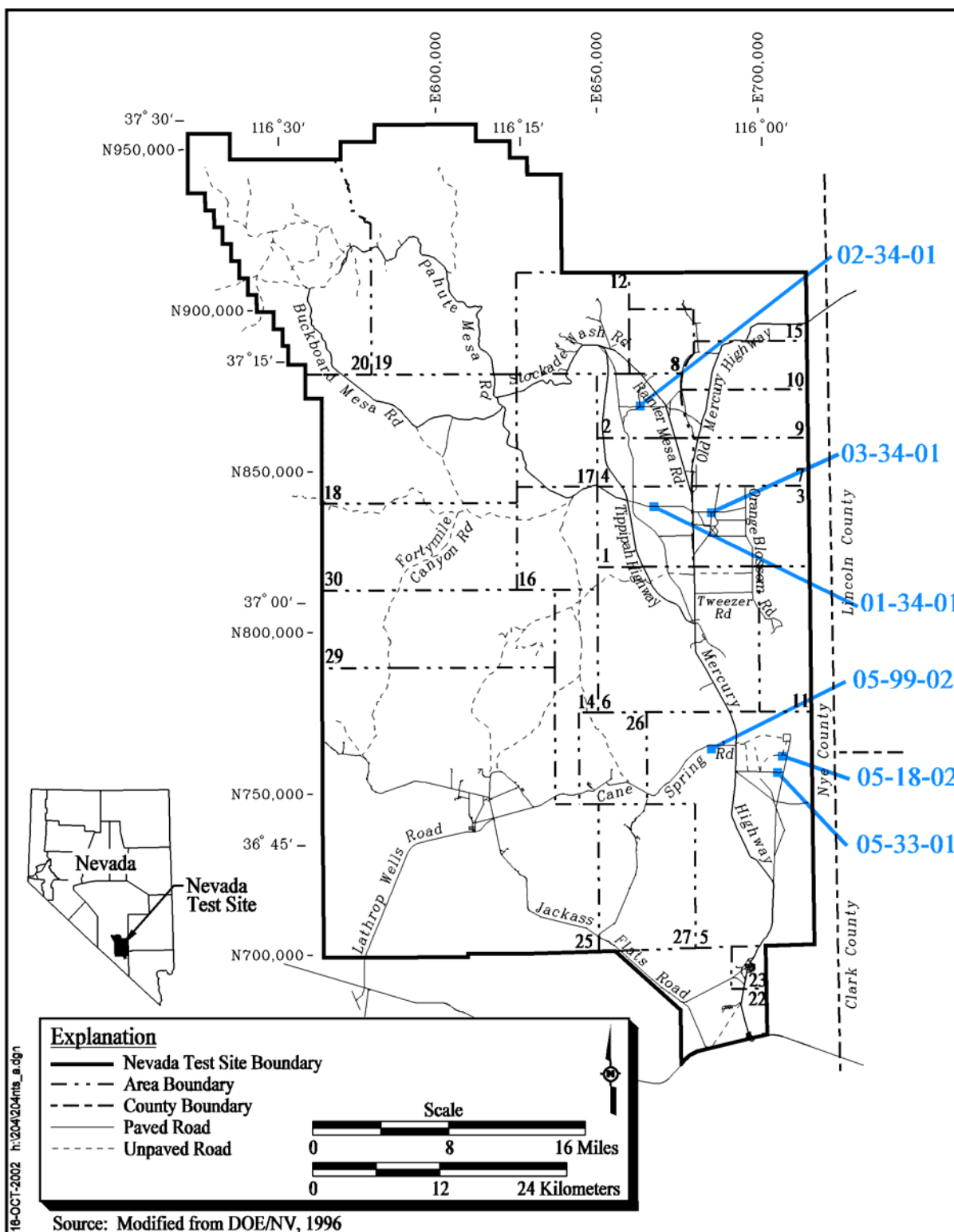


Figure 1-2
 CAU 204, CAS Location Map

Each of the sites will be investigated based on data quality objectives (DQOs) developed by representatives of the Nevada Division of Environmental Protection (NDEP) and the DOE National Nuclear Security Administration Nevada Operations Office (NNSA/NV). 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 204.

The primary question for the investigation is: “Are existing data sufficient to evaluate appropriate corrective actions?” To address this question, resolution of two decisions statements is required:

- Decision I is to “Define the nature of contamination” by identifying any contamination above preliminary action levels (PALs). Data must be collected in areas most likely to contain contamination due to testing and activities associated with the facility, and samples must be collected from areas most likely to be contaminated. If PALs are not exceeded, the investigation is complete. If PALs are exceeded, then Decision II must be resolved.
- Decision II is “Determine the extent of contamination identified above PALs.” This decision will be achieved by the collection of data that are adequate to define the extent of contaminants of concern (COCs).

In addition, data will be obtained to support waste management decisions.

Most of the data will be generated from the analysis of environmental samples collected during the CAI. The general purpose of the investigation is to:

- Identify the presence and nature of COCs.
- Determine the vertical and lateral extent of COCs, if present.
- Ensure that all NDEP, *Resource Conservation and Recovery Act* (RCRA), and DOE closure requirements have been met.

The six CASS in CAU 204 are described in the following sections.

1.1.1 CAS 01-34-01, Underground Instrument House Bunker

Corrective Action Site 01-34-01 consists of Bunker 1-300, its interior, and the exterior directly above the bunker footprint. The bunker was built in 1952 and was used by Reynolds Electrical & Engineering Co., Inc. (REECo) to measure blast, heat, and neutron and/or gamma radiation. In

addition, it was used to take photographs during the T-1 series of atmospheric nuclear tests (Holmes & Narver, 1990; AEC, 1953).

1.1.2 CAS 02-34-01, Instrument Bunker

Corrective Action Site 02-34-01 consists of Bunker 2-300, its interior, and the exterior directly above the bunker footprint. The bunker was built in 1952 and was used by REEC Co to measure blast, heat, and neutron and/or gamma radiation. It was also used to take photographs during the T-2 series of atmospheric nuclear tests (Holmes & Narver, 1990; AEC, 1953). Attached to the bunker is Station 2-63 which is accessible from the exterior. The purpose of the station is not known and there is no equipment currently being housed inside of Station 2-63.

1.1.3 CAS 03-34-01, Underground Bunker

Corrective Action Site 03-34-01 consists of Bunker 3-300, its interior, and the exterior directly above the bunker footprint. This bunker was built in 1952 and was used by EG&G Energy Measurements (EG&G/EM) and Los Alamos National Laboratory (Holmes & Narver, 1990; AEC, 1953). The bunker was used to measure blast, heat, and neutron and/or gamma radiation. It was also used to take photographs during the T-3 series of atmospheric nuclear tests.

1.1.4 CAS 05-18-02, Chemical Explosives Storage

Corrective Action Site 05-18-02, known throughout historical documents and interviews as “Sugar Bunker,” is located in Area 5 of the NTS. The site consists of the Sugar Bunker, a smaller adjacent bunker, and two cellar units which are attached to the Sugar Bunker (IT, 2002a). The Sugar Bunker was used for various experiments conducted during the voluntary nuclear testing moratorium (DOE/NV, 2001).

1.1.5 CAS 05-33-01, Kay Blockhouse

Corrective Action Site 05-33-01 is located in Area 5 of the NTS. The site consists of the Kay Blockhouse and the discrete associated test areas surrounding the Kay Blockhouse (IT, 2002b). The entire area is approximately 25 acres. The Kay Blockhouse was originally used during Operation Ranger, a series of five air drops (atmospheric nuclear tests) conducted in 1951. These tests were

detonated over the Kay Blockhouse, where reaction history, fireball, and neutron and gamma-ray measurements were taken (LANL, 1984).

1.1.6 CAS 05-99-02, Explosives Storage Bunker

Corrective Action Site 05-99-02 is located in Area 5 of the NTS. The site consists of one magazine/storage bunker, identified as Bunker 803 (REECo, 1990b). The date that the bunker was constructed is unknown. This location was used for conventional explosives storage (Jones, 2002).

1.2 Scope

To generate information needed to resolve the decision statements identified in the DQO processes, the scope of the CAI for CAU 204 includes the following activities:

- Conduct radiological surveys at CASs 01-34-01, 02-34-01, and 03-34-01.
- Collect and submit environmental samples for laboratory analysis to determine if COCs are present.
- If COCs are present, collect samples to define the extent of the contamination.
- Collect samples of investigation-derived waste (IDW), as needed, for waste management and minimization purposes.
- Collect soil samples for laboratory analysis of geotechnical parameters and/or bioassessment, as needed.
- In addition to the above activities, samples may be collected, and inspections and surveys performed to support waste management decisions.

Contamination of soil resulting from atmospheric nuclear testing is not included in the scope of CAU 204. This contamination will be addressed by the Soils Project. However, radiological contamination of the bunker interiors, regardless of the source, will be addressed by this investigation.

1.3 CAIP Contents

[Section 1.0](#) presents the purpose and scope of this CAIP, while [Section 2.0](#) provides background information about the CAU. The objectives, including the conceptual site models, are presented in

[Section 3.0](#). Field sampling activities are discussed in [Section 4.0](#), and waste management for this project is discussed in [Section 5.0](#). General field and laboratory quality assurance (QA) and quality control (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](#). [Section 8.0](#) provides a list of references. [Section A.1](#) provides a DQO summary, while [Section A.2](#) contains information on the project organization. The health and safety aspects of this project are documented in the IT Corporation, Las Vegas (ITLV), *Health and Safety Plan* (HASP) (IT, 2001), 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 204 is comprised of six CASs, which were grouped together for site closure based on the similarity of the sites (underground bunkers and associated bunker sites), and because they are all located in close relation to each other at the NTS. All six of these CASs are associated with tests conducted at the sites or related instrumentation.

2.1 Physical Setting

The following sections describe the general physical setting of the NTS. General background information pertaining to topography, geology, hydrogeology, and climatology are provided for these specific areas of the NTS region as described in 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 sections. Locations of the CASs on the NTS are identified on [Figure 1-2](#).

2.1.1 Yucca Flat Hydrogeologic Area

Corrective Action Sites 01-34-01, 02-34-01, and 03-34-01 lie within the Yucca Flat Hydrographic Area of the NTS. Uplift and erosion of the surrounding mountains has resulted in the accumulation of more than 1,000 feet (ft) of alluvial deposits in some areas of Yucca Flat. Carbonate rocks primarily underlie the alluvium in parts of Yucca Flat and form much of the surrounding mountains in this area (Laczniak et al., 1996). The soil in Yucca Flat is typical desert alluvium composed of mostly fine soil and rock particles and includes loose rocks measuring up to 3 inches (in.) diameter.

Groundwater occurs in Yucca Flat within alluvial and volcanic aquifers that overlie a carbonate aquifer. This carbonate aquifer underlies large areas of the NTS and is part of a regional groundwater flow system. Within the overlying alluvial and volcanic aquifers in Yucca Flat, lateral groundwater flow occurs from the margins to the center of the basin. Groundwater flows downward from these aquifers into the carbonate aquifer (Laczniak et al., 1996). The direction of groundwater flow in this region of the carbonate aquifer generally is from the northeast to southwest. The occurrence of local perched water units is unknown at this time.

Depth to groundwater data were obtained for water wells located in the vicinity of the CASs in Yucca Flat. At Well UE-1b, located 0.75 mi southwest of CAS 01-34-01, the depth to groundwater was 645 ft below ground surface (bgs) as measured on September 17, 1991. At Well UE-2ce, located 1.8 mi west of CAS 02-34-01, the depth to groundwater was 1,447 ft bgs as measured on December 4, 1991. At Water Well A, located 0.75 mi from CAS 03-34-01, the depth to groundwater was 1,604 ft bgs as measured on August 28, 1960 (Hale et al., 1995).

Average annual precipitation at rain gauge Station Buster Jangle Wye (BJY) is 6.44 in. for the observation period of 1960 to 2002 (NOAA, 2002). This station is located in Yucca Flat near the intersection of Areas 1, 3, 4, and 7.

2.1.1.1 CAS 01-34-01, Underground Instrument House Bunker

The bunker is of a subsurface concrete structure, with a footprint of approximately 1,920 square feet (ft²) (Holmes & Narver, 1990). The concrete floor is 1.7 ft thick (Holmes & Narver, 1959). The ramp which leads down into the front of the bunker was used for loading and unloading. The cover of the bunker is primarily soil with asphalt near the front sloping area. The bunker is approximately 3,000 ft from the zero point from the T-1 atmospheric nuclear tests conducted in the 1950s (LANL, 1984). The Area 1 bunker consists of three rooms: the equipment room, the coax room, and the instrumentation room (Holmes & Narver, 1960). The bunker includes an air conditioning system, dehydrator, telephone and signal facilities, electric heating system, and a hoist (Holmes & Narver, 1960). A ventilation system leads to the outside of the bunker. Most of the instrumentation used for the tests has been removed.

2.1.1.2 CAS 02-34-01, Instrument Bunker

The bunker is of a subsurface concrete structure, with a footprint of approximately 1,920 ft². The concrete floor is 1.7 ft thick (Holmes & Narver, 1958a). The ramp which leads down into the front of the bunker was used for loading and unloading. The cover of the bunker is primarily soil with asphalt near the front sloping area. On the top south side of the bunker, there is a ventilation chamber that is constructed of concrete and with a steel cover. Bunker 2-300 has an attached building named Station 2-63 that is constructed of concrete with a temporary wooden door. Bunker 2-300 is approximately 3,000 ft from the zero point from the T-2 atmospheric nuclear tests conducted in the

1950s (LANL, 1984). The bunker consists of four rooms: the equipment room, the coax room, the photo processing room, and the instrumentation room (Holmes & Narver, 1960; Holmes & Narver, 1957h). The bunker includes an air conditioning system, dehydrator, telephone and signal facilities, electric heating system, and a hoist (Holmes & Narver, 1960). A ventilation system leads to the outside of the bunker (Holmes & Narver, 1957f). Most of the instrumentation used for the tests has been removed.

2.1.1.3 CAS 03-34-01, Underground Bunker

The bunker is a subsurface concrete structure, with a footprint of approximately 1,160 ft² (Holmes & Narver, 1990). The concrete floor is 1.7 ft thick (Holmes & Narver, 1958a). The bunker has a ramp leading down into the front that was used for loading and unloading. The cover of the bunker is soil with asphalt near the front of the structure. Bunker 3-300 is approximately 3,000 ft from the zero point for the T-3 atmospheric nuclear tests (LANL, 1984). The bunker consists of three rooms: the equipment room, the coax room, and the instrumentation room. The bunker includes an air conditioning system, sump pump, two compressors, signal facilities, and a hoist on the exterior (Holmes & Narver, 1960). A ventilation system leads to the outside of the bunker (Holmes & Narver, 1957j). It is unknown if the above mentioned systems have been removed from the interior.

2.1.2 Frenchman Flat Hydrogeologic Area

Corrective Action Sites 05-18-02, 05-33-01, and 05-99-02 lie within the Frenchman Flat Hydrographic Area of the NTS, a topographically closed basin surrounded by low-lying mountains that separate this area from the Mercury Valley Hydrographic Area to the south and separate it 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 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 in. in diameter.

Groundwater occurs in Frenchman Flat within alluvial and volcanic aquifers that overlie a carbonate aquifer. As discussed in [Section 2.1.1](#), 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 than 1 ft/mi) (Laczniak et al., 1996). The occurrence of local perched water layers is unknown at this time.

Five water wells are located within 4.5 mi of Sugar Bunker. Water Well WW-5a is located approximately 4.5 mi south of the Sugar Bunker. The WW-5a well was constructed in 1951, and water withdrawals were conducted until 1970. The depth to groundwater at WW-5a was 710 ft bgs as measured on September 20, 2002 (USGS, 2002). Water Well RNM-2S is located approximately 1.25 mi south of Sugar Bunker. The RNM-2S well was constructed in 1974, and water withdrawals were conducted until 1991. The depth to groundwater at RNM-2S was 723 ft bgs as measured on September 10, 2002 (USGS, 2002). Water Well WW-5c, constructed in 1954, is located approximately 3 mi south of Sugar Bunker. The depth to groundwater at WW-5c was 719 ft bgs as measured on August 31, 1993 (USGS, 2002). Water Well WW-5b, constructed in 1951, is located approximately 2.5 miles south of Sugar Bunker. The depth to groundwater at WW-5b was 689 ft bgs as measured on May 6, 1991 (USGS, 2002). The third water well associated with Sugar Bunker is UE-5c WW, constructed in 1966, located approximately 1.25 mi southwest of the bunker (USGS, 2002). The depth to groundwater at UE-5c WW was 811 ft bgs as measured on August 11, 1987 (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 station is located near Water Well WW-5b in Frenchman Flat.

2.1.2.1 CAS 05-18-02, Chemical Explosives Bunker

This site consists of the Sugar Bunker, a smaller adjacent bunker, and two cellar units which are attached to the Sugar Bunker on the south end. The Sugar Bunker is constructed of concrete and steel. There is a large ventilation system on the north end outside of the front door of the bunker. Inside of the bunker, the floor is concrete and steel beams are present in the ceiling. The bunker is approximately 2,160 ft². The two cellar units are constructed of steel coverings that are accessible from the southern exterior. The area surrounding the bunker that is included in this CAS is approximately 5 acres.

2.1.2.2 CAS 05-33-01, Kay Blockhouse

The Kay Blockhouse site consists of the Kay Blockhouse, two burn pits with steel frames, one burn pit with a soil berm, two open pits, two steel-lined subsurface pits, one berm with embedded piping, an unidentified underground structure and berm with piping debris, a burn area with a large concrete block with an embedded steel prong, and one open pit with a concrete foundation at the north end. The Kay Blockhouse is constructed of concrete with a wooden door. The details of the construction of the floor are unknown. The entire area surrounding the CAS is approximately 25 acres.

2.1.2.3 CAS 05-99-02, Explosives Storage Bunker

This site consists of a wood shack approximately 60 x 60 x 60 in. It apparently has no constructed floor (i.e., it is built directly on the ground). The bunker is built into a small hillside on the edge of Cane Spring Wash.

2.2 Operational History

The following subsections provide a description of the use and history of each of the CASs in CAU 204 that may have resulted in a potential release to the environment. The CAS-specific summaries are designed to illustrate all significant, known activities.

2.2.1 CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker

Corrective Action Sites 01-34-01, 02-34-01, and 03-34-01 were built to withstand a pressure of 70 pounds per square inch. The bunkers were built to collect data for the T-1, T-2, and T-3 atmospheric nuclear tests, respectively. The bunkers were used to record the blast, heat, and neutron or gamma radiation. They were also used to take photographs during atmospheric detonations (AEC, 1953). The bunkers were also used to protect recording instruments against blast as well as radiation. Without shielding, the intense radiation fields associated with the detonation would have damaged the instruments. [Figures 2-1, 2-2, and 2-3](#) are diagrams of CASs 01-34-01, 02-34-01, and 03-34-01, respectively.

2.2.2 CAS 05-18-02, Chemical Explosives Storage

Corrective Action Site 05-18-02, known throughout historical documents and interviews as “Sugar Bunker,” is located in Area 5 of the NTS. In 1990, REECo identified CAS 05-18-02 as an abandoned facility used for chemical storage (REECo, 1990a).

Historical documents indicate that various experiments were conducted at the Sugar Bunker during the voluntary nuclear testing moratorium (October 31, 1958 to September 1961) (DOE/NV, 2001). Lawrence Livermore National Laboratory (LLNL) (at the time Lawrence Radiation Laboratories) had possession of Sugar Bunker sometime prior to 1959 and returned the bunker to REECo on June 9, 1976. In 1960, LLNL identified the Sugar Bunker as a hazardous area where explosives, radioactive materials, or both are normally present. It is believed that through the 1960s, and possibly into the 1970s, the Sugar Bunker was used for conducting high explosives (HE) tests, some of which likely included depleted uranium (DU) as a tracer (LRL, 1960). In addition, the tests may have used beryllium (Patton, 1992). Other tests may have been conducted at the site, but no data or documentation of these tests has been found. The Sugar Bunker was one of two primary control stations for the Diluted Waters underground nuclear test, which was a line-of-sight hydrodynamic test conducted on June 16, 1965 (AEC, 1965).

[Figure 2-4](#) is a diagram of the CAS 05-18-02.

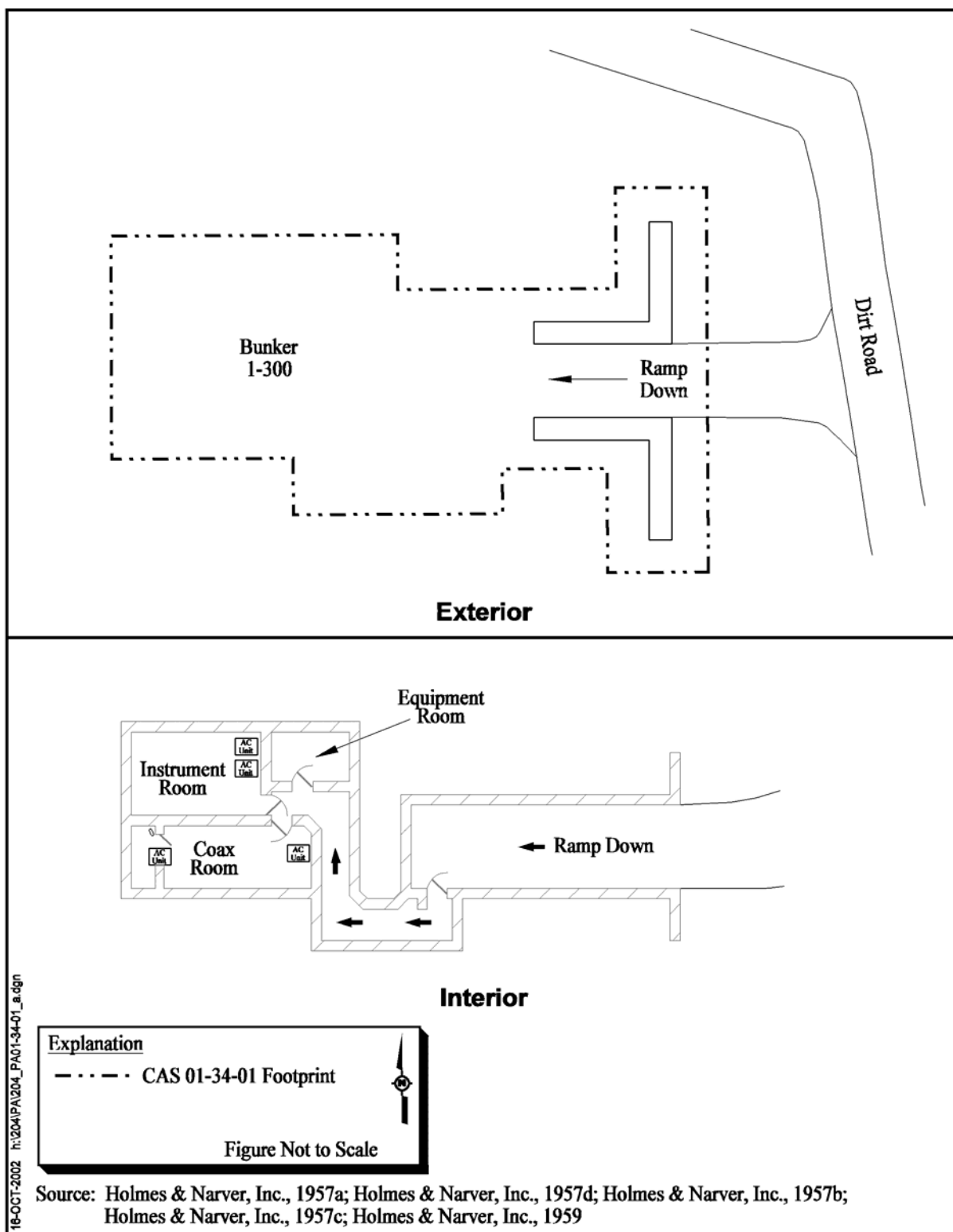


Figure 2-1
CAS 01-34-01, Underground Instrument House Bunker Site Layout

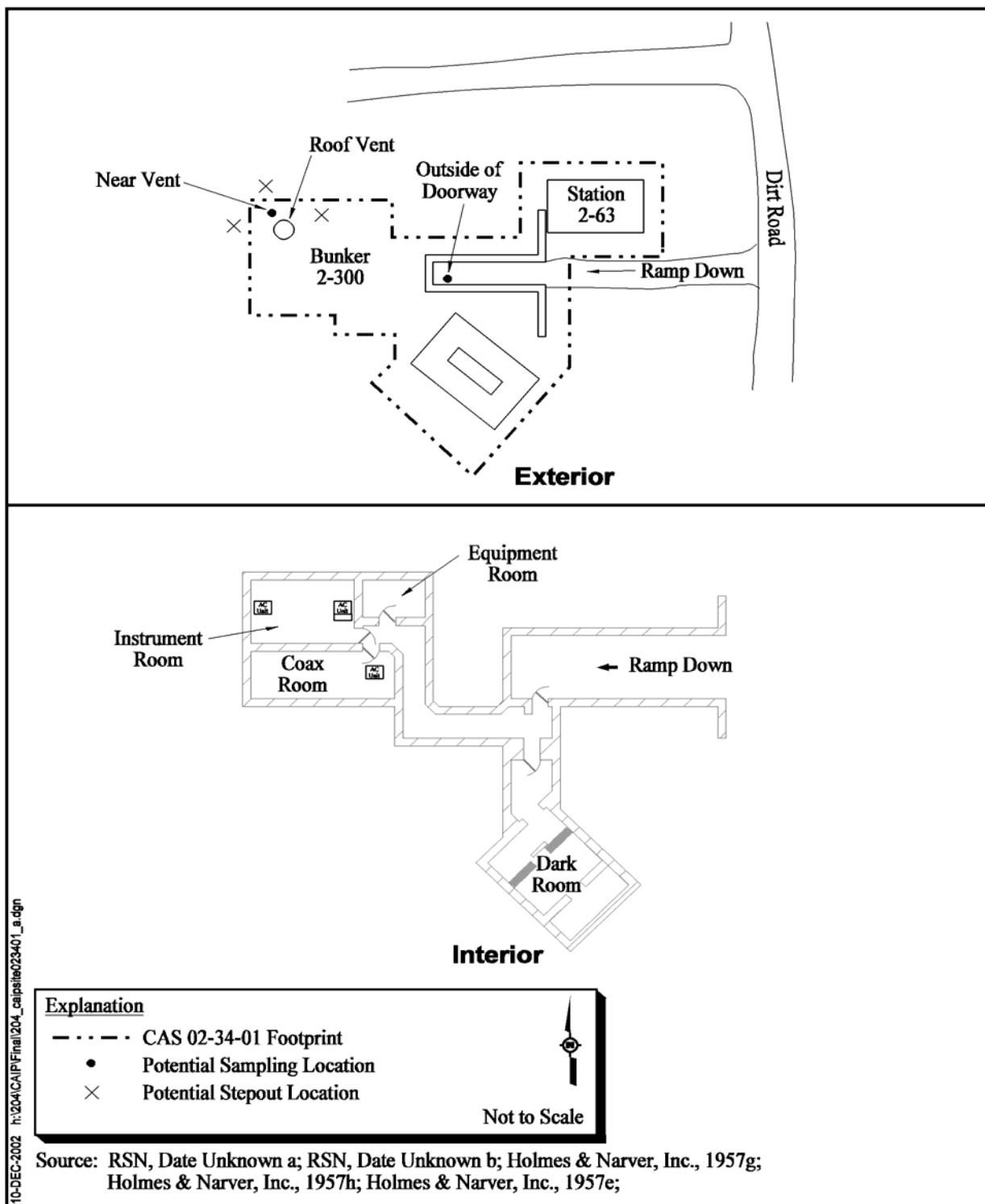


Figure 2-2
CAS 02-34-01, Instrument Bunker Site Layout

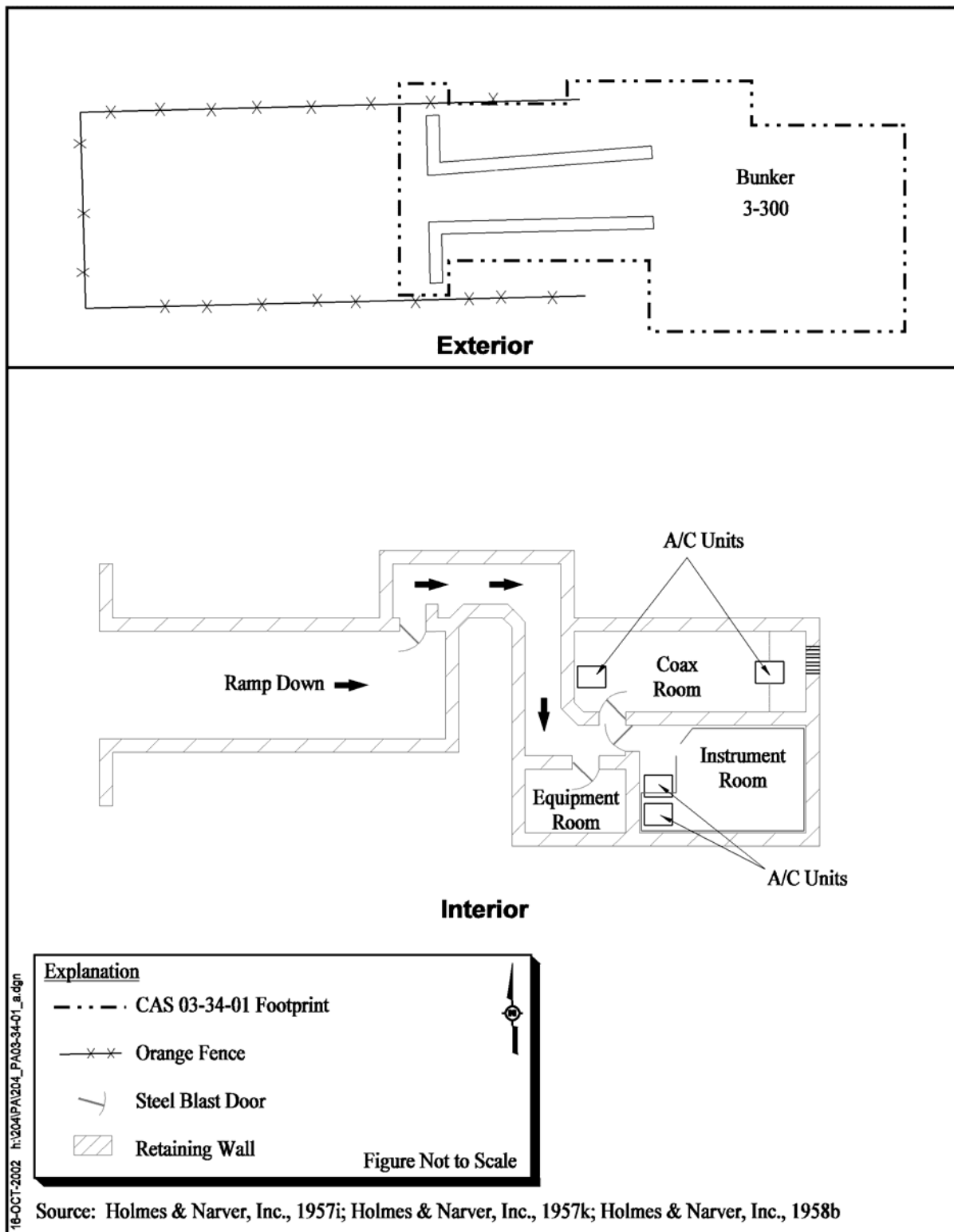


Figure 2-3
CAS 03-34-01, Underground Bunker Site Layout

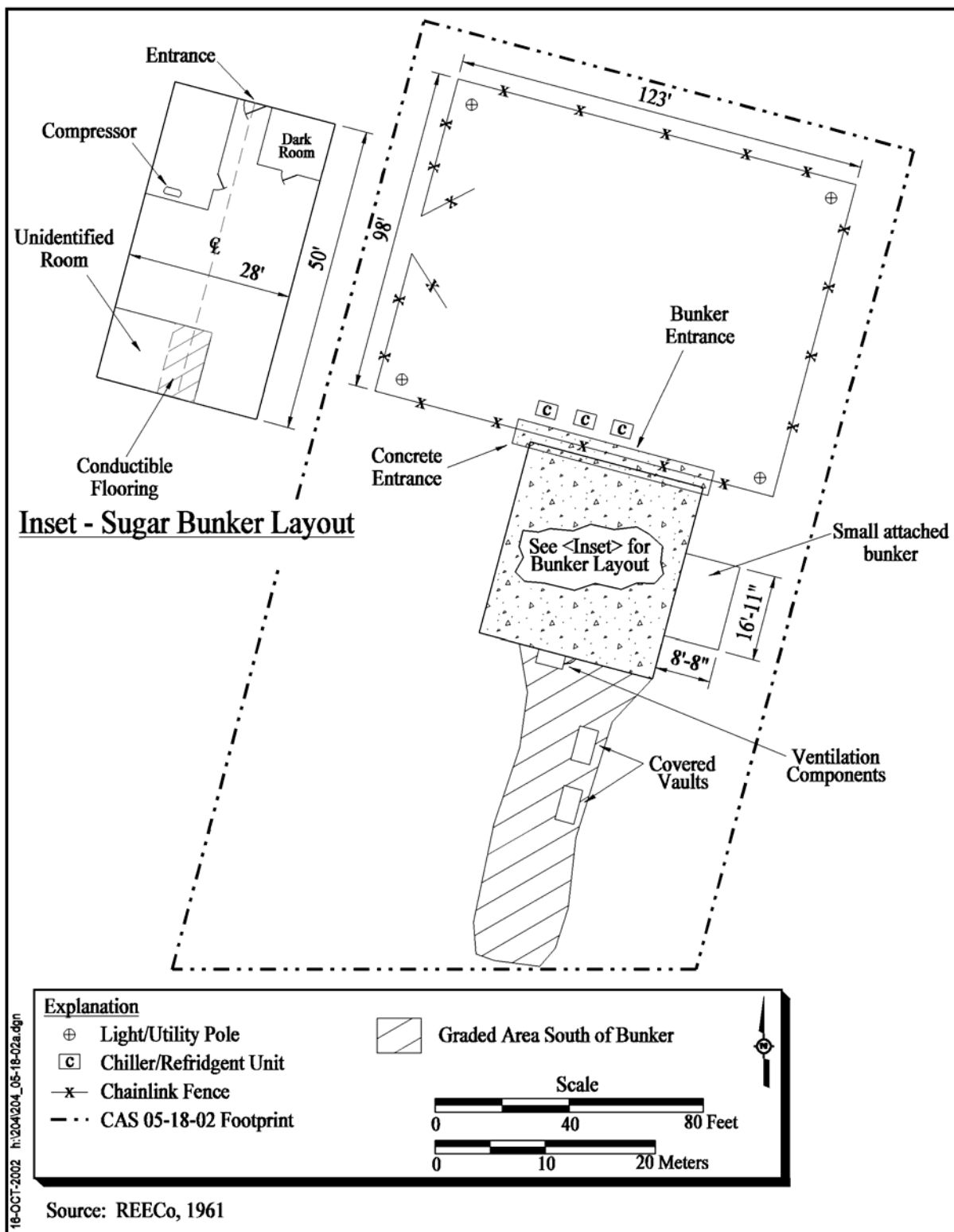


Figure 2-4
CAS 05-18-02, Chemical Explosives Storage Site Layout

2.2.3 CAS 05-33-01, Kay Blockhouse

The site consists of the Kay Blockhouse and numerous burn pits and disturbed areas. The site was identified in the 1992 REEC Co *Contaminated Areas Report I* (Sorum, 1992). Various historical documents and drawings have identified CAS 05-33-01 by the following names: Kay Blockhouse, Kay Bunker, Ranger Blockhouse, and Alpha Blockhouse.

The Kay Blockhouse was originally constructed in 1951 for Operation Ranger, a series of five air drops (atmospheric nuclear tests) conducted from January 27 to February 6, 1951. These tests were detonated over the Kay Blockhouse, where reaction history, fireball and neutron and gamma-ray measurements were taken. The blockhouse was reported to be in generally good condition following the tests. The two main problems associated with operation of the blockhouse following the tests were damage to the timber entrance passage and high radiation levels (neutron-induced sodium activation).

Subsequent to the Ranger series, improvements were made to the site for future tests (LANL, 1984). Engineering drawings show that additions and modifications were made to the Kay Blockhouse throughout the 1950s until 1965. From the 1950s through the 1960s, Kay Blockhouse was used for a wide variety of nuclear and nonnuclear explosives tests using HE, including hydrodynamic tests that utilized HE, D38 (uranium [U] depleted of its U-235 content), and beryllium (DRI, 1989).

In 1963, the Kay Blockhouse was the location of three drop vulnerability tests conducted on “XW-55 (Nike Zeus warhead) Subroc applications,” which contained live HE. The third of these tests resulted in an HE detonation that dispersed debris up to 500 ft in diameter of the shot. This debris was reportedly cleaned by a U.S. Navy explosives ordnance disposal (EOD) team (AEC, 1963).

The “Kay Bunker” was identified as one of the primary control stations for the Diluted Waters underground nuclear test, which was a line-of-sight hydrodynamic test conducted approximately 1,000 ft south of the Kay Blockhouse on June 16, 1965 (AEC, 1965).

Documents from LLNL indicate that a common practice associated with HE testing was disposal of explosive waste by pit burning using excelsior (wood chips) and kerosene. Additionally, acetone was used to dissolve explosives from HE detonators in covered stainless-steel containers. Eventually, the acetone/explosive mix was added to the excelsior in explosive burn pits (LRL, 1960).

Figure 2-5 is a site diagram of CAS 05-33-01.

2.2.4 CAS 05-99-02, Explosives Storage Bunker

The site consists of one magazine/storage bunker, known as Bunker 803. This CAS was identified by REEC Co on October 8, 1990, as abandoned and possibly used for storage of explosives ordnance for use in Area 5 (REEC Co, 1990b).

There are limited available data on the use of CAS 05-99-02. However, various historical documents identify CAS 05-99-02 as a location used for conventional explosives storage. The date of construction and years of operation of the bunker is unknown. In 1991, REEC Co identified CAS 05-99-02 as a potential EOD responsibility (REEC Co, 1991). In 1992, DOE/Test Operation Division verified that Bunker 803 was used for ammunition storage, but had no specific information relating to the operation of the bunker (REEC Co, 1992). A 1998 ITLV record of minutes references Bunker Site 05-99-02 as being operated by Wackenhut Services, Incorporated (WSI) (Lipstate, 1998). An interview with a former WSI patrol officer on the NTS confirmed that several bunkers on the test site had been used for explosives storage. Security inspections were conducted on Bunker 803 approximately 10 years ago. At that time, the bunker was used as storage for the EG&G/EM and WSI "Helicopter Program" (Jones, 2002). There is no information specific as to what was stored in the bunker at that time. Additionally, no historical data or documentation has been found relating to the Helicopter Program.

Figure 2-6 is a site diagram of CAS 05-99-02.

2.3 Waste Inventory

No known occurrences of waste disposal have been identified for any of the CASs addressed by this CAU. However, 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 following may be identified as hazardous and/or radioactive waste: construction materials, equipment, contaminated soil, burn-pit debris, asbestos, and other miscellaneous debris. Not all of these potential waste sources are expected to be present at any given CAS.

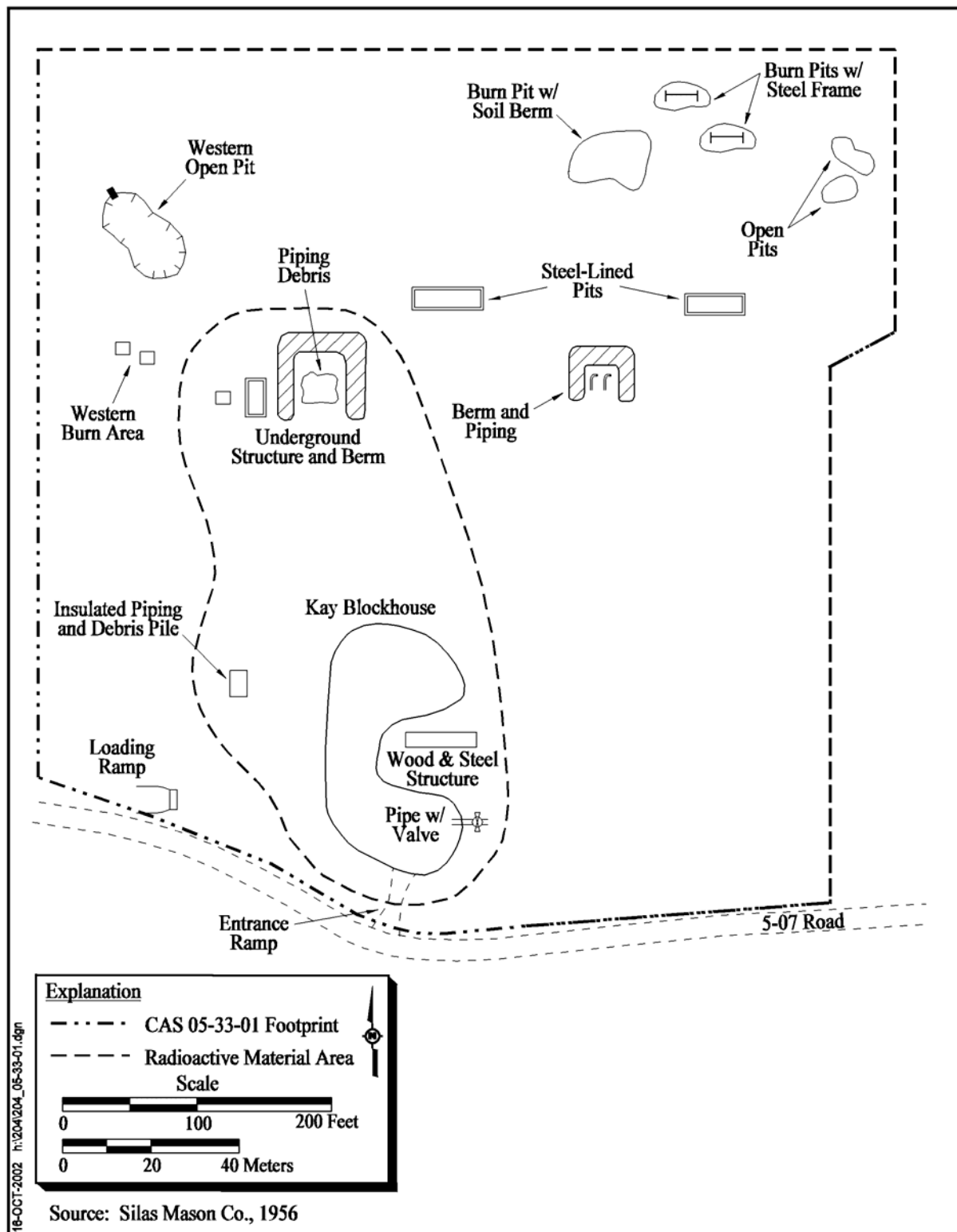


Figure 2-5
CAS 05-33-01, Kay Blockhouse Site Layout

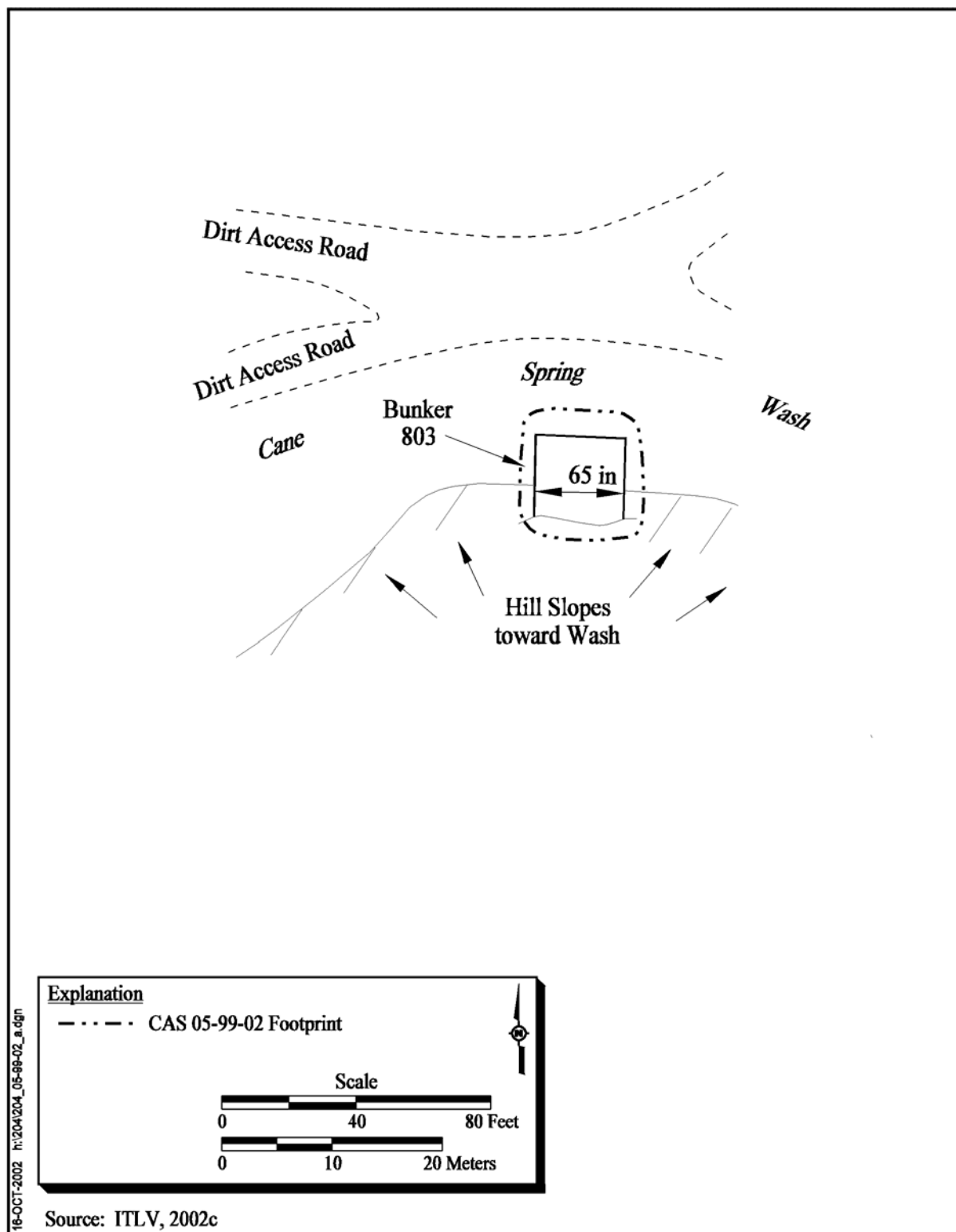


Figure 2-6
CAS 05-99-02, Explosives Storage Bunker Site Layout

2.4 Release Information

The CAS-specific release information, migration routes, exposure pathways, and affected media are discussed in this section.

The following is a list of known or potential releases associated with CAU 204:

- CASs 01-34-01, 02-34-01, and 03-34-01 have no documented releases associated with them. No information exists to support the use or storage of any significant volume of hazardous or radioactive materials in the bunkers. It is likely that any material spilled or leaked onto the floor (e.g., hydraulic oil from equipment) was not of sufficient volume to permit migration to the bunker exteriors. In addition, the concrete floor would act as a barrier to migration. An additional potential release mechanism is the degradation of construction materials (e.g., lead for doors or pipes) into a physical form that could allow migration.
- CAS 05-18-02 has been identified as a chemical explosive storage facility (REECo, 1990a). No documented releases associated with this use as a storage facility have been identified. As discussed in [Section 2.2.2](#), historical information indicates that various experiments were conducted at the Sugar Bunker (DOE/NV, 2001). It is believed that an area immediately outside of the bunker was used to conduct HE tests, some of which likely included DU (LRL, 1960) and beryllium (Patton, 1992). It is assumed that the tests dispersed these materials onto the ground surface within the testing area and vicinity.
- CAS 05-33-01 includes several burn pits, burn areas, debris areas, and soil depressions and berms located in the vicinity of the Kay Blockhouse. The activities that created these features may have released contamination to the ground surface in the immediate vicinity of the features and possibly to the shallow subsurface directly below the features. As discussed in [Section 2.2.3](#), tests conducted at Kay Blockhouse reportedly used HE, DU, and beryllium (DRI, 1989). It is assumed that the tests dispersed these materials onto the ground surface within the testing area and vicinity. Asbestos-containing materials (ACM) may also be present at CAS 05-33-01; these materials may become airborne if disturbed.
- CAS 05-99-02 has been identified as a chemical explosive storage bunker. No documented releases associated with this site have been identified, except that rodenticide may have been used in the bunker to protect stored explosives from rodent damage. The bunker reportedly does not have a constructed floor; therefore, any contaminant released inside the bunker could have migrated into the soil.

Subsequent to the initial release (e.g., CAS 05-33-01), no known migration of contamination has occurred at any CAU 204 CAS. Potential migration routes are expected to be limited to vertical transport due to gravity. However, for spills or leaks at the ground surface, contaminants may migrate laterally prior to infiltration. Additionally, 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). Vertical migration of contaminants directly below bunkers is not expected at CASs 01-34-01, 02-34-01, 03-34-01, and 05-18-02 because of the presence of concrete floors. For contamination inside a bunker to reach the environment at these CASs, transport to doorways, vents, or other openings would be required. This could be accomplished by lateral movement of a liquid spill along the floor or airborne transport of vapors or particulates. Recharge to groundwater from precipitation is minimal at the NTS and does not provide a significant mechanism for migration of contaminants to groundwater. Additionally, asbestos, if present and disturbed during the site investigation, may migrate through the air. Migration will be impacted primarily by the wind direction and speed. Additional information on migration is presented in [Section 3.1.4](#) and [Section A.1.1.3.1](#).

Potentially affected media for all CASs include surface and shallow subsurface soil. For asbestos at CAS 05-33-01, air will be the affected medium if the asbestos is disturbed. To support waste management decisions, bunker concrete may also be an affected medium at CASs 01-34-01, 02-34-01, 03-34-01, and 05-18-02. Additional affected media information is given in [Section A.1.1.3.1](#).

Exposure routes to site workers include oral 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 all CAU 204 CASs, except possibly 05-99-02, surface soils may have been impacted by radiological contamination associated with above-ground nuclear testing. As discussed in [Section 1.2](#), this contamination will not be addressed by CAU 204, unless it is present in the bunker interiors. It will be addressed by the Soils Project.

2.5 Investigative Background

Site investigation activities associated with CAU 204 have been identified and generally documented in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996).

The following text identifies and describes all known investigation activities conducted at CAU 204 sites.

2.5.1 CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker

No previous radiological and geophysical survey results or environmental sampling results have been identified for these CASs.

2.5.2 CAS 05-18-02, Chemical Explosives Storage

Radiological surveys conducted in 1976 and 1977 showed radioactive debris surrounding the bunker up to a 1,000-ft radius. Elevated alpha readings were found within the fenced area of the site. Several pieces of debris containing uranium (some as large as 2-3 in.) were found around the site, particularly within a 4.5 ft² area of twisted metal debris (REECo, Date unknown a; REECo, Date unknown b).

An ITLV radiological land area survey was performed on September 11, 2002 and September 14, 2002, to identify radiological hazards (Wyler, 2002a). A total of 8,705 gamma readings were recorded over an area of approximately 49,300 ft² (Wyler, 2002a). The regions where elevated readings were identified during the survey were investigated for total and removable contamination levels. The maximum readings for total alpha and beta contamination were 3,000 disintegrations per minute (dpm) per 100 square centimeters (cm²) and 800,000 dpm/100 cm², respectively. The maximum readings for removable alpha and beta contamination were 801 and 14,300 dpm/100 cm², respectively (Wyler, 2002a). The top of the bunker and fenced areas to the north were not included in the survey. The results of the survey indicated that above-background radioactivity is present at the ground surface and possibly near-surface in an area south of the Sugar Bunker.

As part of a study of areas of the NTS that were suspected of possible beryllium contamination, 11 surface soil samples (9 site and 2 background samples) were collected in the vicinity of the Sugar Bunker in 1988. The investigation focused on the area immediately south of the bunker. Samples were collected from an array with sampling points located 10 to 400 ft from the south side of the bunker. The nine samples collected had beryllium concentrations ranging from 0.55 to 4.65 milligrams per kilogram (mg/kg). The beryllium detection limit was 0.46 mg/kg. The highest

concentrations were found closest to the bunker. The concentrations decreased with distance from the Sugar Bunker. The two background samples were collected from locations 350 ft west of the bunker. Results for these background samples were less than the detection limit of 0.46 mg/kg (Patton, 1992).

2.5.3 CAS 05-33-01, Kay Blockhouse

Radiological surveys conducted in 1976 and 1977 showed radioactive debris west and north of the Kay Blockhouse. Maximum readings ranged from 3 to 20 millirad per hour (mRad/hr) in an area surrounding the blockhouse. Scattered metal debris north of the blockhouse ranged from 5 to 12 mRad/hr, and a location close to some surface debris measured 110 mRad/hr. A burn area north of the blockhouse measured 10 to 70 mRad/hr. Other readings in the area ranged from 0.3 to 50 mRad/hr (REECo, Date unknown a; REECo, Date unknown b; Author unknown, Date unknown).

A radiological survey performed on June 18, 1998, identified an area of 2,500 ft² located immediately north of the Kay Blockhouse as a radioactive material area (DOE/NV, 2000a). This area is posted as such, but not fenced. Ten locations were surveyed at the site to determine if removable radiological contamination was present. Removable alpha and beta contamination was identified in final readings that were obtained following at least 48 hours of decay (DOE/NV, 2000b). Final alpha readings ranged from 0 to 38 dpm/100 cm² above background, and final beta readings ranged from 0 to 77 dpm/100 cm² above background. Depleted uranium was identified as the source of these readings (DOE/NV, 2000a).

An ITLV radiological walkover survey was performed on July 31, 2002 and August 1, 2002, to identify radiological hazards (Wyler, 2002b). A total of 56,189 gamma readings were recorded over an area of approximately 2.5 million ft² (Wyler, 2002b). After the initial preliminary survey was conducted, the results were used to locate areas where elevated contamination was present. Seven discrete areas were identified with the following elevated readings:

- Total alpha readings ranged from 692 to 55,100 dpm/100 cm²
- Total beta readings ranged from 127,000 to 1,186,000 dpm/100 cm²
- Removable alpha readings ranged from 142 to 1,565 dpm/100 cm²
- Removable beta readings ranged from 890 to 3,200 dpm/100 cm²

In addition to the surveys, samples from three locations were collected and analyzed by on-site high purity germanium gamma spectroscopy. One sample was a small metal fragment that primarily emitted beta radiation from the thorium-232 decay series. Another sample was a metal fragment with heavy yellow oxidation that exhibited elevated levels of uranium series radionuclides. A third sample was soil containing trinity glass; a small amount of cesium-137 was detected in the sample.

As part of a study of areas of the NTS that were suspected of possible beryllium contamination, 15 surface soil samples (13 site and 2 background samples) were collected in the vicinity of the Kay Blockhouse in 1988. Nine of the samples were collected in a 200- by 200-ft grid on the east side of the Kay Blockhouse, and the other four were collected near the south side of the blockhouse. Beryllium concentrations in these samples range from the detection limit of 0.46 mg/kg to 3.54 mg/kg. The two background samples collected 400 ft west of the Blockhouse had results below the detection limit of 0.46 mg/kg (Patton, 1992).

On August 15, 2002, Shaw Environmental & Infrastructure, Incorporated conducted geophysical surveys of area surrounding the Kay Blockhouse to delineate the presence and location of possible waste disposal sites (Shaw E&I, 2002). Geophysical techniques used during the investigation consisted of frequency domain electromagnetic induction (EM31) and time domain metal detection (EM61 MK2). The total survey area covered approximately 3.35 acres (Shaw E&I, 2002). This area was divided into three sections: northern, central, and southern sites.

Surveys of the northern sites identified several anomalies due to surface debris and two large anomalies due to subsurface metal. Anomalies were identified near an open pits site, the northern side of the burn pit/soil berm site, and a small mounds site. The burn pit/soil berm site anomaly was interpreted to be buried metal within a site likely associated with the nearby burn pit, and the anomaly at the small mounds site was identified as a likely fill area or trench, but may include non-metallic structures (Shaw E&I, 2002).

Surveys of the central sites indicated several anomalies due to surface debris and two large anomalies due to subsurface metals. Two significant anomalies were identified at the berm/piping site and appear as continuous anomalies that lead to exposed metal pipes near the center of the surveyed area. Two other areas containing anomalies were identified at the underground structure site and western

pits site. The anomalies identified at the central sites were interpreted to be caused by subsurface piping (Shaw E&I, 2002).

Surveys of the southern sites indicate that large anomalies appear to be due to surface debris. Anomalies were also identified that appear to be due to buried metal, but none were interpreted to be due to subsurface piping or subsurface waste disposal (Shaw E&I, 2002).

2.5.4 CAS 05-99-02, Explosives Storage Bunker

No previous radiological and geophysical survey results or environmental sampling results have been identified for this location.

2.5.5 National Environmental Policy Act

In accordance with the NNSA/NV *National Environmental Policy Act* (NEPA) compliance program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 204. This checklist compels NNSA/NV 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/NV NEPA Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 204 and formulation of the conceptual site models (CSMs). Also presented is information on the contaminants of potential concern (COPCs) and PALs for the investigation.

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. Three CSMs have been developed for CAU 204 using assumptions formulated from historical background information, knowledge from studies of similar sites, and data from previous sampling efforts. [Section A.1.1.3.1](#) provides information on the CSMs as presented for DQO formulation. [Table 3-1](#) identifies how the CSMs apply to the corresponding CASs.

Table 3-1
CSMs and Associated CASs

Conceptual Site Model (CSM)	01-34-01	02-34-01	03-34-01	05-18-02	05-33-01	05-99-02
Interior Bunker Release (#1)	X	X	X	X	X	
Surface Debris/Burn Area (#2)	X ^a	X ^a	X ^a	X	X	X
Subsurface Debris/Burn Area (#3)					X	

X - The CSM applies to this CAS.

X^a - The CSM may apply to this CAS, depending upon site conditions.

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, NDEP will be notified and given the opportunity to comment on and/or concur with the recommendation.

[Figures 3-1](#) through [3-3](#) show the generalized representations of the CSMs constructed for current site conditions at the CAU 204, Storage Bunkers. CSM #1 represents contamination of bunker interiors and potential migration to the exterior. CSM #2 and CSM #3 describe surface and subsurface

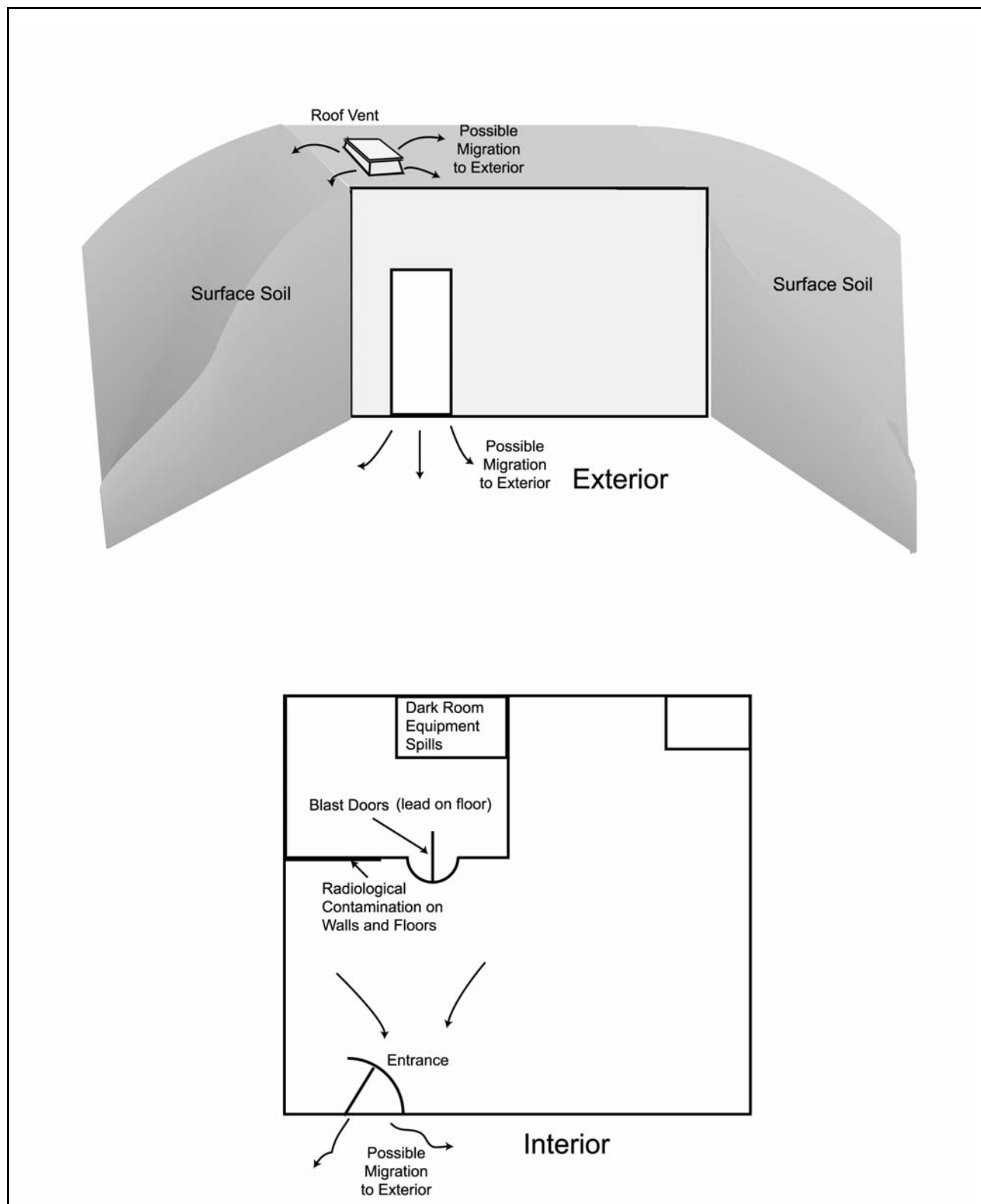


Figure 3-1
CAU 204, Conceptual Site Model #1
Bunker Interiors and Potential Migration

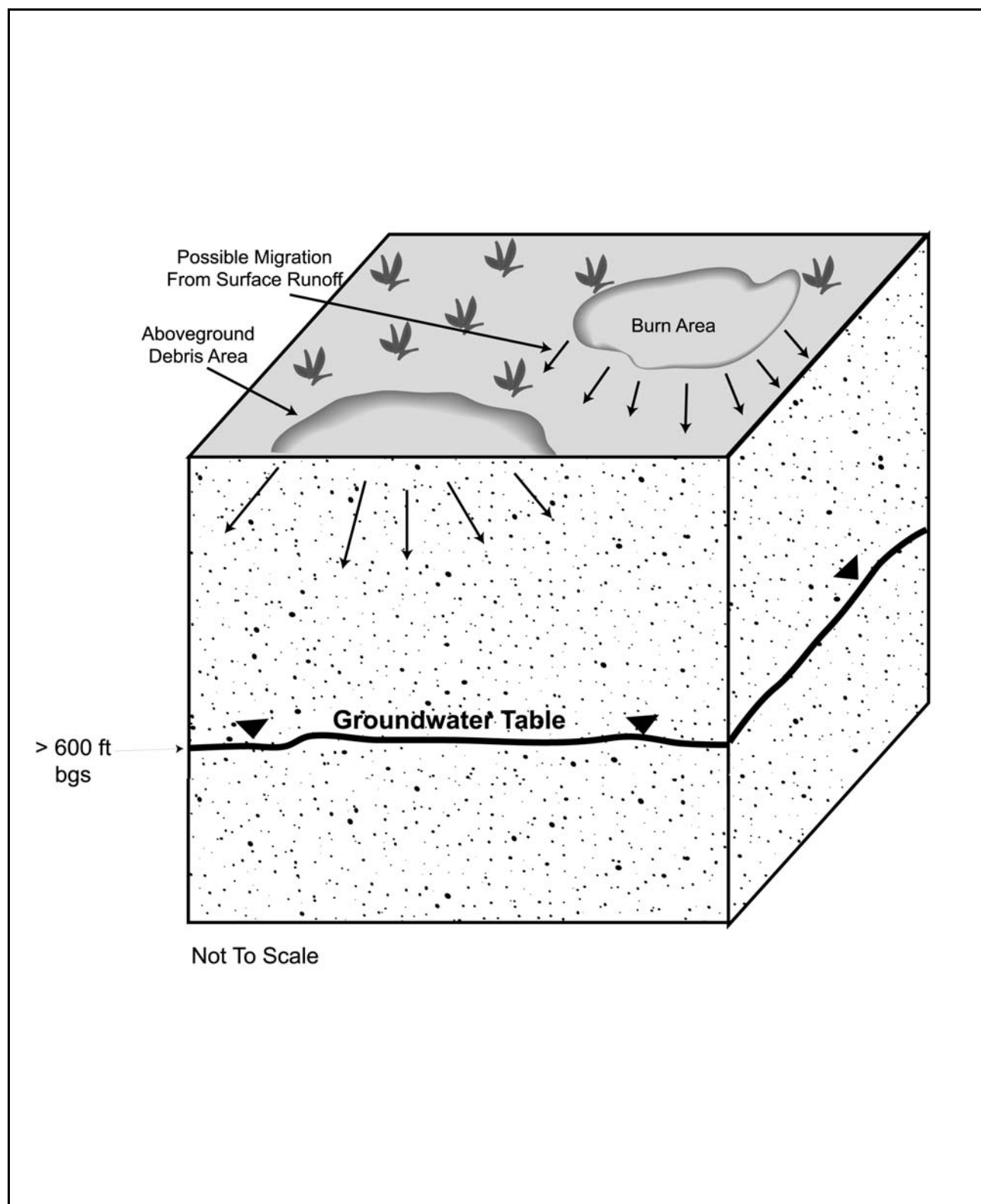


Figure 3-2
CAU 204, Conceptual Site Model #2
Surface Debris/Burn Area

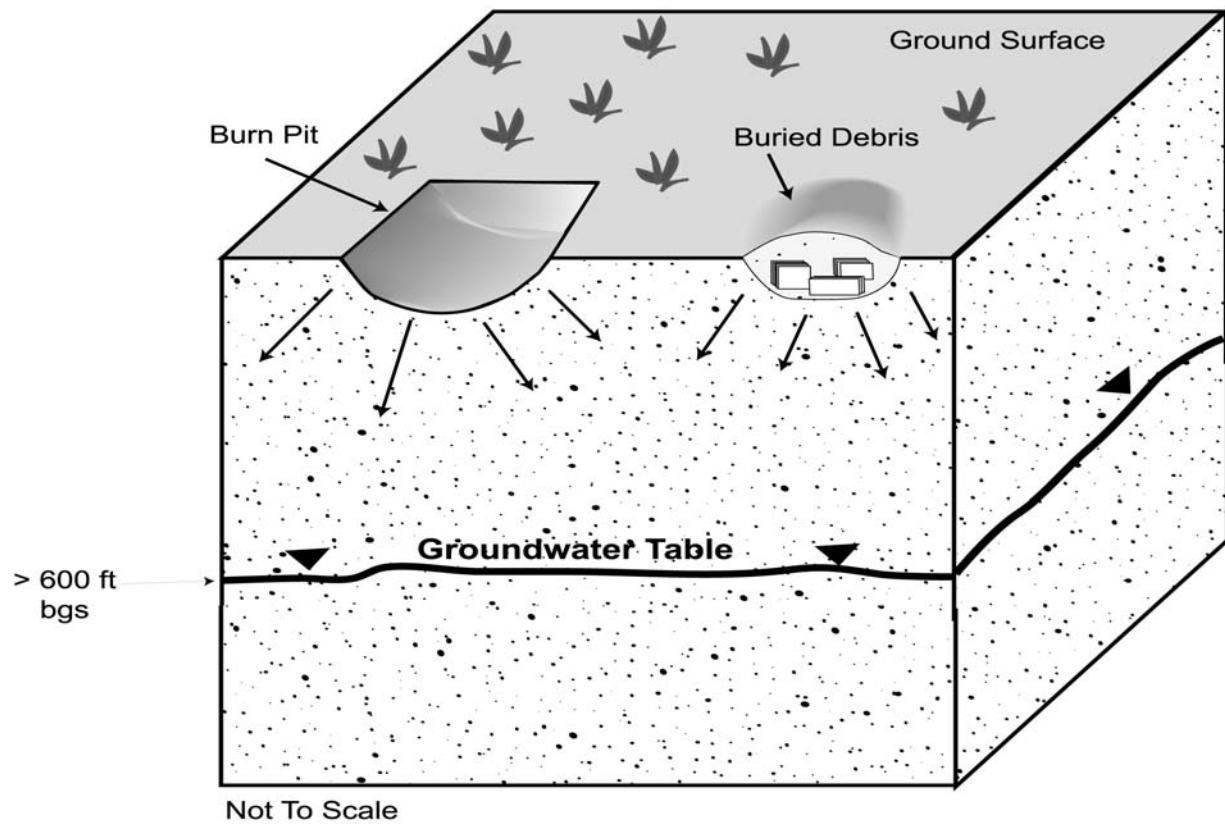


Figure 3-3
CAU 204, Conceptual Site Model #3
Subsurface Debris/Burn Area

contamination, respectively, in areas outside of bunkers. Contamination originating inside of a bunker will be addressed by CSM #2 and/or CSM #3, if it reaches the bunker exterior.

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

The future land-use scenarios discussed below limit future use of the CASs to various nonresidential (i.e., industrial) uses.

Corrective Action Sites 01-34-01, 02-34-01, and 03-34-01 are located in the land use zone described as the Nuclear and High Explosives Test Area. This area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosives tests. This zone also includes compatible defense and nondefense research, development, and testing activities (DOE/NV, 1998).

The remainder of the CASs (i.e., 05-18-02, 05-33-01, and 05-99-02) are located in an area “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).

3.1.2 Contaminant Sources

Conceptual Site Model #1 sources are:

- Atmospheric nuclear testing (interior only)
- Other local tests and experiments that resulted in contamination of the bunker interiors
- Equipment in the bunkers
- Materials from which the bunkers were constructed

For CSM #2, sources are debris and materials at the ground surface. The sources for CSM #3 are debris and materials below the ground surface.

3.1.3 Release Mechanisms

Release mechanisms are spills and leaks from equipment inside the bunkers. Another mechanism is the degradation of construction and other materials such as lead and asbestos. For the rodenticide at CAS 05-99-02, the release mechanism was intentional release onto the floor of the bunker. Nuclear and nonnuclear explosions dispersed contamination that may be present at the sites. In addition, for CASs 05-18-02 and 05-33-01, where sources may be present outside of the bunkers, release mechanisms include leaching and lateral physical dispersal during precipitation events.

3.1.4 Migration Pathways

An important element of the CSM is the expected fate and transport of contaminants, which infer how contaminants migrate through media and where they can be expected in the environment. Fate and transport are influenced by distinguishing physical and chemical characteristics of the contaminants and media. Contaminant characteristics include solubility, density, and adsorption potential. Media characteristics include permeability, porosity, water saturation, sorting, chemical composition, and organic content. In general, contaminants with low solubility, high affinity for media, and high density can be expected to be found relatively close to release points. Contaminants with high solubility, low affinity for media, and low density can be expected to be found further from release points.

Migration pathways at the CASs are expected to be generally limited to vertical migration due to gravity. However, for spills or leaks at the ground surface, contaminants may have migrated laterally prior to infiltration. Additionally, 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). Vertical migration of contaminants directly below bunkers is not expected at CASs 01-34-01, 02-34-01, 03-34-01, and 05-18-02 because of the presence of concrete floors. For contamination inside a bunker to reach the environment at these CASs, transport to doorways, vents, or other openings would be required. This could be accomplished by lateral movement of a liquid spill along the floor or airborne transport of vapors or particulates.

Contamination, if present, is expected to be contiguous to the site, except where multiple sites and activities are adjacent. In these cases, migration from one site may have impacted the immediately

adjacent site. For all CAU 204 CSMs, concentrations of contaminants are expected to decrease with horizontal and vertical distance from the location of the release.

Contaminants could be transported into the subsurface by infiltration of precipitation that 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 (USGS, 1975). The total potential evapotranspiration at the Area 3 Radiological Waste Management Site has been estimated at 62.6 in. (Shott et al., 1997). Thus, the potential annual evapotranspiration is approximately 10 times greater than the annual precipitation. These data indicate that evaporation 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.

Asbestos, if present and disturbed during the site investigation, may migrate through the air. Migration will be impacted primarily by the wind direction and speed.

3.1.5 Exposure Points

Exposure points for CSM #1 are expected to be locations where visitors and site workers will come in contact with potential contaminants within the structures (e.g., areas of staining, contaminated equipment, radiologically contaminated vents and filters).

For CSM #2 and CSM #3, the exposure points for site workers would be the ground surface and shallow subsurface at locations where contamination is present.

3.1.6 Exposure Routes

Exposure routes to site workers include oral 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.

3.1.7 Additional Information

Additional topographic information for CAU 204 will not be necessary because the data available is adequate to make determinations about the sites.

General surface and subsurface soil descriptions will be observed and recorded during the CAI.

Climatic conditions for the CAU are well documented and have been addressed in the CSM. No further information is required.

Groundwater data for the CAU is known and has been addressed in the CSM. The CAS-specific depth to groundwater data are presented in [Section 2.1.1](#) and [Section 2.1.2](#). No further information is required.

Existing floodplain studies are available and will be considered during corrective action, as necessary. No further information is required.

Specific structure descriptions will be observed and recorded during the CAI. The structures are specific aspects of each of the CASs. The CAI will not compromise the structural integrity. Active working utilities will not be impacted by the investigation.

3.2 Contaminants of Potential Concern

Suspected contaminants for CAU 204 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 CAU 204 are listed in [Table 3-2](#). Because complete information regarding activities performed at the CAU 204 sites as well as throughout the NTS is unavailable, some uncertainty as to the list of potential contaminants exists. Due to this uncertainty, constituents (in addition to the suspected contaminants) have been included in the analytical program to define the nature of contamination for the CAU 204 investigation. The analytical program for each CAS is listed in [Table 3-3](#). Chemical COPCs are defined as the analytes reported from the analytical methods listed in [Table 3-4](#) for which the U.S. Environmental Protection Agency (EPA) Region IX has established *Preliminary Remediation Goals* (PRG) (EPA, 2000) or for which toxicity data are listed in the EPA *Integrated Risk Information System* (IRIS) database

Table 3-2
Suspect Contaminants and Critical Analytes for
CAU 204 Nature of Contamination Sampling

CAS	Chemical		Radiological		
	Suspect Contaminant	Critical Analyte(s)	Suspect Contaminant	Critical Analyte(s)	
01-34-01 02-34-01 03-34-01	Lead		Americium-241 Cesium-137 Cobalt-60 Europium-152,-154 Plutonium-238,-239/240 Strontium-90		
	PCBs	Aroclor-1016 Aroclor-1221 Aroclor-1232 Aroclor-1242 Aroclor-1248 Aroclor-1254 Aroclor-1260			
		TPH (DRO)			
		Silver (for CAS 02-34-01 only)			
05-18-02	Beryllium		Americium-241 Cesium-137 Cobalt-60 Europium-152,-154 Plutonium-238,-239/240 Strontium-90 Uranium-234,-235,-238		
	High Explosives	2,4,6-Trinitoluene HMX RDX			
	Lead				
	PCBs	Aroclor-1016 Aroclor-1221 Aroclor-1232 Aroclor-1242 Aroclor-1248 Aroclor-1254 Aroclor-1260			
		TPH (DRO and GRO)			
05-33-01	Beryllium		Americium-241 Cesium-137 Cobalt-60 Europium-152,-154 Plutonium-238,-239/240 Strontium-90 Uranium-234,-235,-238		
	High Explosives	2,4,6-Trinitoluene HMX RDX			
	PCBs	Aroclor-1016 Aroclor-1221 Aroclor-1232 Aroclor-1242 Aroclor-1248 Aroclor-1254 Aroclor-1260			
		TPH (DRO and GRO)			
05-99-02	High Explosives	2,4,6-Trinitoluene HMX RDX	None		
	Warfarin Zinc Phosphide	Warfarin Zinc			

CAS = Corrective Action Site
DRO = Diesel-range organics
GRO = Gasoline-range organics
HMX = High melting explosive

PCB = Polychlorinated biphenyls
RDX = Royal demolition explosive
TPH = Total petroleum hydrocarbons

Table 3-3
Analytical Program and Contaminants of Potential Concern^a
(Includes Site and Waste Characterization Analyses)

Analyses ^b	01-34-01	02-34-01	03-34-01	05-18-02	05-33-01	05-99-02
Organics						
Total Petroleum Hydrocarbons (Diesel- and Gasoline-Range Organics)	X	X	X	X	X	--
Polychlorinated Biphenyls	X	X	X	X	X	X
Semivolatile Organic Compounds	X	X	X	X	X	X
Volatile Organic Compounds	X	X	X	X	X	X
Rodenticide						
Warfarin	--	--	--	--	--	X
Zinc	--	--	--	--	--	X
Metals						
Total Resource Conservation and Recovery Act Metals ^c	X	X	X	X	X	X
Total Beryllium	X	X	X	X	X	X
Other						
Asbestos	X	X	X	X	X	--
Explosives	--	--	--	X	X	X
Radionuclides						
Gamma Spectrometry ^d	X	X	X	X	X	--
Isotopic Uranium	X	X	X	X	X	--
Isotopic Plutonium	X	X	X	X	X	--
Strontium-90	X	X	X	X	X	--

-- = Not applicable

^aThe contaminants of potential concern are the analytes reported from the analytical methods listed in [Table 3-4](#).

^bIf the volume of material is limited, prioritization of the analyses will be necessary.

^cMay also include Toxicity Characteristic Leaching Procedure metals if sample is collected for waste management purposes.

^dIf americium-241 is detected above the minimum detectable activity, isotopic americium-241 may also be performed on sample.

Table 3-4
Analytical Requirements for CAU 204
(Page 1 of 3)

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	8260B ^c	Parameter-specific estimated quantitation limits ^d	Not Applicable (NA)	Lab-specific ^e	Lab-specific ^e
	Soil					
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	8270C ^c	Parameter-specific estimated quantitation limits ^d	NA	Lab-specific ^e	Lab-specific ^e
	Soil					
TCLP SVOCs						
ORGANICS (continued)						
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	8082 ^c	Parameter-specific (CRQL) ^g	NA	Lab-specific ^e	Lab-specific ^e
	Soil					
Total Petroleum Hydrocarbons (TPH)	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 204
(Page 2 of 3)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD) ^a	Percent Recovery (%R) ^b
Explosives	Aqueous	8330 ^c	14 mg/L ^c	NA	Lab-specific ^e	Lab-specific ^e
	Soil		2.2 mg/kg ^c			
Warfarin	Aqueous	8321 modified ^c	5 mg/L ^c	NA	Lab-specific ^e	Lab-specific ^e
	Soil		5 mg/kg ^c			
INORGANICS						
Total Resource Conservation and Recovery Act (RCRA) Metals, Beryllium, and Zinc						
Arsenic	Aqueous	6010B ^c	10 µg/L ^{h, i}	NA	20 ^j	Matrix Spike Recovery 75-125 ^j Laboratory Control Sample Recovery 80 - 120 ^j
	Soil	6010B ^c	1 mg/kg ^{h, i}		35 ^{i, o}	
Barium	Aqueous	6010B ^c	200 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	20 mg/kg ^{h, i}		35 ^{i, o}	
Beryllium	Aqueous	6010B ^c	5 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	0.5 mg/kg ^{h, i}		35 ^{i, o}	
Cadmium	Aqueous	6010B ^c	5 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	0.5 mg/kg ^{h, i}		35 ^{i, o}	
Chromium	Aqueous	6010B ^c	10 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	1 mg/kg ^{h, i}		35 ^{i, o}	
Lead	Aqueous	6010B ^c	3 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	0.3 mg/kg ^{h, i}		35 ^{i, o}	
Mercury	Aqueous	7470A ^c	0.2 µg/L ^{h, i}		20 ^j	
	Soil	7471A ^c	0.1 mg/kg ^{h, i}		35 ^{i, o}	
Selenium	Aqueous	6010B ^c	5 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	0.5 mg/kg ^{h, i}		35 ^{i, o}	
Silver	Aqueous	6010B ^c	10 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	1 mg/kg ^{h, i}		35 ^{i, o}	
Zinc	Aqueous	6010B ^c	20 µg/L ^{h, i}		20 ^j	
	Soil	6010B ^c	2 mg/kg ^{h, i}		35 ^{i, o}	
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B ^c 1311/7470A ^c	0.10 mg/L ^{h, i}	5 mg/L ^f	20 ^j	Matrix Spike Recovery 75-125 ^j Laboratory Control Sample Recovery 80 - 120 ^j
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		

Table 3-4
Analytical Requirements for CAU 204
(Page 3 of 3)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD) ^a	Percent Recovery (%R) ^b
RADIOCHEMISTRY						
Gamma-Emitting Radionuclides	Aqueous	EPA 901.1 ^l	The Minimum Reporting Limits and Minimum Detectable Activities for Radionuclides are given in Table 3-5	NA	Relative Percent Difference (RPD ^a) 20% (Water) ^h 35% (Soil) ^h	Laboratory Control Sample Recovery 80-120 ⁱ
	Soil	HASL-300 ^j		NA		Chemical Yield 30-105 ⁿ
Isotopic Uranium	Aqueous	HASL-300 ^j ASTM D3972-02 ^m		NA	Normalized Difference (ND) -2<ND<2 ^k	Laboratory Control Sample Recovery 80-120 ⁱ
	Soil	HASL-300 ^j ASTM C1000-00 ^m		NA		
Isotopic Plutonium	Aqueous	D3865-02 ^m ASTM		NA		
	Soil	HASL-300 ^j		NA		
Strontium - 90	Aqueous	ASTM D5811-00 ^m		NA		
	Soil	HASL-300 ^j		NA		

^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: $RPD = 100 \times \{(|C_1 - C_2|) / [(C_1 + C_2) / 2]\}$, 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) = $100 \times (C_s - C_u / C_n)$, 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 Waste*, 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, 2001a)

^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*, EPA540/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

(EPA, 2001b). Radiological COPCs are defined as the radionuclides reported from the analytical methods listed in [Table 3-4](#).

The critical analytes for sampling to define the nature of contamination (Decision I) are identified in [Table 3-2](#) for each CAS. Critical analytes are defined as the chemicals and radionuclides that are suspected to be present at the sites based on the information used to identify suspected contaminants. Suspected contaminants and their corresponding critical analytes are both presented in [Table 3-2](#). Because information such as documented use or process knowledge exists for critical analytes, these analytes are given greater importance in the decision-making process relative to other COPCs. For this reason, more stringent performance criteria are specified for critical analyte data quality indicators ([Section 6.0](#)).

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). These follow-up samples will be collected and analyzed only for the COCs determined by Decision I sampling. However, if extent samples are collected prior to nature-of-contamination data becoming available, the extent samples will be analyzed for the full list parameters given for each CAS in [Table 3-3](#).

For samples collected to define the extent of contamination, critical analytes are the COCs only. For example, if lead is detected above the PAL only at CAS 01-34-01, it will be a COC (and therefore a critical analyte) for subsequent sampling only at that CAS.

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, 2000).
- 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 total petroleum hydrocarbon (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; U.S. Ecology and Atlan-Tech, 1992; 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, a similar protocol to that used by the EPA Region 9 will be used in establishing an action level for those COPCs listed in the EPA IRIS database (EPA, 2001b).

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 Manual* (DOE/NV, 2000c).

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

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 close in place). The DQO process is a seven-step process as follows:

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

Table 3-5
Minimum Detectable Concentrations, Preliminary Action Levels,
and Minimum Reporting Limits for Radionuclides
in Samples Collected at CAU 204

Isotope	Soil and Sludge			Liquid		
	MDC ^a (pCi/g) ^d	PAL ^b (pCi/g) ^d	MRL ^c (pCi/g) ^d	MDC ^a (pCi/L) ^e	PAL ^b (pCi/L) ^e	MRL ^c (pCi/g) ^d
Americium-241 (by Gamma spectroscopy)	2.0 ^f	2.0	2.0	50	50	50
Cesium-137	0.5 ^f	7	2.5	10	10	10
Cobalt-60	0.5 ^f	0.5	0.5	10 ^f	10	10
Europium-152	4.0 ^f	4.0	4.0	75 ^f	75	75
Europium-154	2.5 ^f	2.5	2.5	65 ^f	65	65
Europium-155	1.0 ^f	1.35	1.0	20 ^f	20	20
Strontium-90	0.5	1.17	0.5	1.0	1.0	1.0
Uranium-234	0.05	3.47	0.25	0.1	8.92	0.5
Uranium-235	0.05	0.07	0.05	0.1	0.36	0.1
Uranium-238	0.05	3.47	0.25	0.1	9.39	0.5
Plutonium-238	0.05	0.05	0.05	0.1	0.16	0.1
Plutonium-239/240	0.05	0.106	0.05	0.1	9.0	0.5

^a MDC is the minimum detectable concentration: detection limits required for the measurement of ITLV 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; U.S. Ecology and Atlan-Tech, 1992; and DOE/NV, 1999). 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 MRL is the minimum reporting level. It is set equal to 5 times the MDC, or if 5 times the MDC is greater than the PAL, the MRL is set equal to the MDC.

^d pCi/g is picocuries per gram.

^e pCi/L is picocuries per liter.

^f MDC for gamma-emitting radionuclides is relative to Cs-137.

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

The DQO strategy for CAU 204 was developed at a meeting on August 12, 2002. 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 primary question for the investigation is: “Are existing data sufficient to evaluate appropriate corrective actions?” To address this question, resolution of two decisions statements is required:

- Decision I is to “Define the nature of contamination” by identifying any contamination above PALs. Data must be collected in areas most likely to contain contamination due to testing and activities associated with the facility, and samples must be collected from areas most likely to be contaminated. If PALs are not exceeded, then the investigation is complete. If PALs are exceeded, then Decision II must be resolved.
- Decision II is “Determine the extent of contamination identified above PALs.” This decision will be achieved by the collection of data that are adequate to define the extent of COCs.

In addition, data will be obtained to support waste management decisions.

For the CAU 204 DQOs, three CSMs have been developed for the six CASs using historical background information, knowledge from studies at similar sites, and data from previous sampling efforts. The CSMs are termed Interior Bunker Release (CSM #1), Surface Debris/Burn Area (CSM #2), and Subsurface Debris/Burn Area (CSM #3). The applicability of the CSMs to each CAS is shown in [Table 3-1](#) and summarized in [Appendix A.1](#). As discussed in [Section 1.2](#), soil contamination resulting from atmospheric nuclear testing is not included in the scope of CAU 204. This contamination will be addressed by the Soils Project. However, radiological contamination of the bunker interiors, regardless of the source, will be addressed by this investigation.

The analytical methods for CAU 204, minimum reporting limits (MRLs), and precision and accuracy requirements are listed in [Table 3-4](#). The analytical methods are capable of generating data that meet the project needs determined through the DQO process. Specifically, the MRLs are set so that laboratory analyses will generate data with the necessary resolution for comparison to PALs. The MRLs for radiological analytes have been developed considering both the MDCs and PALs. As shown in [Table 3-5](#), the MRL for each radiological analyte is less than or equal to the corresponding PAL.

4.0 Field Investigation

This section of the CAIP contains the approach for investigating CAU 204.

4.1 Technical Approach

The technical approach for the CAU 204 CAI consists of the following activities:

- Perform radiological land area surveys at CASs 01-34-01, 02-34-01, 03-34-01, 05-18-02, and 05-33-01 (surveys at CASs 05-18-02 and 05-33-01 have been completed).
- Perform geophysical surveys at CAS 05-33-01 to identify any subsurface metallic and nonmetallic debris (completed).
- Collect and analyze samples from biased locations as described in this section.
- Perform field screening for applicable COPCs.
- Collect required QC samples.
- Collect additional samples, as necessary, to estimate potential corrective action waste streams.
- Collect soil samples from background locations, if necessary.
- Collect samples from native soils and analyze for geotechnical/hydrologic parameters, if necessary.
- Collect and analyze bioassessment samples if appropriate (e.g., if volatile organic compounds [VOCs] 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 identified during the investigation.
- Stake or flag sample locations and record coordinates (in North American Datum 1927 coordinate system).

4.2 Field Activities

This section provides a description of the field activities for all CASs at CAU 204. Process knowledge indicates that if contamination is identified, it will be found within the spatial boundaries

of the sites as defined in the DQO process and CSMs. If while defining the nature of contamination, the investigation determines that COCs are present at a CAS, that CAS will be further addressed by determining the extent of contamination before evaluating corrective action alternatives.

Modifications to the investigative strategy may be required should unexpected field conditions be encountered. Significant modifications will be justified in a Record of Technical Change (ROTC). Concurrence from NDEP is required on ROTC modifications prior to proceeding with investigation activities significantly different from those described in this document. The investigation will be rescoped if the CSM has failed.

Surface soil samples (0 to 0.5 ft bgs) will be collected by hand from biased locations. Subsurface soil samples will be collected at biased locations by hand augering, backhoe excavation, direct-push, or drilling techniques, as appropriate. Sample locations may be changed based on current site conditions, obvious debris or staining of soils, field-screening results, or professional judgement. Subsurface soil sample depth intervals will be selected based on biasing factors. If necessary, soil samples will be collected from background locations at selected CASs. [Section 3.0](#) 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.

The following sections outline CAS-specific activities for the CAU 204 investigation.

4.2.1 CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker

Interior

A visual inspection, including photodocumentation, of all accessible spaces will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the bunker. The emphasis of this inventory will be to gather information to support waste management decisions.

A radiological survey of the bunker interior, including exterior doors, vents, equipment, and pipe runs, etc. will be performed. If biasing factors such as staining on the floor or areas of elevated radiological survey/swipe readings are present, and sufficient and appropriate unconsolidated material is present, a minimum of one sample of the material will be collected for analysis. If unconsolidated material is not present and staining or radiological contamination of the concrete is observed, the concrete may be characterized by other means (e.g., scabbled or swiped, followed by analysis). In addition, samples from vents, ducts, filters, and equipment may be collected and submitted for analysis to support waste management decisions, as appropriate.

Exterior

A walk-over radiological land area survey of the ground surface within the CAS boundaries will be performed. If the results of this radiological survey or the results of the interior characterization indicate that the exterior may have been contaminated by activities that took place at or within the bunker, surface soil samples will be collected based on biasing factors (e.g., staining, radiological survey data, or field-screening results). If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination. Information on step-out sampling is given in [Section 4.5](#).

[Figure 4-1](#), [Figure 4-2](#), and [Figure 4-3](#) depict possible soil sampling locations at CASs 01-34-01, 02-34-01, and 03-34-01, respectively. The sample locations and number of locations shown on these figures are for illustration, and the actual locations and number may change without an ROTC to this CAIP. Sample locations will be determined from current site conditions based on biasing factors. Samples will be submitted for laboratory analysis as discussed in [Section 3.2](#). In the absence of biasing factors or any other evidence of contamination, it is possible that no soil samples will be collected from any of the three CASs in Yucca Flat.

4.2.2 CAS 05-18-02, Chemical Explosives Storage

Interior

A visual inspection, including photodocumentation, of all accessible spaces will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the

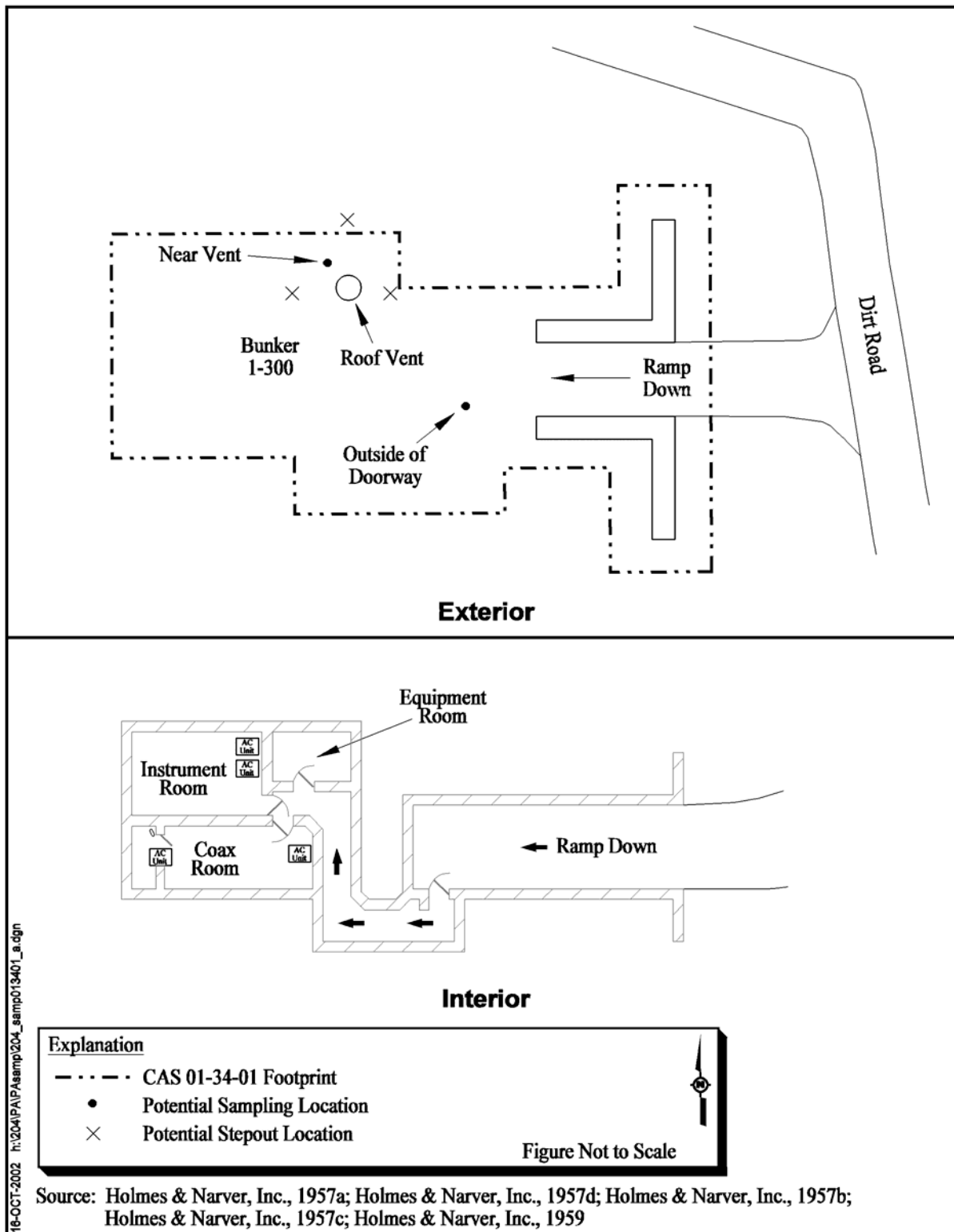


Figure 4-1
CAS 01-34-01, Potential Sampling Locations

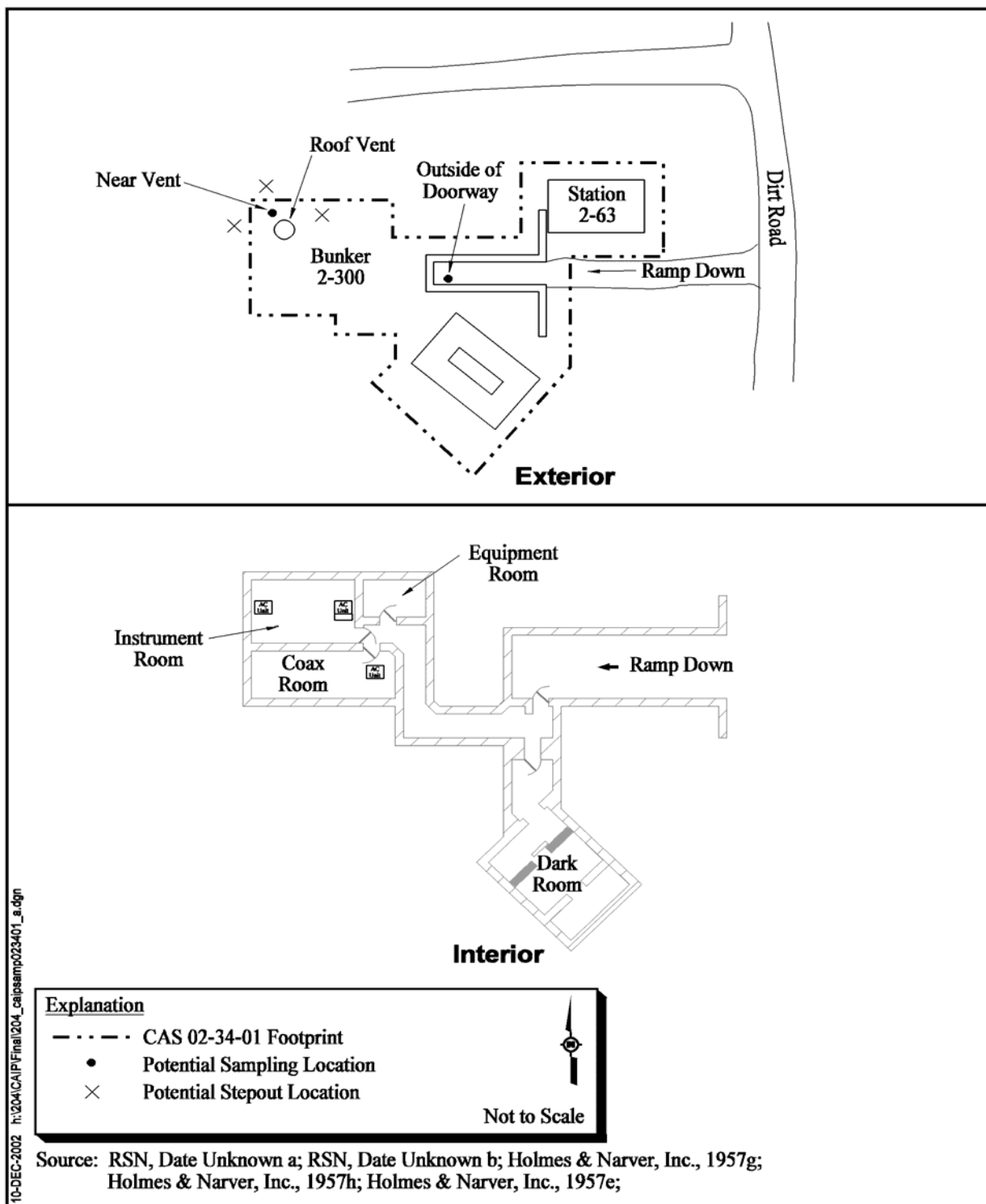


Figure 4-2
CAS 02-34-01, Potential Sampling Locations

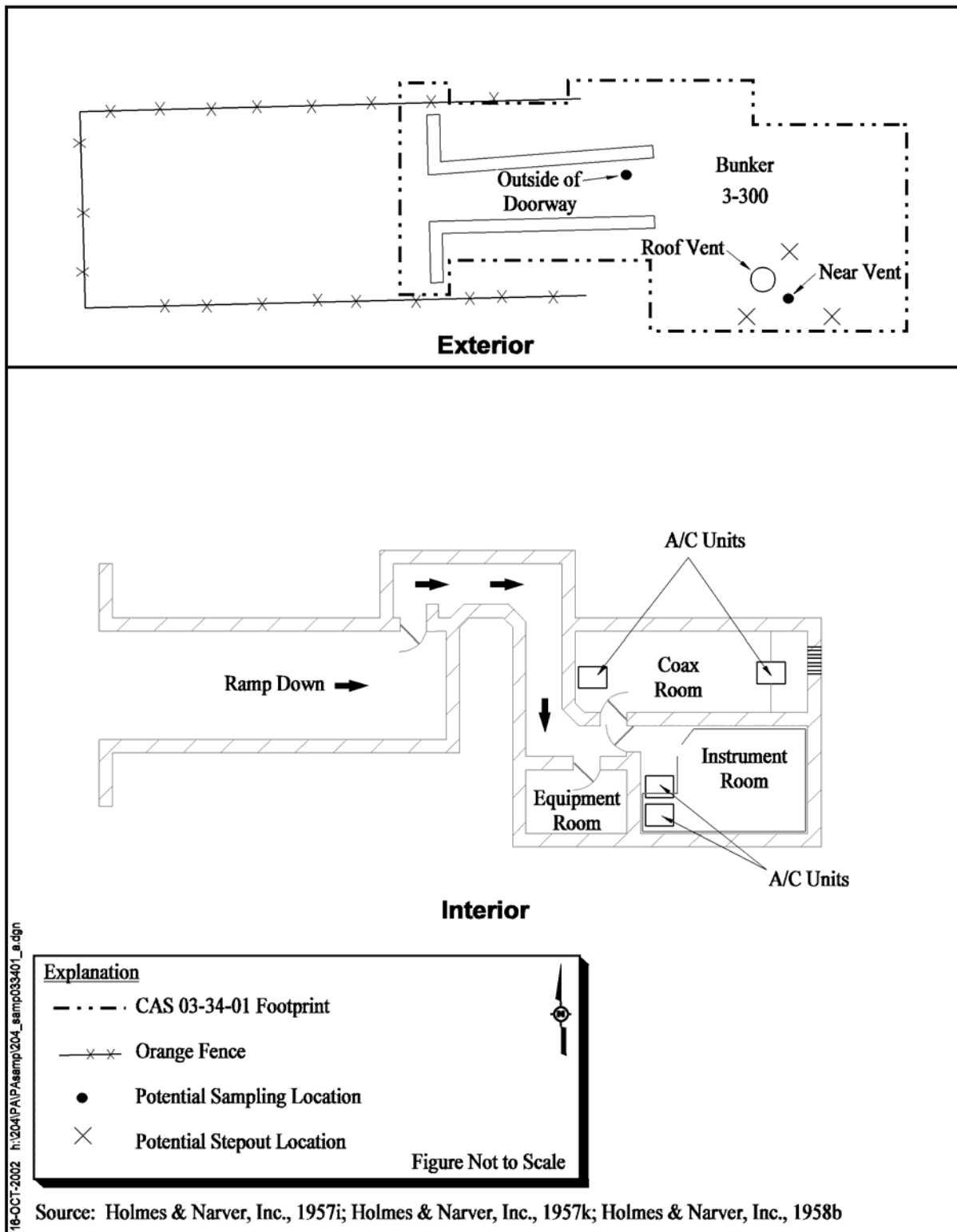


Figure 4-3
CAS 03-34-01, Potential Sampling Locations

bunker. The emphasis of this inventory will be to gather information to support waste management decisions.

A radiological survey of the bunker interior (e.g., exterior doors, vents, equipment, and pipe runs) will be performed. If biasing factors such as staining on the floor or areas of elevated radiological survey/swipe readings are present, and sufficient and appropriate unconsolidated material is present, a minimum of one sample of the material will be collected for analysis. If unconsolidated material is not present and staining or radiological contamination of the concrete is observed, the concrete may be characterized by other means (e.g., scabbled or swiped, followed by analysis).

Exterior

A walk-over radiological land area survey of the ground surface within the CAS boundaries has been performed ([Section 2.5.2](#)). Additional radiological surveys may be performed, as necessary, to support the investigation. Surface soil samples will be collected from a minimum of three biased locations based on the results of the radiological land area survey. Additional surface soil samples will be collected from a minimum of three locations south of the bunker in an area where a previous investigation ([Section 2.5.2](#)) had detected above-background concentrations of beryllium.

In addition to the radiological land area survey and previous beryllium sampling data, if biasing factors are present (e.g., staining), surface soil samples will be collected as appropriate. Also, if the results of the interior characterization indicate that a release to the exterior may have occurred due to activities that took place within the bunker, a surface soil sample or samples will be collected where contamination is suspected.

If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination. Information on step-out sampling is given in [Section 4.5](#).

[Figure 4-4](#) depicts possible soil sampling locations at CAS 05-18-02. The sample locations and number of locations shown on [Figure 4-4](#) are for illustration, and the actual locations and number may change without an ROTC to this CAIP. The sample locations will be determined from current site conditions based on biasing factors. Samples will be submitted for laboratory analysis as discussed in [Section 3.2](#). Since it is not known if clean material was placed over the possible

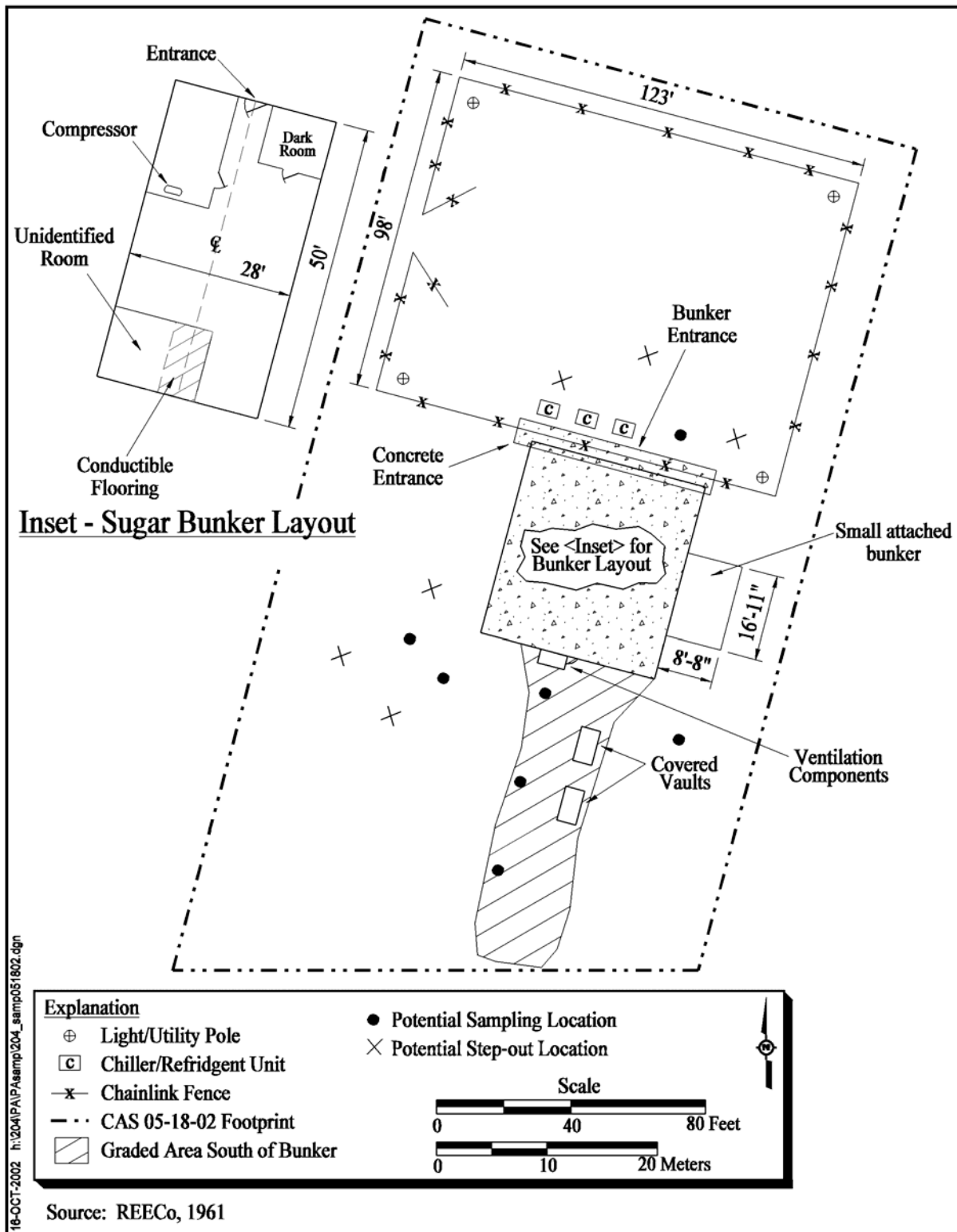


Figure 4-4
CAS 05-18-02, Potential Sampling Locations

contamination in the graded area shown on [Figure 4-4](#), soil samples from locations within this graded area will be field-screened from the ground surface and shallow subsurface depth intervals. Key biasing factors will be vertical stratigraphic discontinuities that may represent old surfaces and areas identified as elevated above radiological background.

4.2.3 CAS 05-33-01, Kay Blockhouse

Interior

A visual inspection, including photodocumentation, of all accessible spaces will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the bunker. The emphasis of this inventory will be to gather information to support waste management decisions.

A radiological survey of the bunker interior (e.g., exterior doors, vents, equipment, and pipe runs) will be performed. If biasing factors such as staining on the floor or areas of elevated radiological survey/swipe readings are present, and sufficient and appropriate unconsolidated material is present, a minimum of one sample of the material will be collected for analysis. If unconsolidated material is not present and staining or radiological contamination of the floor is observed, the floor material may be sampled for analysis or characterized by other means (e.g., scabbled or swiped), if appropriate.

Exterior

A walk-over radiological land area survey and a geophysical survey of the ground surface within the CAS boundaries have been performed ([Section 2.5.3](#)). Additional radiological land area surveys may be performed, as necessary, to support the investigation. Also, to support waste management decisions, radiological characterization surveys of debris and equipment will be performed within the CAS boundaries.

Numerous areas and features are present within the CAS boundary where, based on visual evidence, a contaminant release may have occurred. These areas and features include, burn areas, burn pits, open pits, steel-lined pits, areas inside soil berms, soil disturbances, and areas of debris. In some instances, these areas and features may coincide with the location of elevated radiological readings and/or geophysical anomalies.

Based on the survey results and visual evidence, sampling at CAS 05-33-01 will be conducted as follows:

- A minimum of one surface or subsurface soil sample will be collected from each area or feature where a release may have occurred. Biasing factors may include radiological survey results, geophysical anomalies, stained or discolored soil, low spots in depressions, or the presence of debris. Samples will be collected from the appropriate surface and/or subsurface depth intervals, based on current site conditions observed during the investigation. The typical biased sample interval will be the soil interval immediately below the waste/native soil interface.
- Surface soil samples will be collected from six of the seven locations of elevated radiological levels identified during the walk-over survey. Samples will not include large fragments of metal or other materials that may be the source of the elevated radiological levels. The seventh location that will not be sampled is a location where “trinity glass” was observed. This material was generated during atmospheric nuclear testing, and as discussed in [Section 1.2](#), is not part of scope of the CAU 204 CAI.
- The geophysical anomalies will be investigated by collecting surface soil and subsurface soil samples, as appropriate. Generally, the anomalies coincide with surface features that are already targeted for sampling. However, the anomaly interpreted as a fill area/trench feature in the northern sites area will be investigated by excavating a trench perpendicular to the long axis of the feature. A minimum of one soil sample will be collected from the trench.

If the results of the interior characterization indicate that a release to the exterior may have occurred due to activities that took place within the bunker, a surface soil sample or samples will be collected where contamination is suspected.

If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination. Information on step-out sampling is given in [Section 4.5](#).

[Figure 4-5](#) depicts possible soil sampling locations at CAS 05-33-01. The sample locations and number of locations shown on [Figure 4-5](#) are for illustration, and the actual locations and number may change without an ROTC to this CAIP. Exact sample locations will be determined from current site conditions based on biasing factors. Samples will be submitted for laboratory analysis as discussed in [Section 3.2](#).

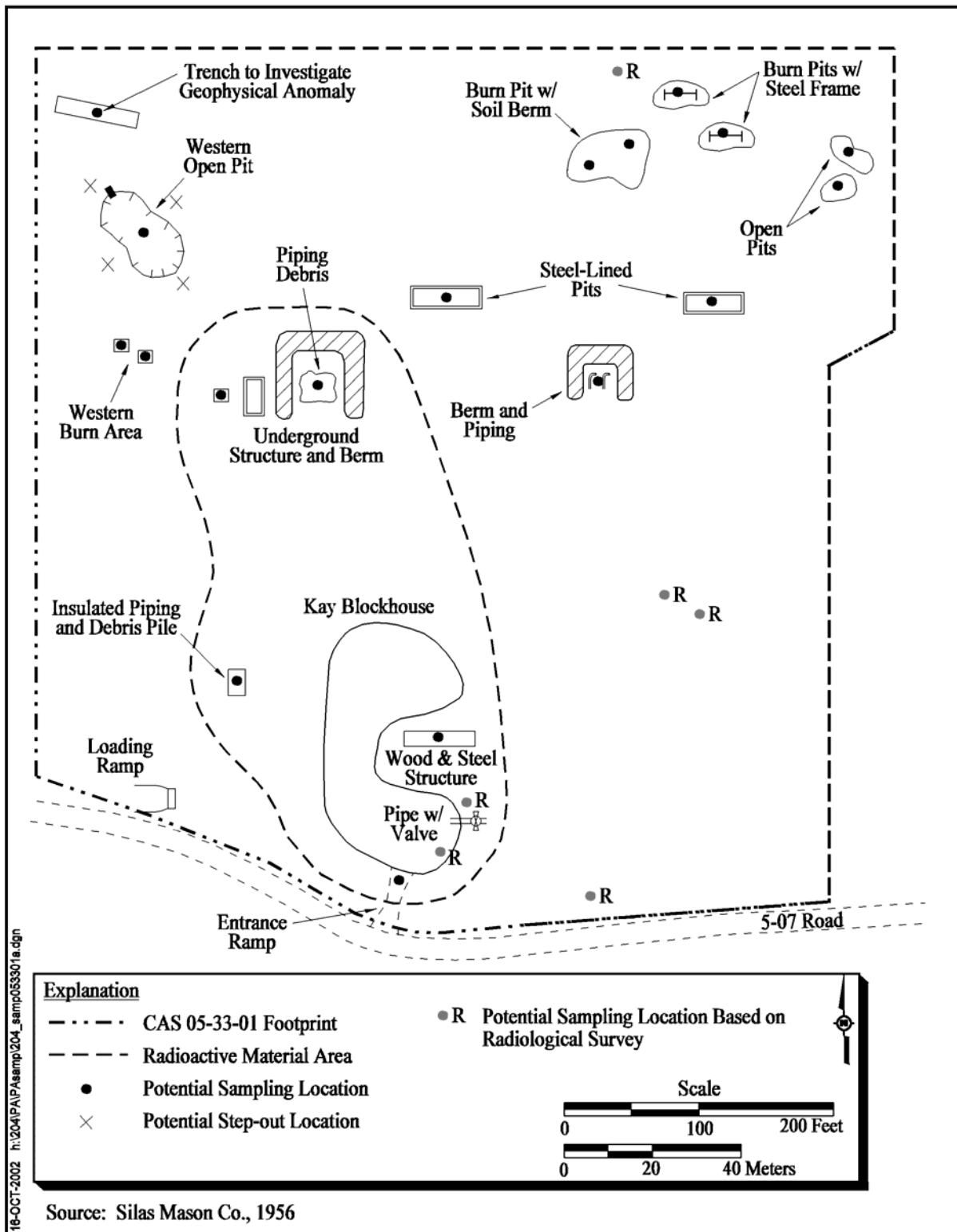


Figure 4-5
CAS 05-33-01, Potential Sampling Locations

Samples of waste or debris may also be collected for analysis to support waste management decisions.

4.2.4 CAS 05-99-01, Explosives Storage Bunker

Interior

A visual inspection of the bunker, including photodocumentation, will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the bunker. The emphasis of this inventory will be to gather information to support waste management decisions. A radiological survey of bunker walls and floor will be performed, focusing on potential pathways to the environment (e.g., doorway, floor, and bottom of walls).

A minimum of one surface soil sample will be collected from the floor within the bunker based upon biasing factors such as staining or radiological survey results.

Exterior

If the results of the interior characterization indicate that the exterior may have been contaminated by activities that took place at, or within, the bunker, surface soil samples will be collected based on biasing factors (e.g., staining, radiological survey data, or field-screening results). If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination. Information on step-out sampling is given in [Section 4.5](#).

[Figure 4-6](#) depicts possible soil sampling locations at CAS 05-99-02. The sample locations and number of locations shown on [Figure 4-6](#) are for illustration, and the actual locations and number may change without an ROTC to this CAIP. Sample locations will be determined from current site conditions based on biasing factors. Samples will be submitted for laboratory analysis as discussed in [Section 3.2](#). In the absence of biasing factors or any other evidence of contamination, it is possible that no soil samples will be collected from the bunker exterior at this CAS.

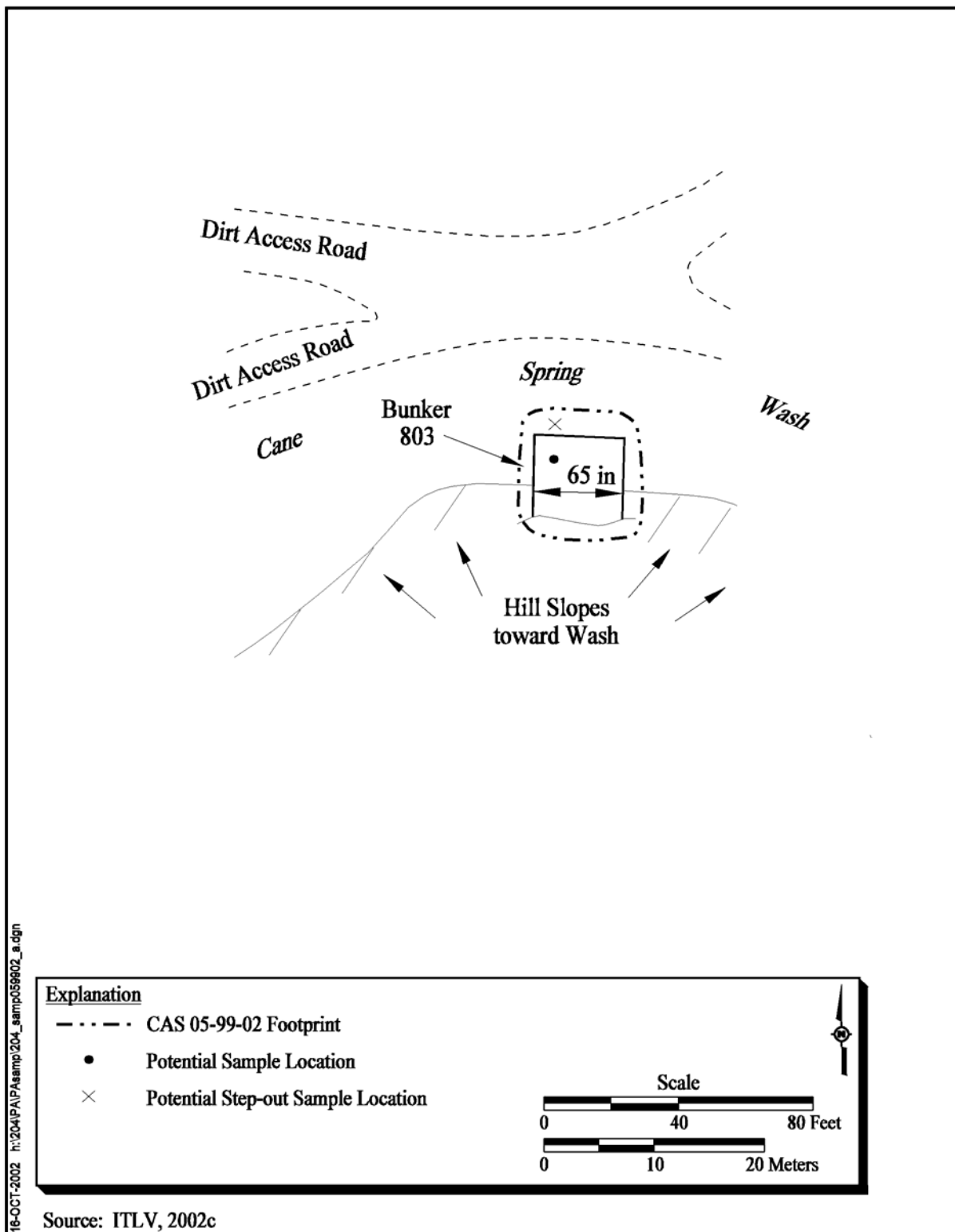


Figure 4-6
CAS 05-99-02, Potential Sampling Locations

4.3 Field-Screening Levels

Field screening, along with other biasing factors, may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following field-screening levels (FSLs) may be used for on-site field screening:

- Headspace VOC levels of 20 ppm or 2.5 times background, whichever is greater.
- The TPH level of 75 ppm measured using an appropriate field-screening method (e.g., Hanby, other test kit, or field analytical method).
- The radiological (alpha and beta/gamma) FSL of the mean background activity plus two times the standard deviation of the mean background activity collected from undisturbed locations within the vicinity of the site (Adams, 1998).
- High explosive FSLs of 10 ppm as measured by the appropriate field-screening tests.

Field-screening concentrations exceeding FSLs indicate potential contamination at that sample location. This information will be documented and the investigation will collect additional samples to delineate the extent of the contamination. Additionally, these data may be used to select discretionary samples for submission to the laboratory.

4.4 Additional Sampling to Define Extent of Contamination

If COCs are detected, step-out sampling may be necessary to properly define the extent of contamination (i.e., contaminant boundaries). Sample locations may be determined by the vertical and/or lateral extent of initial contamination, and will be based on process knowledge, site observations, field-screening data, and analytical results (if available) from nature samples. The target populations at step-out locations will be limited to COC concentrations above PALs for the samples that defined the nature of contamination. They will also be limited by previous extent samples that may continue to exceed PALs.

Step-out samples will be placed at a maximum of 15 ft from the previous sample location where COCs were detected. If biasing factors indicate that the COCs may extend beyond the initial step-out location, further step-out locations may be necessary. As field data are generated, these locations may be modified, but only if the modified locations meet the decision needs and criteria stipulated in the DQOs. At each step-out location, soil samples will be collected at the depth(s) where COCs were

encountered and from two depth intervals below the lowest depth where COCs were observed. These samples will be screened; and, if the results are not greater than FSLs, one of these samples (typically the uppermost) will be submitted to the laboratory for analysis. Laboratory analysis is the only acceptable verification that extent has been determined. In general, samples submitted for laboratory analysis will be those that define the lateral and vertical extent of COCs.

In the event that CASs have multiple features in close proximity to each other (e.g., CAS 05-33-01, Kay Blockhouse), the extent may be defined for an area that combines features rather than defining extent for individual features. In these situations, sample locations to define the extent of contamination will be selected adjacent to the boundaries of the outer features with limited locations between features.

If the nature and/or extent of contamination is inconsistent with the CSM, or if contamination extends beyond the spatial boundaries identified in [Section A.1.4.2](#), NDEP will be notified and the investigation strategy will be reevaluated. As long as contamination is consistent with the CSM and is within spatial boundaries, sampling will continue to define extent.

4.5 *Geotechnical/Hydrological Analysis and Bioassessment Tests*

It may be necessary to measure the geotechnical/hydrological parameters of a CAS. Samples to be analyzed for these parameters will be collected within brass sleeves (or other containers, as appropriate) to maintain the natural physical characteristics of the soil. [Table 4-1](#) lists general geotechnical and hydrological parameters of interest. The testing methods shown are minimum standards, and other equivalent or superior testing methods may be used. In some cases, bioassessment will also be performed on the sample material. 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 is most appropriate for hydrocarbon contamination sites where bioremediation is a potential corrective action. Bioassessment samples may be collected if biasing factors suggests a fuel or solvent plume may be present.

Table 4-1
General Geotechnical and Hydrological Analysis

Geotechnical Parameter	Methods
Initial moisture content	ASTM ^a D 2216-92
Dry bulk density	ASTM ^a D 2937-94
Calculated porosity	EM ^b -1110-2-1906 or MOSA ^c Chp. 18
Saturated hydraulic conductivity	ASTM ^a 2434-68(74) MOSA ^c Chp. 28
Unsaturated hydraulic conductivity	van Genuchten ^d
Particle-size distribution	ASTM ^a D 422-63(90)
Water-release (moisture retention) curve	MOSA ^c Chp. 26 ASTM ^a D 2325-68(94) MOSA ^c Chp. 24 Karathanasis and Hajek ^e

^aASTM, 1996

^bUSACE, 1970

^cMethods of Soil Analysis (MOSA) (Soil Science Society of America, 1986)

^dvan Genuchten, 1980

^eKarathanasis and Hajek, 1982

4.6 Safety

A current version of the ITLV HASP (IT, 2001) 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, semivolatile organic compounds [SVOCs], HE, 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 ACMs are identified (CFR, 2001c; NAC, 2002d), they 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 204 investigation samples. Disposable sampling equipment, PPE, and rinsate are considered potentially contaminated waste by virtue of contact with potentially contaminated media (e.g., soil) or potentially contaminated debris (e.g., construction materials). Decontamination activities will be performed according to approved procedures and, as appropriate, for the COPCs likely to be identified at CAU 204.

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 regulations, RCRA regulations, *Nevada Revised Statutes* (NRS), and agreements and permits between the DOE and NDEP. Polychlorinated biphenyls (PCBs) and ACMs will be managed and disposed of in accordance with appropriate regulations (i.e., *Toxic Substances Control Act* [TSCA] [USC, 1976] and State of Nevada *Administrative Codes* [NAC, 2002d]). Materials that are thought to potentially contain the hantavirus will be managed and disposed of in accordance with appropriate health and safety procedures.

All waste from CAU 204 will be evaluated as potentially characteristic, as no listed organic wastes have been identified. Process knowledge indicates that some CAU 204 locations may be contaminated with radioactive and hazardous constituents. To allow for the segregation of radioactive and nonradioactive waste and materials, radiological swipe and/or direct surveys may be conducted on reusable sampling equipment, PPE, and disposable sampling equipment waste streams exiting the controlled area. Contamination limits, as defined in Table 4-2 of the current *NV/YMP Radiological Control Manual* (DOE/NV, 2000c), shall be used to determine the release status of such materials.

Applicable waste management regulations and requirements are listed in [Table 5-1](#).

5.1 Waste Minimization

Corrective action investigation activities have been planned to minimize IDW generation. All IDW will be segregated to the greatest extent possible. Hazardous materials used at sites will be minimized

**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 State of Nevada Solid Waste Disposal Site Permit SW1309802 NTS Landfill Permit SW13.097.02 ⁱ
Liquid/Rinsate (nonhazardous)	NA	NTS Waste Water Facility Permit GNEV93001, Rev. 3iii ^c
Hazardous	RCRA ^d	NRS 459.400 - 459.600 ^e NAC 444.850 - 444.8746 ^f POC ^g
Low-Level Radioactive	NA	DOE Orders and NTSWAC ^h
Mixed	RCRA ^d	NTSWAC ^h POC ^g
Polychlorinated Biphenyls	TSCA ^j	NRS 459.400 - 459.600 ^e NAC 444.940 - 444.9555 ^l
Asbestos	TSCA ^k	NAC 444.965-444.976 ^m

^aNevada Revised Statutes (NRS, 1998a)

^bNevada Administrative Code (NAC, 2002a)

^cNevada Test Site Sewage Lagoons, Nevada Division of Environmental Protection (NDEP, 1999)

^dResource Conservation and Recovery Act (CFR, 2001a)

^eNevada Revised Statutes (NRS, 1998b)

^fNevada Administrative Code (NAC, 2002b)

^gPerformance Objective for the Certification of Nonradioactive Hazardous Waste (BN, 1995)

^hNevada Test Site Waste Acceptance Criteria, Revision 4 (NNSA/NV, 2002b)

ⁱArea 6 Hydrocarbon Landfill, Nevada Division of Environmental Protection (NDEP, 1997)

^jToxic Substance Control Act (40 CFR 761) (CFR, 2001b)

^kToxic Substance Control Act (40 CFR 763) (CFR, 2001c)

^lNevada Administrative Code (NAC, 2002c)

^mNevada Administrative Code (NAC, 2002d)

NA = Not applicable

to limit the unnecessary generation of hazardous and/or mixed wastes. Decontamination activities will be planned and executed to minimize the volume of rinsate.

5.2 *Potential Waste Streams*

Process/historical knowledge was reviewed during the DQO process to identify suspect contaminants that may have been released at a particular site and to identify waste types that may be generated during the investigation process. The types of IDW that may be generated include low-level radioactive waste (LLW), mixed wastes (LLW and hazardous waste), radioactive/PCB waste, hydrocarbon waste, hazardous waste, PCB waste, and sanitary waste. Investigation-derived wastes typically generated during investigation activities may include one or more of the following:

- Media (e.g., soil)
- PPE and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls)
- Decontamination rinsate
- Field-screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminated by field-screening activities)
- Construction or other nonhazardous debris

All waste from CAU 204 will be evaluated against characteristic standards as no RCRA-listed constituents have been identified. Each waste stream generated will be segregated to the greatest extent possible. Waste will be traceable to its source and associated environmental media samples.

5.3 *Investigation-Derived Waste Management*

The on-site management and ultimate disposition of IDW may be guided by several factors, 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. Management requirements for sanitary, low-level, hazardous, or mixed wastes are discussed in the following sections.

5.3.1 Sanitary Waste

Sanitary waste will be packaged in plastic bags or an appropriate receptacle and will be transported to a solid waste management unit. The IDW generated within the controlled area will be swiped and/or surveyed, as appropriate to determine if the removable contamination is under the limits defined in Table 4-2 of the current *NV/YMP Radiological Control Manual* (DOE/NV, 2000c). The IDW will be characterized as radioactive or “nonradioactive” based on results.

5.3.2 Hydrocarbon Waste

The action level for soil contaminated with hydrocarbons is 100 mg/kg in the State of Nevada (NAC, 2002e). Soils and associated IDW with TPH levels above 100 mg/kg, provided that other regulated constituents are below regulatory limits, shall be managed as hydrocarbon waste and disposed of in accordance with all applicable regulations.

5.3.3 Hazardous Waste

This CAU will have hazardous waste accumulation areas (HWAAs) and/or satellite accumulation areas (SAAs) to accumulate waste that potentially is classified as hazardous. The HWAAs will be properly controlled for access and will be equipped with spill kits and appropriate spill containment. All containers in HWAAs will be managed consistent with the requirements of 40 *Code of Federal Regulations* (CFR) 265 Subpart I. A “Hazardous Waste Pending Analysis” (CFR, 2001a) marking will be placed on the containers of waste until such time that waste characterization is complete. Once the waste is characterized, containers of waste determined to be hazardous will be clearly marked or labeled with the words “Hazardous Waste.” The HWAAs will be inspected weekly and 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 accumulation area.

If SAAs are established, they will be managed in accordance with 40 CFR 262.34(c) (CFR, 2001a). The SAAs may be employed to temporarily accumulate small quantities of hazardous or potentially hazardous waste.

5.3.3.1 PPE/Equipment

Personal protective equipment, disposable sampling equipment, and debris will be visually inspected for gross contamination (e.g., clumps of soil) and segregated as it is generated. Grossly contaminated PPE/equipment will be managed as potentially “characteristic” hazardous waste. This segregated population of waste will either be (1) assigned characterization based on analysis of the soil that was sampled, (2) sampled directly, or (3) undergo further evaluation using the soil sample results and the amount of soil present in the waste to determine waste characteristics. Waste that is determined to be hazardous will be entered into an approved waste management system (i.e., any appropriate facility used for the storage, treatment, or disposal of hazardous IDW generated during FFACO site investigations), where it will be managed and dispositioned according to the requirements of RCRA or subject to agreements between NNSA/NV and NDEP.

The PPE/equipment that is not visibly stained, discolored, or grossly contaminated will be managed as it is generated as nonhazardous waste and disposed of as sanitary or LLW as described in [Section 5.3.1](#).

5.3.3.2 Rinsate

Decontamination rinsate will initially be evaluated using analytical results for samples associated with the rinsate (i.e., soil sample results from excavation or sampling activities associated with the generation of rinsate). Decontamination rinsate at this site will not be considered hazardous waste unless there is evidence that the rinsate displays a RCRA characteristic. Evidence may include such things as hazardous constituents in associated samples, the presence of a visible sheen, pH, or association with equipment/materials used to respond to a release/spill of a hazardous waste/substance. The regulatory status of the rinsate may also be determined 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 the requirements of RCRA or subject to agreements between NNSA/NV and NDEP.

The disposal of nonhazardous rinsate will be consistent with guidance established in current NNSA/NV Fluid Management Plans for the NTS as follows:

- Rinsate that is determined to be nonhazardous and contaminated to less than 5 times *Safe Drinking Water Standards* (SDWS) is not restricted as to disposal.
- Nonhazardous rinsate which is contaminated at 5 to 10 times SDWS will be disposed of in an established infiltration basin, or solidified and disposed of as sanitary or low-level waste depending on the concentration of radioactive contamination, if present.
- Nonhazardous rinsate which is contaminated at greater than 10 times SDWS will be disposed of in a lined basin, or solidified and disposed of as sanitary or low-level waste depending on the concentration of radioactive contamination, if present.

5.3.3.3 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 as a separate waste stream.

5.3.3.4 Soil

This waste stream consists of soil produced during soil sampling, excavation, and/or drilling. Regardless of the COPCs at the site (i.e., listed or not listed), the preferred method for managing this waste stream is to place the material back into the borehole/excavation in the approximate location from which it originated. If this cannot be accomplished, the material will either be managed on site by placement next to the excavation with berming and covering, or by placement in a container(s). Material that is containerized at a site where hazardous constituents are COPCs will be marked "Hazardous Waste Pending Analysis." The disposition of containerized soil may also be deferred until implementation of corrective action at the site.

5.3.4 Low-Level Waste

Suspected low-level waste will be managed in accordance with the contractor-specific waste certification program plan, contractor-specific procedures, and the *Nevada Test Site Waste Acceptance Criteria* (NTSWAC) (NNSA/NV, 2002b). The IDW will be staged at a designated radiological controlled area or radioactive materials area (RMA), pending certification and disposal

under NTSWAC requirements (NNSA/NV, 2002b). Waste drums will be labeled “Radioactive Material Pending Analysis.”

If radiological COPCs are expected at any CAS addressed by this plan, waste may be characterized by incorporating the use of process knowledge, analytical results of direct or associated samples, visual examination, radiological surveys, and swipe results. Direct sampling of the waste may be conducted to aid in determining if a particular waste unit (e.g., drum of soil) contains LLW, as necessary. Waste that is determined to be below the values of Table 4-2 of the current version of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000c), 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 plan. Wastes in excess of Table 4-2 of the current version of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000c) values will be managed as potentially radioactive waste and be managed in accordance with [Section 5.0](#) of this plan, the contractor-specific waste certification program plan, DOE Orders, and the requirements of the NTSWAC (NNSA/NV, 2002b). Potentially radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate shall be staged at a designated RMA 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 Wastes

Mixed waste, if generated, shall be managed in accordance with RCRA (40 CFR 262) (CFR, 2001a) and State of Nevada requirements. Where there is a conflict in regulations or requirements, the most stringent shall apply. For example, weekly inspections per RCRA regulations will be applied to mixed waste even though it is not required for radioactive waste.

In general, mixed waste shall be managed in the same manner as hazardous waste, with additional mandatory radioactive waste management program requirements. Pending characterization and confirmation of its regulatory status, suspected mixed waste will be managed in accordance with applicable regulations and requirements, and will be marked with the words “Hazardous Waste Pending Analysis.” The potentially mixed waste will be managed and dispositioned according to the requirements of RCRA or subject to agreements between NNSA/NV and NDEP, and shall be transported via an approved hazardous 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).

5.3.6 PCB and Radioactive PCB Wastes

The management of PCBs is governed by the TSCA and its implementing regulations in 40 CFR 761 (CFR, 2001b). The PCB contamination may be found as a sole contaminant, or in combination with any of the types of waste discussed in this section. For example, PCBs may be a cocontaminant in soil that contains a RCRA “characteristic” chemical constituent such as lead, resulting in a PCB/hazardous waste. The PCBs may also be a cocontaminant in radioactive wastes (PCB/radioactive waste), in sanitary or hydrocarbon waste (PCB 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, or subject to agreements between NNSA/NV and NDEP.

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 204. [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 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 204 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. It is used to evaluate the performance of analytical methods as well as to evaluate the usability of individual analytical results. Precision is a measure of agreement among a replicate set of measurements of the same property under similar conditions. This agreement is expressed as the relative percent difference (RPD) between duplicate measurements. The method used to calculate 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 is 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

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 204 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 results and matrix spike 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	Detection limits of laboratory instruments 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.

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.

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](#). When laboratory-specific control limits are indicated, they are based on the evaluation at the laboratory on a quarterly basis by monitoring the historical data and performance for each method. 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 judgment about the quality of the reported analytical results. For the purpose of data validation of inorganic analyses, precision is measured in two ways. The RPD is calculated when the sample and its duplicate results are greater than 5 times the contract-required detection limit (CRDL). The absolute difference is calculated and applied to the CRDL when the results are less than 5 times the CRDL. 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 ([Table 6-1](#)) will be assessed based on the analytical method-specific (e.g., VOCs) precision measurements. The analytical method-specific precision measurement is calculated by taking the number of analyses meeting the RPD criteria, dividing that by the total number of analyses with detectable concentrations, and multiplying by 100. 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, is conducted to determine if qualification is warranted.

The evaluation of precision based on duplicate RPD requires that both the sample and its duplicate have concentrations of the target radionuclide exceeding five times their MDC. This excludes many measurements because the samples contain nondetectable or low levels of the target radionuclide. However, the ND method may be used for evaluating duplicate data where the results are less than five times their MDCs. This is based on the measurement uncertainty associated with low-level results. The ND test is calculated using the following formula:

$$\text{Normalized Difference} = \frac{S - D}{\sqrt{(TPU_s)^2 + (TPU_d)^2}}$$

Where:

- S = Sample Result
- D = Duplicate result
- TPU = Total Propagated Uncertainty
- TPU_s = 2 sigma TPU of the sample
- TPU_d = 2 sigma TPU of the duplicate

The control limit for the normalized difference is -1.96 to 1.96, which represents a confidence level of 95 percent.

The criteria to evaluate analytical method performance for precision ([Table 6-1](#)) will be based on the analytical method-specific (e.g., gamma spectrometry) precision measurements. Analytical method-specific precision measurement is calculated by taking the number of analyses meeting the RPD or ND criteria, dividing that by the total number of analyses, and multiplying by 100. 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. Accuracy includes a combination of random error (precision) and systematic error (bias) components that result from sampling and analytical operations. 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). The measure of accuracy is expressed as the percent recovery (%R) (NNSA/NV, 2002b). This is calculated by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100.

6.2.4.1 Accuracy for Chemical Analyses

The %R 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. Matrix spike samples are prepared by adding a known concentration of a target parameter to a specified amount of matrix sample for which an independent estimate of the target parameter concentration is available. Laboratory control samples are prepared by adding a known concentration of a target parameter to a “clean” sample matrix (does not contain

the target parameter). Surrogate samples are prepared by adding known concentrations of specific organic compounds to each sample analyzed for organic analyses (including QC samples).

For organic analyses, laboratory control limits are used for evaluation of %R. They are reevaluated quarterly at the laboratory by monitoring the historical data and performance for each method. The acceptable control limits for inorganic analyses are established in the EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994a).

The %R parameter performance criteria for accuracy will be compared to %R results of spiked samples. This will be accomplished as part of the data validation process. Accuracy values for organic and inorganic analysis that are within the established control criteria indicate that analytical results for associated samples are valid. The %R 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 ([Table 6-1](#)) will be based on the analytical method-specific (e.g., VOCs) accuracy measurements. The analytical method-specific accuracy measurement is calculated by taking the number of analyses meeting the %R criteria, dividing that by the total number of analyses, and multiplying by 100. 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 is prepared by adding a known concentration of the radionuclide being measured to a sample that does not contain radioactivity (i.e., distilled water). This sample is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS is prepared with each batch of samples for analysis by a specific measurement.

The MS samples are prepared by adding a known concentration of a target parameter to a specified field sample with a measured concentration. 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 %R criteria to be used for assessment of accuracy will be the control limits for radiochemical analyses listed in [Table 3-4](#). These criteria will be used to assess qualification of data associated with each spiked sample. This will be accomplished as part of the data validation process. Accuracy values that are within the established control criteria indicate that analytical results for associated samples are valid.

The criteria to evaluate analytical method performance for accuracy ([Table 6-1](#)) will be assessed based on the analytical method-specific (e.g., gamma spectrometry) accuracy measurements. The analytical method-specific accuracy measurement is calculated by taking the number of analyses meeting the %R criteria, dividing that by the total number of analyses, and multiplying by 100. 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 a qualitative evaluation of measurement system performance. It 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. Percent completeness is determined by dividing the total number of valid analyses by the total number of analyses required to meet DQO data needs and multiplying by 100. Problems that may affect completeness include total number of samples sent to the laboratory but not analyzed due to problems with samples (e.g., broken bottles, insufficient quantity, insufficient preservation), samples that were collected and sent but never received by the laboratory, and rejected data. 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 operative procedures.

7.0 Duration and Records Availability

7.1 Duration

After the submittal of the CAIP to NDEP (FFACO milestone date of December 31, 2002), the following is a tentative schedule of activities (in calendar days):

- Day 0: Preparation for field work will begin.
- Day 116: The field work will commence. Samples will be shipped to meet laboratory holding times.
- Day 193: The field investigation will be completed.
- Day 250: The quality-assured laboratory analytical data will be available for NDEP review.
- The FFACO date for the CADD is April 30, 2004.

7.2 Records Availability

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

Adams, S.R., IT Corporation. 1998. Memorandum to R. McCall (Science Applications International Corporation) regarding methodology for determining action levels for CAU 407, the Roller Coaster RADSAFE Area, 16 June. Las Vegas, NV.

AEC, see U.S. Atomic Energy Commission.

American Society for Testing and Materials. 1996. Sections 04.08 and 04.09, "Construction." In the *Annual Book of ASTM Standards*. Philadelphia, PA.

ASTM, see American Society for Testing and Materials.

Author Unknown. Date Unknown. Engineering drawing 5 entitled, "Rad-Safe Reference Map Area 5 Nevada Test Site Radecon Branch." Las Vegas, NV.

Bechtel Nevada. 1995. *Nevada Test Site Performance Objective Criteria 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*. Prepared by S.C. Black and Y.E. Townsend. Las Vegas, NV.

BN, see Bechtel Nevada.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2001a. Title 40 CFR, "Protection of the Environment," Parts 260-282. Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001b. Title 40 CFR, "Protection of the Environment," Part 761, "PCBs." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001c. Title 40 CFR, "Protection of the Environment," Part 763, "Asbestos." Washington, DC: U.S. Government Printing Office.

Desert Research Institute. 1989. *Nevada Test Site Radionuclide Inventory and Distribution Program: Report #5. Areas 5, 11, 12, 15, 17, 18, 19, 25, 26, and 30*, June. Prepared by R.D. McArthur and S.W. Mead. Las Vegas, NV: Water Resources Center.

DOE, see U.S. Department of Energy.

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

DRI, see Desert Research Institute.

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

EPA, see U.S. Environmental Protection Agency.

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.

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

Hale, G.S, D.A. Trudeau, and C.S. Savard. 1995. *Water-Level Data from Wells and Test Holes Through 1991, and Potentiometric Contours as of 1991 for Yucca Flat, Nevada Test Site, Nye County, Nevada*, USGS WRIR-95-4177. Carson City, NV: U.S. Geological Survey.

Holmes & Narver, Inc. 1957a. Engineering drawing 001-300-E4 entitled, "Electrical Lighting Plan." Las Vegas, NV.

Holmes & Narver, Inc. 1957b. Engineering drawing 001-300-E6 entitled, "Air Conditioning Electrical Plan," 4 November. Las Vegas, NV.

Holmes & Narver, Inc. 1957c. Engineering drawing 001-300-M1 entitled, "Structure 300 Air Conditioning Ductwork Sleeve Layout and Details," 4 November. Las Vegas, NV.

Holmes & Narver, Inc. 1957d. Engineering drawing 001-300-S1 entitled, "Structure No 300, Area - 1, Plan & Section," 31 October. Las Vegas, NV.

Holmes & Narver, Inc. 1957e. Engineering drawing 002-300-E3 entitled, "Equipment Room Electrical Plan & Sections," 18 November. Las Vegas, NV.

Holmes & Narver, Inc. 1957f. Engineering drawing 002-300-M1 entitled, "Structure 300 Air Conditioning Ductwork Sleeve Layout & Details," December. Las Vegas, NV.

Holmes & Narver, Inc. 1957g. Engineering drawing 002-300-S12 entitled, "Modifications & Additions Floor Plans & Details," 24 September. Las Vegas, NV.

Holmes & Narver, Inc. 1957h. Engineering drawing 002-300-S13 entitled, "Modifications & Additions Structural Plan & Sections," 24 September. Las Vegas, NV.

Holmes & Narver, Inc. 1957i. Engineering drawing 003-300-E1 entitled, "Structure No. 300 Area T-3 Electrical Plan & Det.," 15 October. Las Vegas, NV.

Holmes & Narver, Inc. 1957j. Engineering drawing 003-300-M4 entitled, "Structure 3-300 Intake and Exhaust Duct Cover Plan & Details," 21 December. Las Vegas, NV.

Holmes & Narver, Inc. 1957k. Engineering drawing 003-300-S6 entitled, "Modification to Structure No. 300," 26 November. Las Vegas, NV.

Holmes & Narver, Inc. 1958a. Engineering drawing BD.2-300-1 entitled, "Plan & Section," 1 April. Las Vegas, NV.

Holmes & Narver, Inc. 1958b. Engineering drawing BD-3-300-1 entitled, "Plan & Section," 1 April. Las Vegas, NV.

Holmes & Narver, Inc. 1959. Engineering drawing BD.1-300-1 entitled, "Plan & Section," 12 June. Las Vegas, NV.

Holmes & Narver, Inc. 1960. *Facilities Brochure of the Nevada Test Site for the Atomic Energy Commission*, Las Vegas, NV.

Holmes & Narver, Inc. 1990. *Nevada Site Development Plan, Nevada Test Site Building Inventory*, September. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 2001. *ITLV Health and Safety Plan*, February, ITLV/13052--105, Rev. 1. Las Vegas, NV.

IT Corporation. 2002a. CAU 204, CAS 05-18-02 File, "Field Forms," 12 February. Las Vegas, NV.

IT Corporation. 2002b. CAU 204, CAS 05-33-01 File, "Field Forms," 12 February. Las Vegas, NV.

IT Corporation. 2002c. CAU 204, CAS 05-99-02 File, "Field Forms," 12 February. Las Vegas, NV.

Jones, H. Wackenhut Services Incorporated. 2002. Record of telecon with Sarah Cloud (SAIC) concerning CAU 204, 27 February. Las Vegas, NV.

Karathanasis, A.D., and B.F. Hajek. 1982. "Quantitative Evaluation of Water Adsorption on Soil Clays." In *Soil Science Society of America Journal*, 46: 1321-1325. Madison, WI.

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, NV*. As accessed at <http://water.usgs.gov/pubs/wri/wri964109/report.htm> on January 28, 2002. Las Vegas, NV: U.S. Geologic Survey.

LANL, see Los Alamos National Laboratory.

Lawrence Radiation Laboratory. 1960. *LRL- Nevada Safety Manual*, October. Las Vegas, NV.

Lipstate, M., Bechtel Nevada. 1998. Record of meeting with J. Zimpher (SAIC) regarding Bunker 05-99-02. Las Vegas, NV: ITLV.

Los Alamos National Laboratory. 1984. *The Nevada Test Site - Electrical Experience Associated with Blockhouse Recording with Emphasis on Alpha Measurements*, June. Prepared by J. Malik. Los Alamos, NM.

LRL, see Lawrence Radiation Laboratory.

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*.

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

NBMG, see Nevada Bureau of Mines and Geology.

NDEP, see Nevada Division of Environmental Protection.

Nevada Administrative Code. 2002a. NAC 444.570 - 444.7499, "Solid Waste." 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 Biphenyls." 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. 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*, 7 June. Transmittal from P. Liebendorfer (NDEP) to D. Elle (DOE/NV). Carson City, NV.

Nevada Division of Environmental Protection. 1997 (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. 1999. *State of Nevada Water Pollution Control General Permit*, No. GNEV93001. Carson City, NV.

Nevada Revised Statutes. 1998a. NRS 444.440 - 444.620, "Collection and Disposal of Solid Waste." Carson City, NV.

Nevada Revised Statutes. 1998b. NRS 459.400 - 459.600, "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.

Patton, S.E. 1992. *Beryllium in Soils of the Nevada Test Site: A Preliminary Assessment*. Prepared for the USDOE, Nevada Field Office, July. Las Vegas, NV.

RSN, see Raytheon Services Nevada.

Raytheon Services Nevada. Date Unknown a. Engineering drawing JS-002-300-E2 entitled, "Bunker 2-300 Counterproliferation Power Plan." Las Vegas, NV.

Raytheon Services Nevada. Date Unknown b. Engineering drawing JS-002-300-M2 entitled, "Bunker 2-300 Counterproliferation Floor Plan." Las Vegas, NV.

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

Reynolds Electrical & Engineering Co., Inc. Date Unknown a. Drawing 6 24a entitled, "Sugar Bunker-Kay Blockhouse Area." Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. Date Unknown b. Drawing 6 24b entitled, "Sugar Bunker-Kay Blockhouse Area." Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1961. Engineering drawing FR-10-C1 entitled, "Proposed Layout Plan Sugar Bunker Facilities," 11 May. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1990a. *Nevada Test Site Environmental Compliance Inventory Form*, 9 September. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1990b. *Nevada Test Site Environmental Compliance Inventory Form*, 8 October. Compiled by J.R. Boland. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1991. *ECI Project Cleanup Reports FY 1991*, 30 August. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1992. *Detailed Site Activity Summary NTS Cleanup and Restoration*, 14 May. Las Vegas, NV.

Shaw E&I, see Shaw Environmental & Infrastructure, Inc.

Shaw Environmental & Infrastructure, Inc. 2002. *Results of Geophysical Survey Selected FFACO Sites Nevada Test Site*, 27 September. Sacramento, CA.

Silas Mason Co. 1956. Engineering drawing FRK-S2 entitled, "Structural Plan Kay Blockhouse," 5 December. 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.

Soil Science Society of America. 1986. *Methods of Soil Analysis*, 2nd Edition, Part 1. Madison, WI.

Sorom, E.R., Reynolds Electrical & Engineering Co., Inc. 1992. Transmittal to L. Whiteside (ITLV) entitled, "Contaminated Areas Report," 23 October. Las Vegas, NV.

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.

USACE, see U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. 1970. "Laboratory Soils Testing." In *Engineering Manual* 1110-2-1906, Appendix II. Washington, DC.

U.S. Atomic Energy Commission. 1953. *Technical Structures and Operations*, 14 March. Las Vegas, NV.

U.S. Atomic Energy Commission. 1963. Communique entitled, "Drop Vulnerability Test was Conducted on an Inert XW-55 Subrock at Kay Bunker in Frenchman Flats," 14 November. Las Vegas, NV.

U.S. Atomic Energy Commission. 1965. Readiness briefing notes entitled, "Diluted Waters Readiness Briefing Notes," 15 June. Mercury, NV.

USC, see *United States Code*.

U.S. Department of Energy. 1997. *Environmental Measurements Laboratory Procedures Manual*, 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. 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. 1997. *Integrated Safety Management Policy*, DOE/NV Order NV P 450.4. 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. *Nevada Test Site Annual Site Environmental Resource Report for Calendar Year 1998*, DOE/NV/11718-361. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000a. *Nevada Test Site Contaminated Land Areas Report Volume I*, DOE/NV/11718--481-Vol I. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000b. *Nevada Test Site Contaminated Land Areas Report Volume II*, DOE/NV/11718--481-Vol II. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000c. *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. Department of Energy, Nevada Operations Office. 2001. *Nevada Test Site Guide*, November, DOE/NV-715. Las Vegas, NV.
- U.S. Ecology and Atlan-Tech. 1992. *Environmental Monitoring Report for the Proposed Ward Valley, California, LLRW Facility*. Rosewell, GA.
- 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 Evacuating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, CD-ROM PB97-501928GEI. 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. 2000. Memorandum from S.J. Smucker to PRG table mailing list regarding *Region IX Preliminary Remediation Goals (PRGs)*, 1 August. San Francisco, CA.

- 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 1 May. Washington, DC.
- U.S. Geological Survey. 1975. *Hydrogeologic and Hydrochemical Framework, South Central Great Basin Nevada-California, with Special Reference to the Nevada Test Site*, U.S. Geological Survey Professional Paper 712-C. Prepared by I.J. Winograd and W. Thordarson. 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.
- USGS, see U.S. Geological Survey.
- van Genuchten, M. 1980. "A Closed Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils." In *Soil Science Society of America Journal*, 44: 892-898. Madison, WI.
- Wyller, S. 2002a. Memorandum to J. Follette (IT) entitled, "Additional Information Pertaining to the RAR dated 9/14/02 for CAS 05-18-02, Sugar Bunker," 18 September. Las Vegas, NV.
- Wyller, S. 2002b. Memorandum to J. Follette (IT) entitled, "Supplemental Information Pertaining to Radiological Awareness Report for Kay Blockhouse," 3 August. Las Vegas, NV.

Appendix A.1

Data Quality Objectives

A.1 Seven-Step DQO Process for CAU 204 Investigations

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 close in place). The DQO process is a seven-step process as follows:

- 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 CAU 204 DQOs were developed using this seven-step process, and each step is discussed in detail in this appendix.

Background Information on CAU 204

Corrective Action Unit 204 is comprised of the following CASs:

- 01-34-01, Underground Instrument House Bunker
- 02-34-01, Instrument Bunker
- 03-34-01, Underground Bunker
- 05-18-02, Chemical Explosives Storage
- 05-33-01, Kay Blockhouse
- 05-99-02, Explosives Storage Bunker

Corrective Action Sites 01-34-01, 02-34-01, and 03-34-01 are in areas associated with the T-1, T-2, and T-3 atmospheric nuclear test series, respectively. Widespread radiological contamination is expected at the three sites as a result of these atmospheric tests. Because of this, the investigation of radiological contamination associated with these tests will be limited to the interior of the bunkers. Exterior radiological contamination due to these tests will not be addressed in this investigation because exterior contamination associated with atmospheric testing will be addressed by the Soils

Project. However, any radiological contamination encountered during the investigation that is not related to atmospheric tests will be included in the CAU 204 investigation.

According to historical documentation and interviews, all of the CAU 204 sites are classified as magazine/bunkers. At CASs 05-18-02 and 05-33-01, the sites include areas near the bunker where other activities were conducted or are identified as related to the bunkers themselves. The following text is provided as background information for the sites in CAU 204. Additional background information is presented in the CAIP.

CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker

These three CASs are all similar in construction, purpose, and use. The bunkers have soil and asphalt roofs and a concrete walkway leading to the bunkers. The three bunkers were instrumentation locations for the T-1, T-2, and T-3 atmospheric test series, respectively. Each of the bunkers are located approximately 3,000 ft from the zero point for their respective atmospheric tests.

CAS 05-18-02, Chemical Explosives Storage

This CAS is a bunker location commonly referred to as Sugar Bunker. The site consists of the Sugar Bunker and attached small bunker, and two cellar units. This bunker was the location of a series of tests using HE. The location was also the primary control station for the Diluted Waters underground test, which was a line-of-sight, hydrodynamic test.

CAS 05-33-01, Kay Blockhouse

The main feature of the Kay Blockhouse CAS is a bunker. However, the site also includes a surrounding area where activities associated with non-nuclear explosives tests were conducted. The site consists of a bunker, a wood and steel structure near the bunker, insulated piping and debris, two open pits, two burn pits with steel frames, a burn pit with soil berm, two steel-lined burn pits, one berm and piping, an underground structure and berm with piping debris, and a burn area and open pit located near the western edge of the site. It is not clear whether the Kay Blockhouse has a concrete floor or a wooden floor.

CAS 05-99-02, Explosive Storage Bunker

This location was used only as an explosives storage bunker and is commonly referred to as Bunker 803. A review of historical documentation indicates that this bunker has a dirt floor. Historical documentation is limited; however, information indicates that this bunker was used in approximately 1992 during the “Helicopter Program” by WSI. No historical information was found regarding the Helicopter Program. A wooden box that apparently contained explosives or ordnance is presently just inside the door of the bunker. The box appears to be filled with soil; however, the presence of explosives or ordnance below the soil cannot be ruled out.

A.1.1 Step 1 - State the Problem

Step 1 defines the problem that has initiated the CAU 204 site investigation. This step identifies the DQO planning team members, describes the problem, and develops a CSM.

A.1.1.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NV, ITLV, and Bechtel Nevada (BN). The primary decision-makers include NDEP and NNSA/NV representatives.

[Table A.1-1](#) lists representatives from each organization in attendance at the August 13, 2002, DQO meeting.

A.1.1.2 Describe the Problem

Corrective Action Unit 204 is being investigated because:

- The CASs are abandoned sites that were not properly closed and may not comply with the requirements of future land use.
- Hazardous and/or radioactive constituents may be present at concentrations and locations that could potentially pose a threat to human health and the environment.
- Disposed waste may be present without appropriate controls (i.e., use restrictions).

The problem statement for CAU 204 is: “Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for the six CASs.”

**Table A.1-1
DQO Meeting Participants**

Participant	Affiliation
Sean Kosinski	NNSA/NV
Clem Goewert	NDEP
Dan Tobiason	BN
Allison Urbon	BN
R. Lynn Kidman	ITLV
Robert Sobocinski	ITLV
Jill Dale	ITLV
Thomas Thiele	ITLV
Dave Schrock	ITLV
Barbara Quinn	ITLV
Stacey Alderson	ITLV
Joe Hutchinson	ITLV
Jack Ellis	ITLV
Jeanne Wightman	ITLV
Steve Ward	ITLV

BN – Bechtel Nevada
ITLV – IT Corporation, Las Vegas Office
NDEP – Nevada Division of Environmental Protection
NNSA/NV – DOE, National Nuclear Security Administration Nevada Operations Office

A.1.1.3 Develop Conceptual Site Model

The CSM describes the most probable scenario for current conditions at a site and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. An accurate CSM is important as it serves as the basis for all subsequent inputs and decisions throughout the DQO process.

If additional elements are identified during the investigation that are outside of the scope of the CSMs as presented in this section, the situation will be reviewed and a recommendation will be made to revise the DQOs. If this occurs, NDEP will be notified and given the opportunity to comment on, or concur with, the recommendation.

A.1.1.3.1 Conceptual Site Models for CAU 204

An important element of a CSM is the expected fate and transport of contaminants, which describe 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 characteristics of the contaminants and media. Contaminant characteristics include solubility, density, and affinity for nonmobile particles. Media characteristics include permeability, porosity, hydraulic conductivity, composition, and degree of saturation. In general, contaminants with low solubility, high density, and high affinity can be expected to be found relatively close to release points. Contaminants with high solubility, low density, and low affinity can be expected to be found further from release points or in areas where settling may occur. Vapor phase diffusion is limited by the vapor pressure of the contaminant and is expected to be confined to relatively short distances from the contaminant source. Contaminant migration at the NTS that is controlled by these factors would result in contaminant concentrations that decrease with distance from the contaminant source.

Three CSMs have been developed for the six CASs at CAU 204 using historical background information, knowledge from studies at similar sites, and data from previous sampling efforts. The CSMs are termed Interior Bunker Release (CSM #1), Surface Debris/Burn Area (CSM #2), and Subsurface Debris/Burn Area (CSM #3). The applicability of the CSMs to each CAS is summarized in [Table A.1-2](#). As shown in [Table A.1-2](#), contaminant release and exposure at CAS 05-33-01 is covered by all of the CSMs; a single CSM will only cover a portion of the CAS. The CSMs are discussed in the following sections and depicted in [Figures A.1-1, A.1-2, and A.1-3](#).

Table A.1-2
CSMs and Associated CASs

Conceptual Site Model (CSM)	01-34-01	02-34-01	03-34-01	05-18-02	05-33-01	05-99-02
Interior Bunker Release (#1)	X	X	X	X	X	
Surface Debris/Burn Area (#2)	X ^a	X ^a	X ^a	X	X	X
Subsurface Debris/Burn Area (#3)					X	

X - The CSM applies to this CAS.

X^a - The CSM may apply to this CAS, depending upon site conditions.

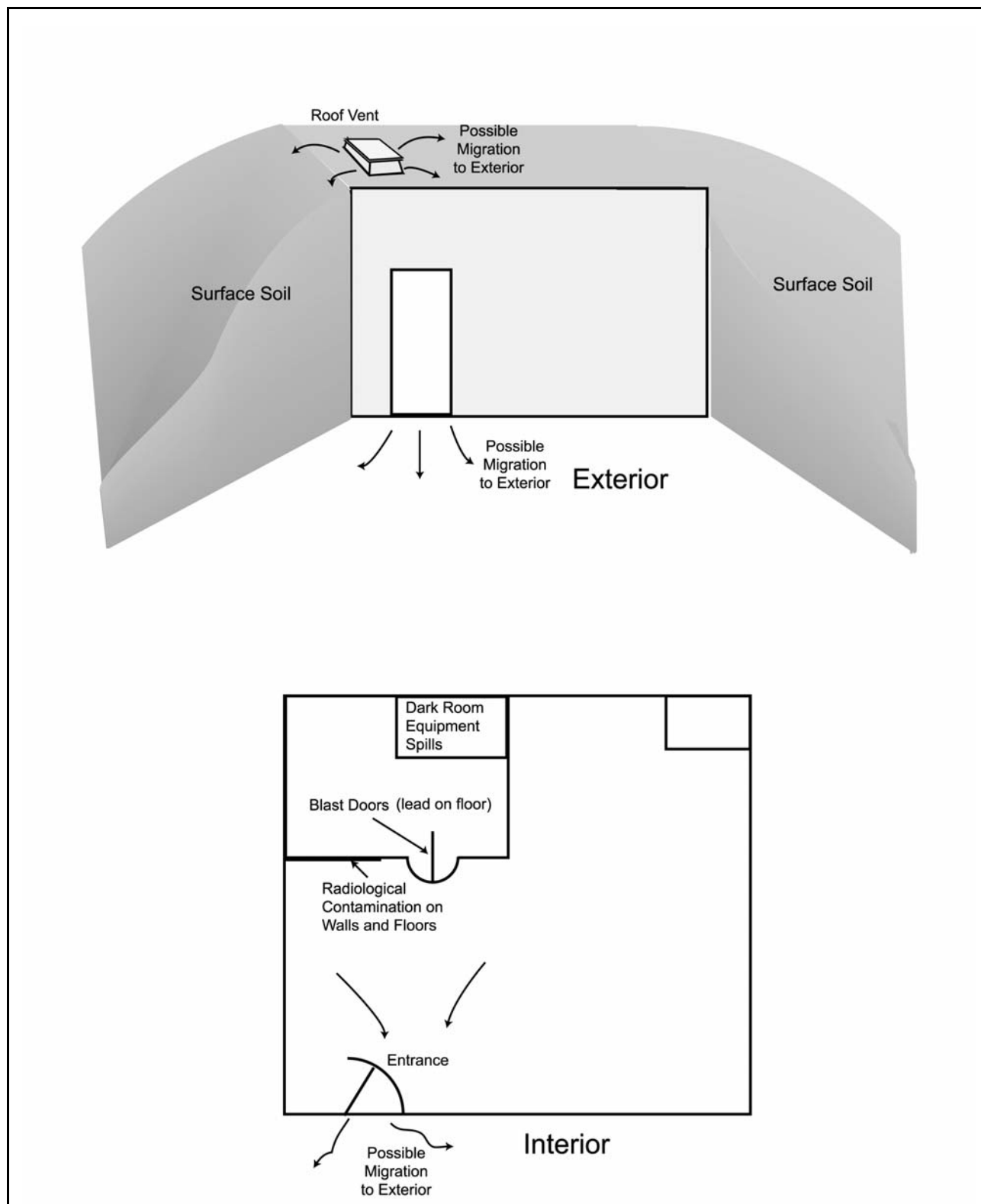


Figure A.1-1
CAU 204, Conceptual Site Model #1,
Bunker Interiors and Potential Migration

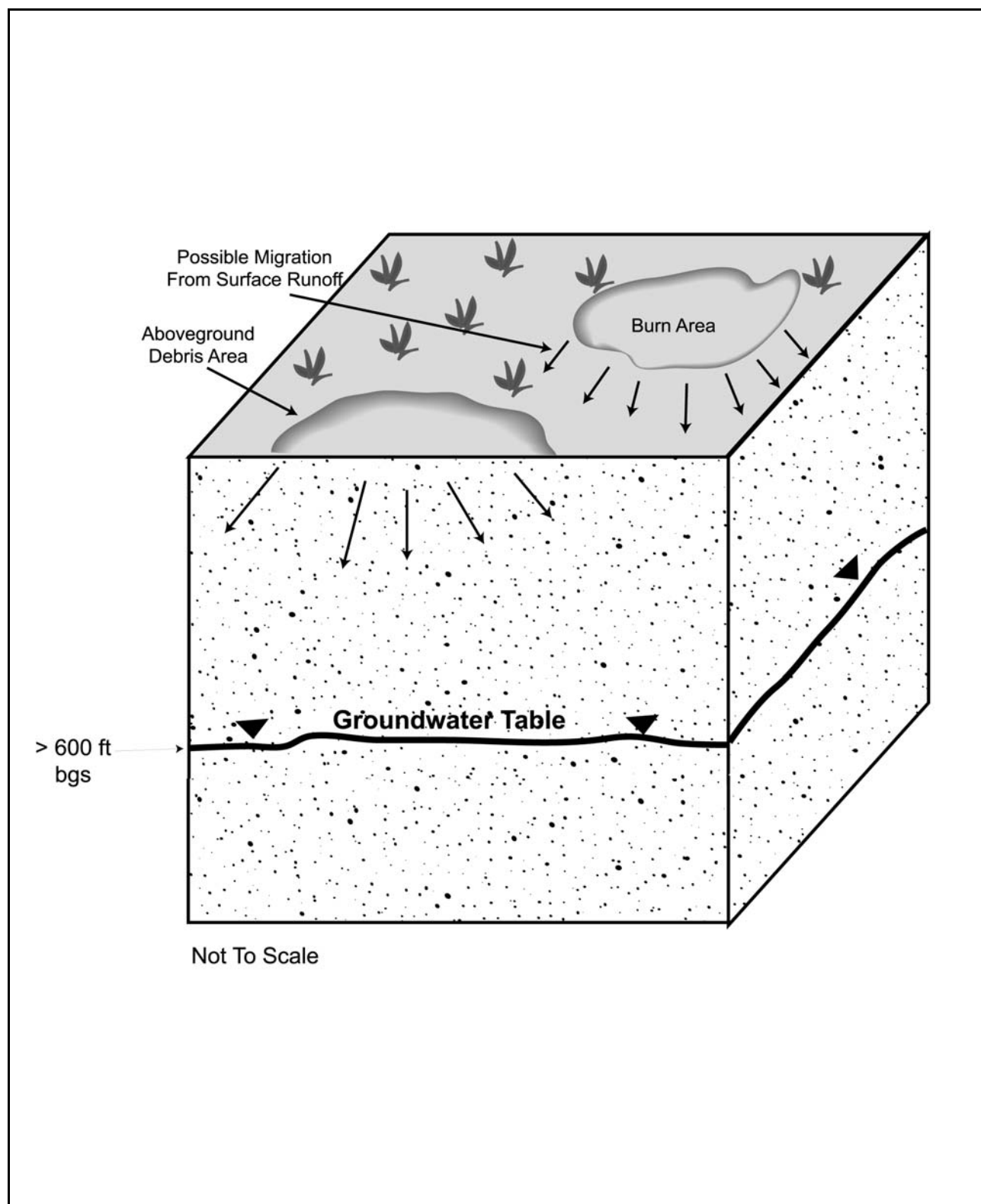


Figure A.1-2
CAU 204, Conceptual Site Model #2,
Surface Debris/Burn Area

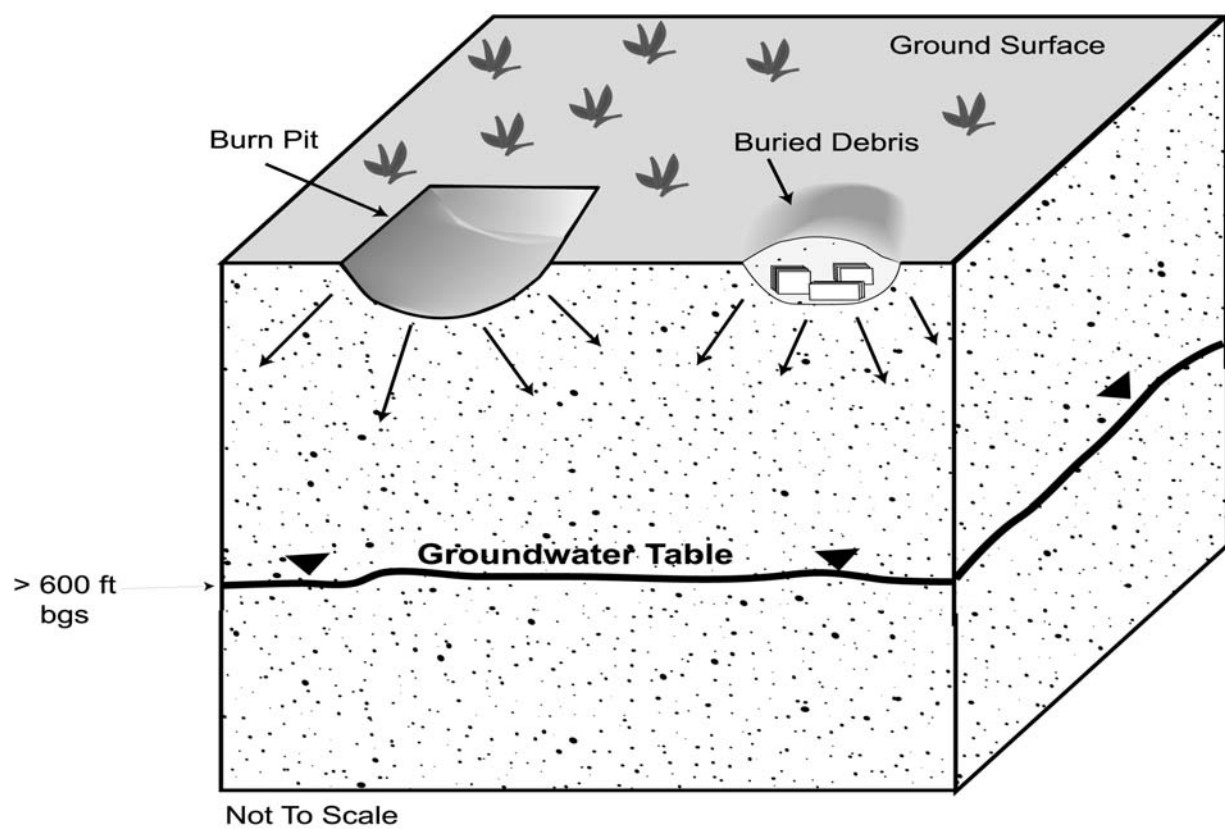


Figure A.1-3
CAU 204, Conceptual Site Model #3,
Subsurface Debris/Burn Area

A review of historical documentation indicates that there was possible storage and/or release of explosives, petroleum hydrocarbons, and hazardous and/or radiological materials at CAU 204 locations. Based upon these CSMs, contamination would be attributable to a release to the interior of the bunkers, or to the surface or subsurface soils. The interiors of all bunkers/structures have concrete floors and walls with the exception of CAS 05-99-02, which has a dirt floor, and CAS 05-33-01 which may have a wooden floor.

Interior Bunker Release Conceptual Site Model (CSM #1)

Figure A.1-1 shows a generalized representation of CSM #1. Instrumentation and equipment used for various tests and/or climate control systems were present at one time in the interior at these CASs. If a liquid spill or release occurred within one of these bunkers, the liquid-containing potential contaminants may have migrated through the doors of the structure. Contaminants may have penetrated the surface of the concrete, especially if cracks were present within the area impacted by the release. However, any penetration of the concrete would be minor, and it is highly unlikely that contamination would have reached the underlying soil. Lateral migration within the bunker is possible; however, based upon the bunker design, migration to the environment is improbable. Vertical migration is unlikely due to the practically impermeable concrete floor of the bunkers, unless a significant release occurred and the release was able to migrate beyond the exterior door of the bunker, or the release was in an area of substantial cracking in the concrete floor. Thus, even though a release may have occurred within the bunker, it is highly unlikely that the release migrated to the outside environment. In addition, there is no evidence that large volumes of materials capable of migration were ever used in the bunkers.

If an airborne release occurred within a bunker, the airborne contaminants may have migrated to the environment through the exterior door or ventilation system of the bunker. If this occurred, airborne contaminants could be deposited on the surfaces within the ventilation system, and possibly on the ground surface outside the doors and/or vents. It would be expected that contaminant levels decrease with distance from the bunker.

This CSM predicts that the concentration of the contaminants would be highest in the immediate vicinity of a release to the environment, and would decrease with distance (both horizontally and vertically) from the release. It should be noted that even if a release occurred within the bunker,

migration to the environment did not necessarily occur, and thus sampling of media outside of the bunker may not be necessary. The decision to sample media outside of the bunker will be based upon biasing factors within the bunker and the results of interior bunker samples that may be required to confirm a release. Additionally, as discussed previously, any exterior contamination caused by the atmospheric nuclear tests for which CASs 01-34-01, 02-34-01, and 03-34-01 were constructed is outside of the scope of this investigation and no sampling outside of the bunker will be specifically performed to verify contamination due to these tests. Contamination within the bunker attributable to these tests will be quantified, as described in [Section A.1.4](#).

Surface Debris/Burn Area Conceptual Site Model (CSM #2)

This CSM predicts that contamination originating above the ground or at the ground surface may exist due to activities that occurred at the sites. CSM #2 is depicted in [Figure A.1-2](#).

This CSM includes burn areas or areas where materials/wastes may have been stored, disposed of, burned, or otherwise impacted soil at the ground surface. Contaminants may have been released due to these activities, which would have caused contamination originating at the surface. These areas are specific locations within the CAS that were identified based upon process knowledge and site visits. Contaminants would be expected to migrate away from the release point, primarily downward, and to a lesser degree horizontally, although runoff may have occurred prior to infiltration into the surface soil. This CSM predicts that the concentration of contaminants would be highest in the immediate vicinity and directly below the surface release location, and would decrease with distance, both horizontally and vertically. If friable asbestos or ACMs are present, the asbestos could become airborne if disturbed.

Subsurface Debris/Burn Area Conceptual Site Model (CSM #3)

This CSM predicts that subsurface contamination may exist due to activities that occurred in the shallow subsurface at the site. CSM #3 is depicted in [Figure A.1-3](#). This CSM includes burn areas or areas where materials/wastes may have been stored, disposed of, burned, or otherwise impacted subsurface soil at the site. Contaminants may have been released due to these activities, which would have caused contamination originating below the ground surface. These areas are specific locations within the CAS that were identified based upon process knowledge and site visits. Contaminants would be expected to migrate away from the release point, primarily downward, and to a lesser

degree horizontally. This CSM predicts that the concentration of contaminants would be highest in the immediate vicinity and directly below the disturbed soil location. If a release occurred under this CSM, the location most likely to be contaminated would be at the soil interface directly below the release. If friable asbestos or ACMs are present, the asbestos could become airborne if disturbed.

The following sections provide additional information on CSMs #1, 2, and 3.

Future Land-Use Scenarios

Future land-use scenarios limit future uses of the CASs to various nonresidential (i.e., industrial) uses (DOE/NV, 1998). The future land-use scenarios for CAU 204 are presented in [Table A.1-3](#).

**Table A.1-3
Future Land-Use Scenarios for CASs Within CAU 204**

CAS	Land Use Zone	Zone Description
01-34-01 02-34-01 03-34-01	Nuclear and High Explosives Test	This area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities. (DOE/NV, 1998)
05-18-02 05-33-01 05-99-02	Reserved (within 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 and Federal Radiological Monitoring and Assessment Center training and U.S. Department of Defense land-navigation exercises and training. (DOE/NV, 1998)

Exposure scenarios for sites located within the NTS boundaries are limited by the future land-use scenarios to site workers who may be exposed through oral ingestion, inhalation, or dermal contact (absorption) of contaminants associated with soils and/or objects (e.g., debris) due to inadvertent disturbance of these materials. An additional exposure pathway for workers is through external exposure to beta/gamma radiation at sites containing radiological contamination.

Affected Media

For CSM #1, Interior Bunker Release, the potentially affected media are concrete inside and outside the bunkers, and the surface and subsurface soils outside the bunkers, adjacent to exterior doors and ventilation exit points. If contamination is found at any of these points, potential migration to soil

outside the bunker may need to be considered. For CSM #2, Surface Debris/Burn Area, the potentially affected media are surface and subsurface soils. For CSM #3, Subsurface Debris/Burn Area, the potentially affected media are subsurface soils.

Based upon these CSMs, contamination found at the CAU 204 CASS would be attributable to a release to the interior of the bunkers, or to the surface or subsurface soils. Insufficient records are available for many of these areas; therefore, the information related to the COPCs is based upon limited historical documentation, interviews with current/former site employees, and site visits.

Location of Contamination/Release

For CSM #1, any releases to the environment would first occur within the interior of the bunker and then would have had to migrate out of the bunker and into the soil outside the bunker. For airborne contaminants, releases would first be to the air within the bunker and then through the vents or exterior door to the soil outside. Under this scenario, the surface soil adjacent to the vents or door would have been the most likely point of release to the environment. Contamination may also be found in subsurface soils, if sufficient contamination migrated to the exterior of the bunker. If the contaminant migrated to the environment via the vents or door, the contamination will be covered under CSM #2. For CSM #2, the release would have been to surface soils. Therefore, contamination would be expected in the surface and possibly subsurface soils. For CSM #3, the release would have been below the ground surface and, thus, only subsurface contamination is expected. Migration of contamination for all the CSMs would be expected to be primarily downward, with horizontal migration to a lesser extent. For CSMs #1 and #2, some horizontal migration on the ground surface prior to infiltration is possible. For all CSMs, the presence of relatively impermeable layers (e.g., concrete or caliche) may influence both lateral and vertical migration.

Transport Mechanisms

The degree of contaminant migration at these sites is unknown, but it is assumed to be minimal based on impervious surfaces (for CSM #1), low precipitation, and high evapotranspiration rates. Runoff could cause lateral migration of contaminants over the ground surface for both CSMs #1 and #2. Contaminants may also have been transported by infiltration and percolation of precipitation through soil, which would serve as a driving force for downward migration. See "Lateral and Vertical Extent

of Contamination” for additional information. Friable asbestos could become airborne if disturbed, and transported by wind to become an air and surface soil contaminant.

Preferential Pathways

Preferential pathways for contaminant migration are not expected for the CAU 204 CASs. As discussed previously, the presence of relatively impermeable layers could modify transport pathways both on the ground surface (e.g., concrete floors at CSM #1) and in the subsurface (e.g., caliche layers for CSMs #2 and #3). Contamination would travel laterally prior to infiltration, under CSM #1. Under CSMs #2 and #3, contamination may travel laterally, if the contamination encountered an impermeable layer in the subsurface soil. The potential effect of these will be considered in the development of sampling schemes and sampling contingencies discussed in the CAIP.

Lateral and Vertical Extent of Contamination

Contamination, if present, is expected to be confined to the release site. Concentrations of contamination are expected to decrease with distance and depth from the release.

Surface migration may occur as a result of storm events when precipitation rates exceed infiltration rates (stormwater runoff). However, these events are infrequent. Surface migration is a biasing factor considered in the selection of sampling points.

As stated previously, downward contaminant transport is expected to be very limited. Subsurface migration will be influenced by the geophysical properties of the soil, such as permeability, porosity, and conductivity. The vertical migration of contaminants is expected to be limited due to the lack of a driving force (minimal infiltration). Migration of certain constituents (i.e., metals, radionuclides) will also be controlled to varying degrees by geochemical processes, such as adsorption, ion exchange, and precipitation of solids from solution.

Groundwater contamination is not considered a likely scenario at CAU 204, due to the factors described above minimal precipitation, high evapotranspiration, and significant depths to groundwater. For example, well depths in Area 5 are recorded between 887 ft bgs at Well WW-5a to 2,862 ft bgs at UE-5c WW (USGS, 2002).

A.1.1.3.2 Contaminants of Potential Concern and Suspected Contaminants

Contaminants of potential concern are defined as the analytes reported by the analytical program listed in [Table A.1-6](#) that are also listed in the *Region IX Preliminary Remediation Goals* (EPA, 2000), or the IRIS Database (EPA, 2002). Suspected contaminants are defined as the chemicals, substances, or materials identified during a preliminary assessment that can be expected to be present due to activities related to the site. The CAS-specific list of suspected contaminants was developed based on process knowledge of the CASs, review of historic documents, past investigations at related CASs, and interviews with former site employees. Suspected contaminants will be used to assist in the identification of data needs, and are summarized below, with supporting information about how they were developed. As complete information regarding activities performed at these sites as well as throughout the NTS is unavailable, some uncertainty as to the comprehensive list of potential contaminants exists. Due to this uncertainty, constituents (in addition to the suspected contaminants) have been included in the analytical program for the investigation of CAU 204. The analytical program for each CAS is provided in [Section A.1.3.3](#).

CAS 01-34-01, Underground Instrument House Bunker; CAS 02-34-01, Instrument Bunker; and CAS 03-34-01, Underground Bunker

The suspected contaminants at each of these sites are similar. Based upon historical information, the suspected contaminants for these CASs are radionuclides (from the atmospheric tests) americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium-152 (Eu-152), Eu-154, plutonium-238 (Pu-238), Pu 239/240, and strontium-90 (Sr-90). Other suspected contaminants are: lead from bricks, pipes, and doors; PCBs and petroleum hydrocarbons from electrical equipment; and for CAS 02-34-01 only, silver nitrate from photo processing.

CAS 05-18-02, Chemical Explosives Storage

Corrective Action Site 05-18-01 includes a bunker that will be addressed similar to CASs 01-34-01, 02-34-01, and 03-34-01. Radiological-suspected contaminants for this CAS are DU, Am-241, Co-60, Cs-137, Eu-152, Eu-154, Pu-238, Pu-239/240, Sr-90, and U-235. Other suspected contaminants are HE, PCBs, beryllium (Be), hydraulic oil, gasoline, lead, and asbestos.

CAS 05-33-01, Kay Blockhouse

Corrective Action Site 05-33-01, Kay Blockhouse, includes a bunker that will be addressed similar to CASs 01-34-01, 02-34-01, and 03-34-01; however, the site also includes a surrounding area where activities associated with nonnuclear explosives tests were conducted.

This CAS includes suspected contaminants on the surface as well as below grade. Radiological-suspected contaminants associated with this site include DU, Am-241, Co-60, Cs-137, Eu-152, Eu-154, Pu-238, Pu-239/240, Sr-90, and U-235. Other suspected contaminants are Be, HE, acetone, kerosene, hydraulic oil, pyrolytic oil, PCBs, and asbestos.

CAS 05-99-02, Explosive Storage Bunker

The floor of this bunker is dirt and, thus, contamination may have migrated to the surface soils from within the bunker. The suspected contaminants at this site are limited to HE resulting from storage of explosives and application of rodenticide. The only rodenticides identified with action levels are warfarin, an organic compound, and zinc phosphide, an inorganic compound. Of these, only zinc phosphide use is documented for the NTS. No documentation regarding rodenticide use or identification specific to the CAS 05-99-02 bunker was found.

A.1.2 Step 2 - Identify the Decision

This step develops decision statements and defines alternative actions.

A.1.2.1 Develop Decision Statements

The primary problem statement is: “Is sufficient information available to evaluate and recommend corrective action alternatives?” Because existing information at each CAS is insufficient to resolve this problem statement, the following two decision statements have been established as criteria for determining the adequacy of the data collected during the investigation:

- Decision I: “Is the nature of contamination defined?”
- Decision II: “Is the extent of contamination defined?”

A.1.2.2 Alternative Actions to the Decisions

- Decision I: If a COC is not present, further assessment of the CAS is not required.
- Decision II: If a COC is present and its extent is defined in the lateral and vertical directions, further assessment of the CAS is not required. If the extent is not defined, reevaluate site conditions and collect additional samples.

A.1.3 Step 3 - Identify the Inputs to the Decisions

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 can meet the data requirements. To determine if a COC is present (define the nature of the contamination), each sample result is compared to a PAL ([Section A.1.3.2](#)). If any sample result is greater than the PAL, the vertical and lateral extent of the contamination is determined via additional sampling. This approach does not use a statistical mean/average for comparison to the PAL, but rather the individual result to identify COCs.

A.1.3.1 Information Needs and Information Sources

In order to determine the nature of a COC at a particular CAS, sample data must be collected and analyzed following these two criteria: (1) samples must be collected in areas most likely to be contaminated (e.g., a stained area or soil immediately beneath debris), and (2) the analytical suite selected must be sufficient to detect any contamination present in the samples.

Biasing factors to support criteria #1 include:

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

In order to determine the extent of a COC, samples must be collected from locations to bound the lateral and vertical extent. The data required to satisfy the information need is a sample analytical result from each location that demonstrates that each COC concentration is below the corresponding

PAL. Generally, three lateral step-out samples and one vertical sample will be collected around a location or area where the PAL has been exceeded for one or more COCs. The lateral samples will be located a maximum of 15 ft from the previous location, while the vertical samples will generally begin 2 ft below the depth where COCs have been detected. The lateral step-out distance will generally be based upon the size of the already determined contaminated area. The step-outs for small areas will be just a few feet from the previous contaminated locations; whereas, on large contaminated areas, the step-outs will increase to as much as 15 ft. When indicators or biasing factors indicate that the COC concentration at the step-out location may still exceed the PAL, then an additional step-out distance may be used to collect the analytical sample. If the location where the PAL is exceeded is surrounded by clean locations, then lateral step-outs may not be necessary. In that case, sampling may consist only of sampling from deeper intervals at or near the original location to determine the vertical extent of contamination. Step-out locations may be moved due to access or safety issues; however, the modified locations must meet the decision needs and criteria necessary to fulfill the information needs.

Samples for extent of contamination will only be analyzed for those parameters that exceeded PALs (i.e., COCs) in previous samples. Biasing factors to support selection of extent of contamination sampling locations may include:

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

[Table A.1-4](#) (Decision I) and [Table A.1-5](#) (Decision II) list the information needs, the source of information for each need, and the proposed methods to collect the data. The last column addresses the QA/QC data type and associated metric. The data type is determined by the intended use of the resulting data in decision making. Data types are discussed below.

Table A.1-4
Information Needs to Resolve Decision I
(Page 1 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision: Define nature of contamination. Criteria 1: Samples will be collected in areas most likely to contain COCs.				
Source and location of release points	Process knowledge compiled during a preliminary assessment and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Not Applicable	Qualitative – CSM has not been shown to be inaccurate
	Field observations	Conduct site visits and document field observations	Visible evidence of release	Qualitative – CSM has not been shown to be inaccurate
	Geophysical surveys	Perform geophysical surveys using appropriate methods	Bias locations based upon areas of visible or likely surface contamination, also areas of subsurface contamination based on historical information and/or process knowledge	Semiquantitative – Sampling based on biasing criteria stipulated in DQO Step 7
	Radiological surveys	Perform radiological surveys using appropriate methods	Bias locations based upon areas of visible or likely surface contamination	Semiquantitative - Locations based on biasing criteria stipulated in DQO Step 7
	Field Screening	Collect soil samples from stained areas or areas likely to have contamination	Bias locations based upon results of process knowledge and field observation	Semiquantitative - Sampling locations based on visual or process knowledge

Table A.1-4
Information Needs to Resolve Decision I
(Page 2 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Nature of contamination	Biased Samples	Generate sampling points based on results of geophysical and radiological surveys and field screening	Send samples with highest survey/screening results to laboratory	Semiquantitative - Sampling based on survey and screening results
	Biased Samples	Additional points will be located near CAS features	Bias locations along/around features	Semiquantitative - Sampling based on CAS features
Decision: Define nature of contamination. Criteria 2: Analyses must be sufficient to detect COCs.				
Identification of all potential contaminants	Process knowledge and previous investigations of similar sites; Use analytical suite in Table A.1-6	Information documented in CSM and public reports – no additional data needed; comprehensive analytical suite developed to account for uncertainty	None	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; Minimum detection limits (MDLs) and minimum detectable activity (MDA) are sufficient to provide quantitative results for comparison to PALS	None	Quantitative – Validated analytical results will be compared to PALS

Decision: Determine if sufficient information exists to characterize waste.
Criteria: Analyses must be sufficient to allow disposal options to be accurately identified and estimated.

Table A.1-4
Information Needs to Resolve Decision I
(Page 3 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Radiological data for comparison to unrestricted release criteria.	Radiological surveys and swipe measurement.	Perform radiological surveys and swipe measurements using appropriate methods.	Bias locations based upon areas of visible or likely surface spills/leaks, and areas of accumulation.	Semiquantitative – Locations based on biasing criteria stipulated in DQO Step 7.
Analytical results	Data packages of analytical results; Use analytical suite in Table A.1-6 ; Require TCLP if results are >20X TCLP limits	Appropriate sampling techniques and approved analytical methods will be used MDLs and MDA are sufficient to provide quantitative results for comparison to disposal requirements	Sufficient material must be available for analysis	Quantitative – Validated analytical results will be compared to disposal criteria

Quantitative Data

Quantitative data measure the quantity or amount of a characteristic or component within the population of interest. These data require the highest level of QA/QC in collection and measurement systems because the intended use of the data is to resolve primary decisions (i.e., rejecting or accepting the null hypothesis) and/or verifying closure standards have been met. Laboratory analytical data are generally considered quantitative.

Semiquantitative Data

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

Table A.1-5
Information Needs to Resolve Decision II

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision II: Determine the extent of contamination. Criteria 1: Data collection and analysis methods must be sufficient to detect COCs.				
Identification of applicable contaminants	Sample data packages	Review analytical results to select COCs	None	Quantitative – Only COCs identified will be analyzed in subsequent samples
Extent of contamination	Field observations	Document field observations	None	Qualitative – CSM has not been shown to be inaccurate
	Field-screening results	Conduct field screening with appropriate instrumentation	Bias locations based upon results of process information and field observations	Semiquantitative – FSRs will be compared to field screening levels
	Analytical results	Appropriate sampling techniques and approved analytical methods will be used to bound COCs	None	Quantitative – Validated analytical results will be compared to PALs to determine COC extent

Qualitative Data

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

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.1.3.2 Determine the Basis for the Preliminary Action Levels

To define both nature and extent, 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:

- EPA Region 9 Risk-Based PRGs for chemical constituents in industrial soils (EPA, 2000)
- Background concentrations for RCRA metals 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 times the standard deviation of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- The TPH action limit of 100 ppm per the NAC 445A.2272 (NAC, 2000)
- 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, 1992; BN, 1996). If an isotope has not been reported in soil samples taken from undisturbed background locations, the PAL will be equal to the minimum detectable activity ([Table 3-4](#)).
- For detected chemical COPCs without established PRGs, a similar protocol to that used by EPA Region 9 will be used in establishing an action level for those COPCs listed in IRIS (EPA, 2002).

At locations such as the CASs in Yucca Flat, surface soil radionuclide concentrations greater than PALs may not be a concern to CAU 204 if the concentrations are associated with fallout from atmospheric nuclear testing. As discussed in [Section A.1](#), potential contamination of bunker exteriors that is related to atmospheric testing will be addressed by the Soils Project.

Solid media such as concrete and/or structures may only pose a potential radiological exposure risk to site workers. Surface radiological surveys of the solid media will be compared to the unrestricted-release criteria, as defined in the *NV/YMP Radiological Control Manual* (DOE/NV, 2000), to evaluate if COPCs are present at levels that may pose an unacceptable risk to human health and/or the environment.

A.1.3.3 Potential Sampling Techniques and Appropriate Analytical Methods

Sampling

Augering, direct-push, excavation, drilling, or other appropriate sampling methods will be used to collect soil samples. Sample collection and handling activities will follow standard procedures. Radiological surveys and swipe collection and measurement will also follow standard procedures.

At all CASs within CAU 204, both site characterization and waste characterization efforts are proposed. Site characterization sampling and analysis are the focus of the DQO process. However, waste characterization sampling and analysis has been addressed to support the decision-making process for waste management, and also to ensure an efficient field program.

Samples from vents, ducts, filters, and equipment may be collected, as appropriate, and submitted for analysis. Specific analyses required for the disposal of IDW are identified in [Section 5.0](#) of the CAIP.

Analytical Program

To ensure that laboratory analyses are sufficient to detect contamination in samples at concentrations exceeding the MRL, chemical and/or radiological parameters of interest have been selected for each CAS. The parameters for each CAS are identified in [Table A.1-6](#). The analytical program was developed based on the suspected-contaminant information presented in [Section A.1.1.3.2](#). Because complete information regarding activities performed at these sites, as well as throughout the NTS, is unavailable, some uncertainty exists regarding the complete list of suspected contaminants at CAU 204. Due to this uncertainty, additional constituents have been included in the analytical program for the investigation. Analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) are specified in the Industrial Sites QAPP (NNSA/NV, 2002), unless superseded by the CAIP.

Critical analytes are defined as the chemicals and radionuclides that are suspected to be present at the CASs based on the suspected-contaminant information presented in [Section A.1.1.3.2](#). Because information such as documented use or process knowledge exists for critical analytes, these analytes are given greater importance in the decision-making process relative to other COPCs. For this reason, more stringent performance criteria are specified for critical analyte data quality indicators

Table A.1-6
Analytical Program
(Includes Site and Waste Characterization Analyses)

Analyses ^a	01-34-01	02-34-01	03-34-01	05-18-02	05-33-01	05-99-02
Organics						
Total Petroleum Hydrocarbons (Diesel- and Gasoline-Range Organics)	X	X	X	X	X	--
Polychlorinated Biphenyls	X	X	X	X	X	X
Semivolatile Organic Compounds	X	X	X	X	X	X
Volatile Organic Compounds	X	X	X	X	X	X
Rodenticide						
Warfarin	--	--	--	--	--	X
Zinc	--	--	--	--	--	X
Metals						
Total Resource Conservation and Recovery Act Metals ^b	X	X	X	X	X	X
Total Beryllium	X	X	X	X	X	X
Other						
Asbestos	X	X	X	X	X	--
Explosives	--	--	--	X	X	X
Radionuclides						
Gamma Spectrometry ^c	X	X	X	X	X	--
Isotopic Uranium	X	X	X	X	X	--
Isotopic Plutonium	X	X	X	X	X	--
Strontium-90	X	X	X	X	X	--

-- = Not applicable

^aIf the volume of material is limited, prioritization of the analyses will be necessary.

^bMay also include Toxicity Characteristic Leaching Procedure metals if sample is collected for waste management purposes.

^cIf americium-241 is detected above the minimum detectable activity, isotopic americium-241 may also be performed on sample.

(Section 6.0 of the CAIP). Table A.1-7 presents the critical analytes for samples collected to define the nature of contamination (Decision I).

Table A.1-7
Critical Analytes for Nature of Contamination (Decision I) Sampling

CAS	Critical Analytes	
	Chemical	Radiological
01-34-01	Lead PCBs ^a TPH (DRO) Silver (for CAS 02-34-01 only)	Americium-241 Cesium-137 Cobalt-60 Europium-152,-154 Plutonium-238,-239/240 Strontium-90
02-34-01		
03-34-01		
05-18-02	Beryllium High Explosives ^c Lead PCBs ^a TPH (DRO and GRO)	Americium-241 Cesium-137 Cobalt-60 Europium-152,-154 Plutonium-238,-239/240 Strontium-90 Uranium-234,-235,-238
05-33-01	Beryllium High Explosives ^c PCBs ^a TPH (DRO and GRO)	
05-99-02	Zinc (associated with rodenticide) High Explosives ^c Warfarin	none

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

For sampling performed to define the extent of contamination (Decision II), on a per CAS basis, samples will be collected and analyzed only for COCs identified in samples collected to resolve Decision I at that CAS. However, if extent samples are collected prior to nature-of-contamination data becoming available, the extent samples will be analyzed for the full list parameters given for each CAS in Table A.1-6. For samples collected to define the extent of contamination, critical analytes are the COCs based on the data from the Decision I samples. These critical analytes may be different than those listed for each CAS in Table A.1-7.

A.1.4 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 that population that are pertinent for decision making, determine practical constraints on data collection, and define the scale of decision making relevant to target populations.

A.1.4.1 Define the Target Population

The target populations for investigation of the nature of contamination (Decision I) represent locations within the CAS that will contain COCs, if they are present. The target populations are dependent upon the CSM(s) applicable to the CAS.

The target populations for investigation of the extent of contamination (Decision II) are areas where COC concentrations are less than PALs that are contiguous to areas of COC contamination.

These target populations represent locations within the system that, when sampled, will provide sufficient data to address data needs discussed in [Section A.1.3](#).

A.1.4.2 Identify the Spatial and Temporal Boundaries

The spatial boundaries that apply to each CAS are listed in [Table A.1-8](#). The smaller horizontal boundaries at CASs 01-34-01, 02-34-01, 03-34-01, and 05-99-02 reflect the better-defined footprint of the area of concern (i.e., bunker) at these CASs relative to CASs 05-18-02 and 05-33-01. As discussed in [Section 1.0](#), contamination related to atmospheric nuclear testing outside the bunkers will be addressed by the Soils Project. Even though this contamination has been “superimposed” on the CAU 204 CASs, it will not be investigated by CAU 204.

Temporal boundaries are time constraints due to time-related phenomena, such as weather conditions, seasons, activity patterns, etc. Significant temporal constraints due to weather conditions are not expected; however, snow events may affect site access during December, January, and February. Moist weather may place constraints on sampling and field-screening of contaminated soils because of the attenuating effect of moisture in samples. 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 sites were last used.

Table A.1-8
Spatial Boundaries Investigation

CAS	Spatial Boundary	
	Horizontal	Vertical
01-34-01	25-ft buffer around the CAS	30 ft bgs
02-34-01	25-ft buffer around the CAS	30 ft bgs
03-34-01	25-ft buffer around the CAS	30 ft bgs
05-18-02	50-ft buffer around the CAS	30 ft bgs
05-33-01	50-ft buffer around the CAS	30 ft bgs
05-99-02	25-ft buffer around the CAS	30 ft bgs

A.1.4.3 Identify Practical Constraints

Nevada Test Site-controlled activities may affect the ability to characterize these CASs, although the sites are generally abandoned without any ongoing activity. [Table A.1-9](#) indicates practical constraints that may be encountered at each CAS.

Table A.1-9
Practical Constraints Identified for CAU 204

CAS	Utilities Likely to be Encountered ^a	Topography/Site Conditions Likely to Affect Planned Activities	Structures (Tanks/Pipes/Bldgs) Likely to Affect Planned Activities	Area Subject to Access Restrictions ^b	Confined Space, Health & Safety, Structural Integrity Issues
01-34-01	yes	no	no	no	yes
02-34-01	yes	no	no	no	yes
03-34-01	yes	no	no	yes	yes
05-18-02	yes	no	yes	no	yes
05-33-01	yes	no	yes	yes	yes
05-99-02	yes	no	no	no	yes

Source: Site visits.

^aUtility constraints are subject to change as detailed information is collected prior to commencement of investigation activities, and will be appropriately documented. All CASs will be surveyed for utilities prior to field activities in accordance with the SSHASP. Does not include underground piping that is included as part of the CAS.

^bAccess restrictions include both scheduling conflicts on the NTS with other entities, and areas posted as contamination areas requiring appropriate work controls, and areas requiring authorized access.

A.1.4.4 Define the Scale of Decision Making

For CASs 01-34-01, 02-34-01, 03-34-01, and 05-99-02, the scale of decision making for the nature of contamination is defined as the CAS. For CASs 05-18-02 and 05-33-01, the scale of decision making is defined as the individual releases within the CAS or area around the point of release.

The scale of decision making for the investigation of the extent of contamination is defined as the maximum extent of COC contamination. Additionally, the scale of decision making for an unrestricted release determination is the entire object/structure (e.g., steel pipe, concrete structure) surveyed.

A.1.5 Step 5 - Develop a Decision Rule

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

A.1.5.1 Specify the Population Parameter

The population parameter will be the observed concentration of each COC within the target population.

A.1.5.2 Choose an Action Level

Action levels are defined as the PALs, which are defined in [Section A.1.3.2](#). As appropriate, action levels may also be the unrestricted release criteria given in the *NV/YMP Radiological Control Manual* (DOE/NV, 2000).

A.1.5.3 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 to resolve nature and extent. The detection limit of the measurement method to be used is less than the PAL for each COPC, unless specified otherwise in the CAIP.

A.1.5.4 Decision Rule

If the concentration of any COPC in a target population exceeds the PAL for that COPC, then that COPC is identified as a COC, and the nature of contamination (Decision I) will be determined. If the COPC concentration is less than the PAL, then the decision will be no further action.

If investigation of the nature of contamination determines that a COC is present, then additional samples will be collected to define extent of contamination (Decision II). If the observed concentrations in the additional samples are less than the PAL, then the decision will be that the extent of contamination has been defined in the vertical and/or horizontal direction.

If contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in [Table A.1-8](#), 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 extent.

A.1.6 Step 6 - Specify the Tolerable Limits on Decision Errors

The sampling approach for the investigation relies on biased sampling locations. Only validated analytical results (quantitative data) will be used to determine if COCs are present. The baseline condition (i.e., null hypothesis) and alternative condition for the investigation of the nature of contamination 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 the investigation of the extent of contamination are as follows:

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

Decisions and/or criteria have an alpha (false negative) or beta (false positive) error associated with their determination (discussed in the following subsections). Since quantitative data are individually compared to action levels, statistical evaluations of the data such as averages or confidence intervals are not appropriate.

A.1.6.1 False Negative Decision Error

The false negative (rejection or alpha) decision error would mean deciding that a COC is not present when it is, or that the extent of a COC has been defined when it has not. In both cases, this would result in an increased risk to human health and environment.

A false negative decision error (where consequences are more severe) is controlled by meeting these criteria: (1) having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS or that they will identify the extent of COCs, and (2) having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

To satisfy the first criterion for the determination of the nature of contamination, data and samples will be collected in areas most likely to be contaminated by any COCs. To satisfy the first criterion for the determination of the extent of contamination, data collection will sample areas that represent the lateral and vertical extent of contamination. To accomplish this, the following characteristics are considered:

- 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. The biasing factors listed in [Section A.1.3.1](#) will be used to further ensure that these criteria are met.

To satisfy the second criterion, all samples used to define nature of contamination will be analyzed for the chemical and radiological parameters listed in [Section A.1.3.3](#) using analytical methods that are capable of producing quantitative data to concentrations below or equal to PALs (unless stated otherwise in the CAIP). For those samples used to define the extent of contamination, samples will be analyzed for those chemical and radiological parameters that have been identified as COCs in previous samples. Strict adherence to established procedures and QA/QC protocol protects against false negatives.

A.1.6.2 False Positive Decision Error

The false positive (acceptance or beta) decision error would mean deciding that a COC is present when it is not, or accepting that the extent of a COC has not been defined when it really has, resulting in increased costs for unnecessary characterization or corrective action, respectively.

The false positive 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/QC samples such as field blanks, trip blanks, laboratory control samples, and method blanks minimize the risk of a false positive analytical result. Other measures include proper decontamination of sampling equipment and using certified clean sample containers to avoid cross-contamination.

A.1.6.3 Quality Assurance/Quality Control

Geophysical, if used, and radiological survey instruments will be calibrated in accordance with the manufacturer's instructions, and periodic calibrations will be performed in accordance with approved procedures.

Quality control samples will be collected as required by established procedures. The required QC samples include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per source lot per sampling event)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples or 1 per CAS if less than 20 collected)
- Field blanks (minimum of 1 per 20 environmental samples, or 1 per CAS if less than 20 collected)
- Matrix spike/matrix spike duplicate (minimum of 1 per matrix per 20 environmental samples or 1 per CAS if less than 20 collected, not required for all radionuclide measurements)

Additional QC samples may be submitted based on site conditions.

Data Quality Indicators of precision, accuracy, comparability, completeness, and representativeness are defined in the Industrial Sites QAPP (NNSA/NV, 2002). In addition, sensitivity has been included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in [Section 6.0](#) of the CAIP.

A.1.7 Step 7 - Optimize the Design for Obtaining Data

This section presents an overview of the strategy to be used to obtain the data required to meet the project DQOs developed in previous steps. [Section A.1.7.1](#) provides general investigation activities for each CSM, and the planned sampling strategy for each CAS is detailed in [Section A.1.7.2](#).

A.1.7.1 General Investigation Strategy

Radiological and geophysical surveys of the ground surface will be conducted at selected CASs in CAU 204 prior to intrusive sampling. These surveys are currently planned for the Kay Blockhouse, CAS 05-33-01, as part of preinvestigation activities. Radiological surveys of the ground surface within the CAS boundaries will also be performed at CASs 01-34-01, 02-34-01, 03-34-01, and 05-18-02. Radiological surveys of the interiors of the bunkers will be conducted at all of the CASs to determine if radiological contamination is present within the bunkers.

The interior of the bunkers will be visually inspected and photodocumented. The inspection will focus on evidence of contamination and potential released to the environment outside the bunkers. The inspection will also include an inventory of objects and equipment within the bunkers, with an emphasis on waste management concerns. Samples to determine the nature of contamination and/or for waste characterization will be collected from bunker interiors, as appropriate.

Intrusive investigations will be conducted at CASs 05-18-02, 05-33-01, and 05-99-02 to determine if COCs are present and, if present, to determine the extent. Intrusive investigations are not planned for CASs 01-34-01, 02-34-01, or 03-34-01, nor the interior of the bunkers at CASs 05-18-02 and 05-33-01. However, if field information indicates that a release to the environment from any of these five bunkers has occurred, sampling will be performed, as described below.

Samples will be collected from biased locations based on the results of the geophysical and radiological surveys and other biasing factors listed in [Section A.1.3.1](#). Rotary sonic drilling,

hollow-stem auger drilling, direct-push, handheld augers, or excavation may be used, as appropriate, to access subsurface sample intervals for laboratory analysis at select locations. Due to the nature of buried features possibly present at these sites (e.g., structures, buried debris, and utilities), sample locations may be biased adjacent to a buried feature, based upon the review of engineering drawings, and information obtained during site walkovers. The locations may also be biased, based upon specific site conditions encountered. Surface soil samples (<0.5 ft bgs) will be collected by hand according to approved procedures.

Although not specifically discussed in the following subsections, samples for waste characterization purposes may be collected from the interior or exterior of the bunker at any CAS. Samples from vents, ducts, filters, and equipment may be collected and submitted for analysis, as appropriate.

A.1.7.1.1 Investigation Strategy for CSM #1

The bunker interiors, with concrete floors and walls, will be investigated under the CSM #1. Initially, a visual inspection (including photodocumentation) will be performed on the interior of each bunker, and potential contamination will be identified and documented. The investigation will identify any potential pathways (i.e., vents, exterior doorways, significant cracks in concrete floor). Specifically, the investigation will focus on any staining on the floor or walls that would indicate a spill or other release within the bunker. Next, an inventory will be made of objects and equipment present in the bunkers, with an emphasis on waste management concerns (e.g., fluorescent light ballasts, fluids in equipment, or asbestos). Samples from vents, ducts, filters, and equipment may be collected and submitted for analysis, as appropriate. A radiological survey of the bunker interiors will be performed, focusing on any potential pathways, in order to obtain an indication of whether or not radiological contamination is present.

If there are no biasing factors (e.g., staining, elevated radiological readings) to indicate potential contamination, then no samples will be required. However, if biasing factors indicate that contamination may be present, samples will be collected for laboratory analysis at the potentially contaminated location. If unconsolidated media are available and if appropriate, this material will be collected for laboratory analysis; but, if no such material is available, then the concrete surface will be scabbled in order to obtain the necessary quantity of material to be analyzed. If no biasing factors are present but unconsolidated media are present and if appropriate, this material may be collected in

order to confirm the assumption of no contamination. If the investigation of a bunker interior indicates that contamination potentially reached the outside environment, that contamination will be investigated according to the strategy discussed for CSM #2.

A.1.7.1.2 Investigation Strategy for CSM #2

Intrusive investigations will be conducted at each of the CASs with surface debris/burn areas to determine if any COCs are present and, if present, to determine the extent. As discussed in [Section A.1.7.1.1](#), potential ground surface contamination originating from the interior of a bunker (e.g., from a vent or door) will also be investigated. Locations for sampling will be based on the results of the radiological and geophysical surveys and other biasing factors listed in [Section A.1.3.1](#).

Samples will be selected from biased locations focusing on contamination that may have migrated from the suspected source area, considering the potential for lateral surface migration prior to infiltration. The frequency of sample intervals will be based on biasing factors such as: debris, staining, odor, low points, and field-screening results. Direct-push, hand auger, drilling, and/or excavation will be used to access soil sample intervals at select locations. Surface intervals (<0.5 ft bgs) will be collected by hand.

A.1.7.1.3 Investigation Strategy for CSM #3

Intrusive investigations will be conducted at each of the CASs with subsurface debris/burn areas to determine if any COCs are present and, if present, to determine the extent. Locations for these samples will be based on the results of the radiological and geophysical surveys and other biasing factors listed in [Section A.1.3.1](#).

Sample intervals will be selected from the biased locations focusing on any contamination that may be present within or migrated from the disposal feature. The frequency of sample intervals below the waste/soil interface will be based on biasing factors such as: presence of debris, staining, odor, or field-screening results. Direct-push, hand auger, drilling, and/or excavation will be used to access soil sample intervals at select locations.

A.1.7.2 Site-Specific Sampling Strategy

The planned sampling strategy for each CAS is listed in [Table A.1-10](#). The biasing factors listed in [Section A.1.3.1](#) will be used to determine sampling locations. Where soil sampling is proposed in [Table A.1-10](#), if field-screening results greater than FSLs or other biasing factors indicate the presence of contamination at levels above the PALs, an extent investigation will be instituted.

Table A.1-10
Planned Sampling Strategy
(Page 1 of 4)

CAS	Sampling Strategy ^a
01-34-01 Underground Instrument House Bunker (Building 1-300)	Interior A visual inspection, including photodocumentation, of all accessible spaces will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the bunker. The emphasis of this inventory will be to gather information to support waste management decisions.
02-34-01 Instrument Bunker (Building 2-300)	A radiological survey of the bunker interior, including exterior doors, vents, equipment, and pipe runs, etc. will be performed. If biasing factors such as staining on the floor or areas of elevated radiological survey/swipe readings are present, and sufficient and appropriate unconsolidated material is present, a minimum of one sample of the material will be collected for analysis. If unconsolidated material is not present and staining or radiological contamination of the concrete is observed, the concrete may be characterized by other means (e.g., scabble or swipe, followed by analysis). Samples from vents, ducts, filters, and equipment may be collected and submitted for analysis to support waste characterization, as appropriate.
03-34-01 Underground Bunker (Building 3-300)	Exterior Walk-over radiological land-area survey of the ground surface within the CAS boundaries will be performed. If the results of this radiological survey or the results of the interior characterization indicate that the exterior may have been contaminated by activities that took place at or within the bunker, surface soil samples will be collected based on biasing factors (e.g., staining, radiological survey data, or field-screening results). If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination.
05-18-02 Chemical Explosives Storage (Sugar Bunker)	Interior A visual inspection, including photodocumentation, of all accessible spaces will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the bunker. The emphasis of this inventory will be to gather information to support waste management decisions.

Table A.1-10
Planned Sampling Strategy
(Page 2 of 4)

CAS	Sampling Strategy ^a
05-18-02 Chemical Explosives Storage (Sugar Bunker)	Interior A radiological survey of the bunker interior, including exterior doors, vents, equipment, and pipe runs, etc. will be performed. If biasing factors such as staining on the floor or areas of elevated radiological survey/swipe readings are present, and sufficient and appropriate unconsolidated material is present, a minimum of one sample of the material will be collected for analysis. If unconsolidated material is not present and staining or radiological contamination of the concrete is observed, the concrete may be characterized by other means (e.g., scabble or swipe, followed by analysis). Exterior A walk-over radiological land-area survey of the ground surface within the CAS boundaries has been performed. Additional radiological surveys may be performed, as necessary, to support the investigation. Surface soil samples will be collected from a minimum of three biased locations based on the results of the radiological land area survey. Additional surface soil samples will be collected from a minimum of three locations south of the bunker in an area where a previous investigation had detected above background concentrations of beryllium. In addition to the radiological land-area survey and previous beryllium sampling data, if biasing factors are present (e.g., staining), surface soil samples will be collected as appropriate. Also, if the results of the interior characterization indicate that a release to the exterior may have occurred due to activities that took place within the bunker, a surface soil sample or samples will be collected where contamination is suspected. If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination.
05-33-01 Kay Blockhouse	Interior A visual inspection, including photodocumentation, of all accessible spaces will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the bunker. The emphasis of this inventory will be to gather information to support waste management decisions. A radiological survey of the bunker interior, including exterior doors, vents, equipment, and pipe runs, etc. will be performed. If biasing factors such as staining on the floor or areas of elevated radiological survey/swipe readings are present, and sufficient and appropriate unconsolidated material is present, a minimum of one sample of the material will be collected for analysis. If unconsolidated material is not present and staining or radiological contamination of the floor is observed, the floor material may be sampled for analysis or characterized by other means (e.g., scabble or swipe), if appropriate.

Table A.1-10
Planned Sampling Strategy
(Page 3 of 4)

CAS	Sampling Strategy ^a
05-33-01 Kay Blockhouse	Exterior A walk-over radiological land area survey and a geophysical survey of the ground surface within the CAS boundaries have been performed. Additional radiological land area surveys may be performed, as necessary, to support the investigation. Also, to support waste management decisions, radiological release surveys of debris and equipment will be performed within the CAS boundaries. Numerous areas and features are present within the CAS boundary where, based on visual evidence, a contaminant release may have occurred. These areas and features include, burn areas, burn pits, open pits, steel-lined pits, areas inside soil berms, soil disturbances, and areas of debris. In some instances, these areas and features may coincide with the location of elevated radiological readings and/or geophysical anomalies. Based on the survey results and visual evidence, sampling at CAS 05-33-01 will be conducted as follows: A minimum of one surface or subsurface soil sample will be collected from each area or feature where a release may have occurred. Biasing factors may include radiological survey results, geophysical anomalies, stained or discolored soil, low spots in depressions, or the presence of debris. Samples will be collected from the appropriate surface and/or subsurface depth intervals, based on current site conditions observed during the investigation. The typical biased sample interval will be the soil interval immediately below the waste/native soil interface. Surface soil samples will be collected from six of the seven locations of elevated radiological levels identified during the walk-over survey. Samples will not include large fragments of metal or other materials that may be the source of the elevated radiological levels. The seventh location that will not be sampled is a location where "trinity glass" was observed. This material was generated during atmospheric nuclear testing, which is not part of scope of the CAU 204 CAI.
05-33-01 Kay Blockhouse (Continued)	The geophysical anomalies will be investigated by collecting surface soil and subsurface soil samples, as appropriate. Generally, the anomalies coincide with surface features that are already targeted for sampling. However, the anomaly interpreted as a fill area/trench feature in the northern sites area will be investigated by excavating a trench perpendicular to the long axis of the feature. A minimum of one soil sample will be collected from the trench. Also, if the results of the interior characterization indicate that a release to the exterior may have occurred due to activities that took place within the bunker, a surface soil sample or samples will be collected where contamination is suspected. If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination.

Table A.1-10
Planned Sampling Strategy
(Page 4 of 4)

CAS	Sampling Strategy ^a
05-99-02 Explosive Storage Bunker (Bunker 803)	Interior A visual inspection of the bunker, including photodocumentation, will be performed. The inspection will focus on identifying potential contamination and pathways to the exterior environment. The inspection will include an inventory of objects, materials, and equipment inside the bunker. The emphasis of this inventory will be to gather information to support waste management decisions. A radiological survey of bunker walls and floor will be performed, focusing on potential pathways to the environment (e.g., doorway, floor, and bottom of walls). A minimum of one surface soil sample will be collected from the floor within the bunker based upon biasing factors such as staining or radiological survey results. Exterior If the results of the interior characterization indicate that the exterior may have been contaminated by activities that took place at or within the bunker, surface soil samples will be collected based on biasing factors (e.g., staining, radiological survey data, or field-screening results). If COCs are detected or suspected, additional soil samples from deeper intervals at existing locations or from step-out locations will be collected to define the extent of contamination.

^aThe sampling locations may be altered based upon additional information.

A.1.8 References

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

BN, see Bechtel Nevada.

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

EPA, see U.S. Environmental Protection Agency.

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.

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.

Nevada Administrative Code. 2000. 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.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002. *Industrial Sites Quality Assurance Project Plan (QAPP)*, DOE/NV--372--Rev. 3. 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. 2000. *NV/YMP Radiological Control Manual*, DOE/NV/11718-079, Rev. 4. Prepared by Bechtel Nevada. Las Vegas, NV.

U. S. Ecology and Atlan-Tech. 1992. *Environmental Monitoring Report for the Proposed Ward Valley, California, Low Level Radioactive Waste (LLRW) Facility*. Rosewell, GA.

U.S. Environmental Protection Agency. 2000. *Region IX Preliminary Remediation Goals (PRGs)*. Prepared by S.J. Smucker. San Francisco, CA.

U.S. Environmental Protection Agency. 2002. Integrated Risk Information System (IRIS) Database, as accessed at <http://www.epa.gov/iris/index.html> on October 16, 2002.

USGS, see U.S. Geological Survey.

U.S. Geological Survey. 2002. "USGS/DOE Nevada Water Use Wells." As accessed at http://nevada.usgs.gov/doe_nv/wateruse/ on 7 February.

Appendix A.2

Project Organization

A.2 Project Organization

The NNSA/NV Project Manager is Janet Appenzeller-Wing, and her telephone number is (702) 295-0461. The NNSA/NV Task Manager for CAU 204 will be identified in the FFACO Biweekly Activity Report prior to the start of field activities.

The names of the project Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate NNSA/NV plan. However, personnel are subject to change, and it is suggested that the DOE Project Manager be contacted for further information.

Appendix A.3

NDEP Comment Responses

NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action 204: Storage Bunkers, Nevada Test Site, Nevada			2. Document Date: October 2002	
3. Revision Number: 0			4. Originator/Organization: IT Corporation	
5. Responsible NNSA/NV ERP Project Mgr.: Janet Appenzeller-Wing			6. Date Comments Due: November 18, 2002	
7. Review Criteria: Full				
8. Reviewer/Organization/Phone No.: NDEP			9. Reviewer's Signature:	

10. Com- ment Num- ber/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1)		NDEP reviewed the Draft Corrective Action Investigation Plan for Corrective Action Unit 204: Storage Bunkers and had no comments to this document.		

^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)*

Donald R. Elle
State of Nevada
Bureau of Federal Facilities
Division of Environmental Protection
1771 E. Flamingo Road, Suite 121-A
Las Vegas, NV 89101

1 (Controlled)*

Sabrina Lawrence
Environmental Restoration Division
U.S. Department of Energy
National Nuclear Security Administration
Nevada Operations 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 Operations Office
P.O. Box 98518, M/S 505
Las Vegas, NV 89193-8518

1 (Uncontrolled)*

Copies

Sabine Curtis
Environmental Restoration Division
U.S. Department of Energy
National Nuclear Security Administration
Nevada Operations 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)*

Allison Urbon
Bechtel Nevada
P.O. Box 98521, M/S NTS306
Las Vegas, NV 89193-8521

1 (Uncontrolled)*

Robert W. Sobocinski
IT Corporation, Las Vegas
P.O. Box 93838
Las Vegas, NV 89193

1 (Controlled)*

Brandi Mulkey
IT Corporation, Las Vegas
P.O. Box 93838
Las Vegas, NV 89193

1 (Controlled)*

FFACO Support Office
IT Corporation, Las Vegas
P.O. Box 93838
Las Vegas, NV 89193

1 (Controlled)

IT Corporation Central Files
P.O. Box 93838
Las Vegas, NV 89193

1 (Uncontrolled)*

Manager, Southern Nevada FFACO
Public Reading Room Facility
P.O. Box 98521, M/S NLV040
Las Vegas, NV 89193-8521

1 (Controlled)

1 (Uncontrolled)

Copies

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 Operations 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)