RECORD OF TECHNICAL CHANGE

Technical Change No. 1 | Page 1 of 3

Project/Job No. IS04 - 160 | Date 3/10/04

Project/Job Name Corrective Action Investigation Plan for CAU 516: Septic System and Discharge Points

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, and 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 516 Corrective Action Investigation (CAI) are listed in Table 3-3."
   - Replace Table 3-3 with the new Table 3-3 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 analytes is less than or equal to the corresponding PAL."

3. **Section A.1.4.2 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 516 CAI are listed in Table 3-3."

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

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

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

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

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

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

Applicable Project-Specific Document(s): **Corrective Action Investigation Plan for Correction Action Unit 516: Septic System and Discharge Points, Revision 0, May 2003.**

CC:

Approved By: Kevin Cabble Date 3-15-04

Kevin Cabble, Acting Project Manager
Industrial Sites Project

Janet Appenzeller-Wing Date 3/15/04

Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence Yes___ No___ Date ______

NDEP Signature ______

Contract Change Order Required Yes___ No ____

Contract Change Order No. ______

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 Correction Action Unit 516: Septic System and Discharge Points, Revision 0, May 2003.

CC:

Approved By: Kevin Cabble Date: 3-15-04
Kevin Cabble, Acting Project Manager
Industrial Sites Project

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

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

ok to Sign.

Table 3-3
Preliminary Action Levels for Radionuclides in Samples Collected at CAU 516

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] [c] 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--889

National Nuclear Security Administration

Corrective Action Investigation Plan for Corrective Action Unit 516: Septic Systems and Discharge Points, Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

May 2003

Environmental Restoration
Division

U.S. Department of Energy
National Nuclear Security Administration
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CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 516: SEPTIC SYSTEMS AND DISCHARGE POINTS, NEVADA TEST SITE, NEVADA

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

Controlled Copy No.: ___

Revision No.: 0

May 2003

CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 516: SEPTIC SYSTEMS AND DISCHARGE POINTS, NEVADA TEST SITE, NEVADA

Approved by: Signature Approved Date: 4-28-03

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: Signature Approved Date: 4/28/03

Runore C. Wycoff, Division Director
Environmental Restoration Division

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List of Acronyms and Abbreviations

A-E	Architect-Engineer
Am	Americium
bgs	Below ground surface
BJY	Buster Jangle Wye
BN	Bechtel Nevada
CADD	Corrective Action Decision Document
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
cm^2	Square centimeter
COC	Contaminant of concern
COPC	Contaminant of potential concern
CRQL	Contract-required quantitative limits
Cs	Cesium
CSM	Conceptual site model
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm	Disintegrations per minute
DQI	Data quality indicator
DQO	Data quality objective

List of Acronyms and Abbreviations *(Continued)*

EG&G/EM	EG&G Energy Measurements
EIS	Environmental impact statement
EPA	U.S. Environmental Protection Agency
FADL	Field activity daily log
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
FSR	Field-screening results
ft	Foot (feet)
ft^3	Cubic feet
gal	Gallon
GPS	Global positioning system
HASP	Health and Safety Plan
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 Office
LANL	Los Alamos National Laboratory
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
MDC	Minimum detectable concentration
MDL	Minimum detection limit
MOSA	Methods of Soil Analysis

List of Acronyms and Abbreviations *(Continued)*

mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MRL	Minimum reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
M&O	Management and Operating
NAC	*Nevada Administrative Code*
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NEPA	*National Environmental Policy Act*
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
NTSWAC	Nevada Test Site Waste Acceptance Criteria
PAL	Preliminary action level
PCB	Polychlorinated biphenyls
pCi/g	Picocurries per gram
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal
Pu	Plutonium
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control

List of Acronyms and Abbreviations *(Continued)*

RadCon	Radiological control
RCA	Radiologically controlled area
RCRA	*Resource Conservation and Recovery Act*
REECo	Reynolds Electrical & Engineering Co., Inc.
R/h	Roentgen per hour
RMA	Radioactive material area
ROTC	Record of technical change
RPD	Relative percent difference
RWMS	Radioactive Waste Management Site
SD	Standard deviation
SDG	Sample delivery group
Shaw	Shaw Environmental, Inc.
Sr	Strontium
SSHASP	Site-specific health and safety plan
SVOC	Semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total petroleum hydrocarbon
TSCA	*Toxic Substance Control Act*
U	Uranium
UST	Underground storage tank
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
%R	Percent recovery

Executive Summary

This corrective action investigation plan contains information for conducting site investigation activities at Corrective Action Unit 516: Septic Systems and Discharge Points. This information includes facility descriptions and environmental sample collection objectives and criteria. The results of the field investigation will support a defensible evaluation of viable corrective action alternatives that will be presented in the corrective action decision document.

Corrective Action Unit 516 is located in Areas 3, 6, and 22 of the Nevada Test Site, which is 65 miles northwest of Las Vegas, Nevada. Corrective Action Unit 516 is comprised of the following Corrective Action Sites:

- 03-59-01, Building 3C-36 Septic System
- 03-59-02, Building 3C-45 Septic System
- 06-51-01, Sump and Piping
- 06-51-02, Clay Pipe and Debris
- 06-51-03, Clean Out Box and Piping
- 22-19-04, Vehicle Decontamination Area

Corrective Action Site 06-51-02, Clay Pipe and Debris, was originally identified in the *Federal Facility Agreement and Consent Order* as another component associated with the Corrective Action Sites 06-51-01 and 06-51-03. After further review during the preliminary assessment, it was determined that the site consists of only surficial housekeeping debris. Therefore, the debris will be removed from the site during the field investigation.

A conceptual site model was developed for each Corrective Action Site, except for 06-51-02, to address all releases associated with the site.

The data quality objective process was used to identify and define the type, quantity, and quality of data needed to complete the investigation phase of the corrective action process. The data quality objectives addressed the primary problem that sufficient information was not available to determine

the appropriate corrective action for the site. To determine the corrective action alternatives, two critical decisions were defined:

1. Determine if a contaminant of concern is present.

2. Determine the lateral and vertical extent of a contaminant of concern.

For the purpose of determining distinct data needs, resolution of the first decision is addressed as Phase I, and resolution of the second decision is addressed as Phase II. Phase I data will be generated and evaluated at each corrective action site. Phase II data will be generated and evaluated for each corrective action site with at least one contaminant exceeding preliminary action levels. Phase I data will be evaluated at all corrective action sites, except 06-51-02. Corrective action closure alternatives (i.e., no further action, closure in place, or clean closure) will be recommended for each corrective action site based on an evaluation of all data required to meet the data quality objectives.

Based on existing data and process knowledge, the contaminants of potential concern for Corrective Action Unit 516 include constituents associated with volatile organics, semivolatile organics, petroleum hydrocarbons, polychlorinated biphenyls, *Resource Conservation Recovery Act* metals, the metals aluminum and beryllium, and radionuclides.

The general technical approach for investigation of Corrective Action Unit 516 will consist of the following activities:

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

- Collect required quality control samples.

- Collect additional environmental soil samples to define the lateral and vertical extent of contaminants of concern, if necessary.

- For corrective action sites with septic systems, inspect septic tanks and portions of associated septic system piping for the presence of septic waste contents. If present, collect samples for analysis.

Additional samples will be collected and analyzed for the purpose of managing and disposing investigation-derived waste and developing corrective action alternatives.

This Corrective Action Investigation Plan has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Under the *Federal Facility Agreement and Consent Order*, this 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.

1.0 Introduction

This Corrective Action Investigation Plan (CAIP) contains project-specific information for conducting site investigation activities at Corrective Action Unit (CAU) 516: Septic Systems and Discharge Points, Nevada Test Site (NTS), Nevada. This information includes facility descriptions and environmental sample collection objectives and criteria.

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

The NTS is approximately 65 miles northwest of Las Vegas, Nevada (Figure 1-1). Six corrective action sites (CASs) comprise CAU 516 (Figure 1-2). The CASs are located in Areas 3, 6, and 22 of the NTS. The six CASs are:

- 03-59-01, Building 3C-36 Septic System
- 03-59-02, Building 3C-45 Septic System
- 06-51-01, Sump Piping
- 06-51-02, Clay Pipe and Debris
- 06-51-03, Clean Out Box and Piping
- 22-19-04, Vehicle Decontamination Area

The CAS 06-51-02 was originally identified in the FFACO as associated with CASs 06-51-01 and 06-51-03. After further review during the preliminary assessment, it was determined that the site is only surficial housekeeping debris. During the Data Quality Objectives (DQO) process, it was determined that CAS 06-51-02 requires only a housekeeping action to clean up debris. Therefore, no investigation is necessary for closure of the CAS.

1.1 Purpose

Corrective Action Unit 516 is being investigated because disposed waste may be present without appropriate controls (i.e., use restrictions) and hazardous and/or radioactive constituents may be present or migrating at concentrations and locations that could potentially pose a threat to human health and the environment. Existing information and process knowledge on the expected nature and extent of contamination are insufficient to select preferred corrective actions (i.e., no further action,

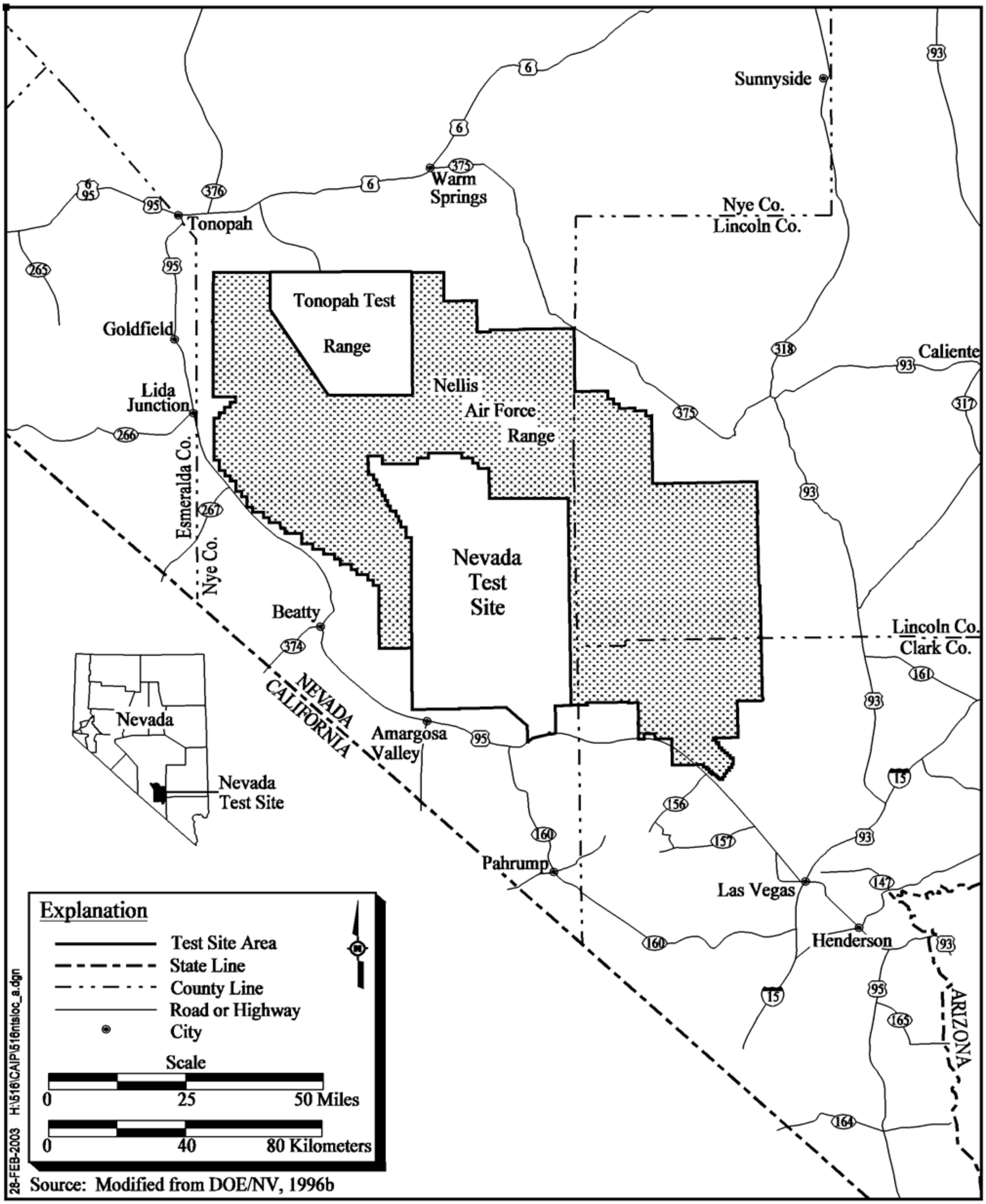

Figure 1-1
Nevada Test Site Location Map

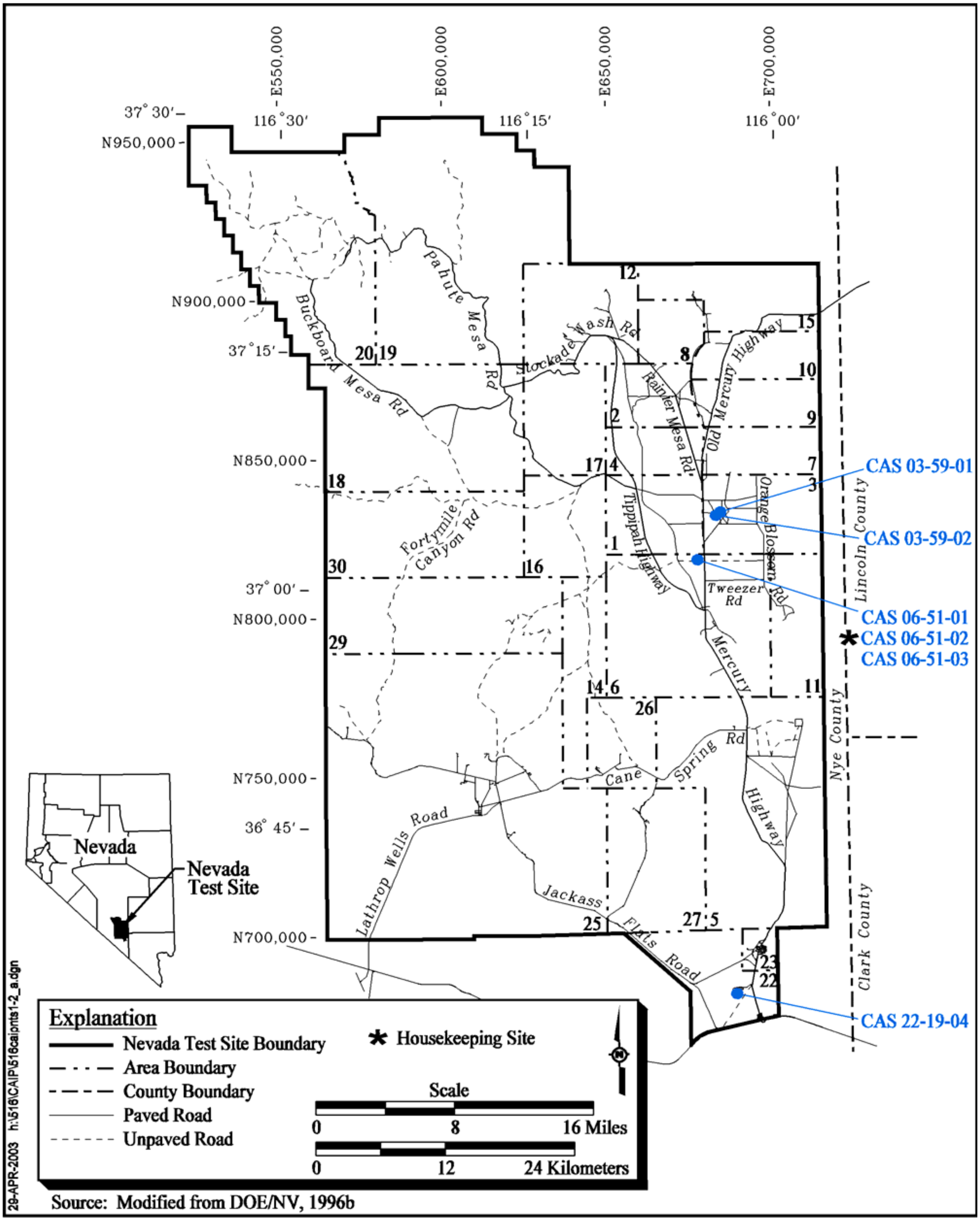

Figure 1-2
CAU 516, Corrective Action Sites Location Map

closure in place, or clean closure). Therefore, additional information will be obtained by conducting a corrective action investigation at the CAU 516 CASs. However, after a preliminary assessment of and site visits to CAS 06-51-02, it was determined that the site consists of only housekeeping waste. Therefore, CAS 06-51-02 will be addressed as a housekeeping action and the debris removed. No further action is necessary at this CAS.

1.1.1 Background

The NTS has been used for various research and development projects including weapons-related tests. With the exception of CAS 22-19-04, and the aforementioned CAS 06-51-02, the CASs to be investigated in CAU 516 were primarily used for septic waste disposal. Corrective Action Site 22-19-04 was used as a vehicle decontamination pad. Details of each CAS are provided in Section 2.0, Section 3.0, and Section A.1.1. The following is a brief history and description of the CASs.

CAS 03-59-01 - Consists of a septic tank, leachfield, distribution box and associated piping connected to Building 3C-36. The building was also referred to as Building 3C-36, JP2, J-7 Los Alamos Office, J-7 Modular Office Complex, Los Alamos National Laboratory (LANL) J-7 Trailer, and the WX-9 Office Complex. Building 3C-36 was abandoned in 1992, and in June 1998 it was relocated to the Area 3 Radiological Waste Management Site (RWMS). The CAS was first identified in a 1985 Holmes & Narver, Inc. engineering drawing depicting this septic system connected to Building 3C-36. The septic system is inactive and abandoned.

CAS 03-59-02 - Consists of a septic tank, leachfield, distribution box, associated piping connected to Building 3C-45, and a dry well. The building was also referred to as Building 45, the Rack and Compensatory Facility, the Zero Racks and Alpha Support Building, and the EG&G Energy Measurements (EG&G/EM) Alpha Support Building. The building became inactive sometime between 1990 and 1991 and has since been removed from the site. The dry well is located about 8 feet (ft) northeast of the leachfield and was used for disposing photoprocessing waste from the on-site mobile photoprocessing trailers. The site was first identified in a 1976 Reynolds Electrical & Engineering Co., Inc. (REECo) engineering drawing titled, “Nevada Test Site Area LASL Building 3C-45 Rack and Compensator Fac. Addition Surface Treatment.” In addition, a dry well located 10 ft from the west side of Building 3C-45 was added to the investigation scope during a site visit on December 18, 2002. The origin and operational history of the dry well is unknown. Both the septic collection system and the dry well are inactive and abandoned.

CAS 06-51-01 and CAS 06-51-03 - The CAS 06-51-01 consists of a 4-inch (in.) vitric clay pipe trending north from Building 660 approximately 300 ft into a sump. Corrective Action Site 06-51-03 consists of a 2- by 2- by 3-ft clean out box with 6-in. cast-iron piping located 5 ft north of Building 660 in the Well 3 Yard in Area 6. The clean out box piping appears to serve as an access pipe to the main 4-in. vitric clay pipe that extends north from Building 660 into the CAS 06-51-01. Building 660 was used for part of the Animal Investigation Program conducted by the U.S. Public Health System. Both sites were first included in the FFACO as a result of a 1995 IT Corporation, Las Vegas Office (ITLV) site visit and consequently were included in a 1996 document titled *Records of Site Notification* (IT, 1996). Both sites are inactive and abandoned.

CAS 06-51-02 - Consists of a 6-in. clay pipe and associated debris which lies in a slight depression approximately 225 ft west of Building 660 in the Well 3 Yard in Area 6. This CAS was originally identified in the FFACO as another component associated with the aforementioned septic system. After further review, it was determined that the site is surficial housekeeping waste.

CAS 22-19-04 - Consists of a 32-ft long and 15-ft wide rock-lined washdown feature connected to a trench leading to a sump located 800 ft southeast of the Area 22 Weather Station. Operations at Camp Desert Rock spanned from 1951 to 1964. A 1991 preliminary investigation associates CAS 22-19-04 with Camp Desert Rock (Bingham, 1991). The specific operational time range for this CAS remains unknown, including the date of construction. Also unknown are any activities that took place at or in the area of the CAS prior to the construction of the vehicle decontamination area. The amount of decontamination and site-specific decontamination methods are unknown. Reports on atmospheric testing suggest that vehicles, equipment, and personnel were initially decontaminated near the location of the tests conducted in the forward areas of the NTS and that additional (e.g., secondary, tertiary) decontamination was conducted in Area 22 as necessary. However, this is unconfirmed. The site was first identified in REECo's 1991 *Nevada Test Site Inventory of Inactive and Abandoned Facilities and Waste Sites* (REECo, 1991). In addition, the inventory states that the site may have unknown buried material; however, a surface geophysical survey (SAIC, 2001) indicated that there are no buried materials present at this site. The site is inactive and abandoned.

1.1.2 Data Quality Objectives Summary

The CASs will be investigated based on DQOs developed by representatives of the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO). The DQOs were used to identify and define the type, quantity, and quality of information needed to identify, evaluate, and recommend potentially viable corrective actions. A phased approach has been selected to generate the data needed to satisfy the DQOs. Phase I data will be generated and evaluated at each CAS, except 06-51-02, to determine the presence or absence of contaminants of concern (COCs). Contaminants of concern are defined as contaminants of potential concern (COPCs) that are present in samples at concentrations above the preliminary action levels (PALs) defined in Section 3.3. Phase II data will be generated and evaluated for each CAS with at least one contaminant exceeding PALs to determine the extent of COCs. Table 1-1 summarizes the CASs, associated releases, and the applicable conceptual site model (CSM). Corrective action alternatives (i.e., closure in place, clean closure, or no further action) will be recommended for each CAS based on an evaluation of the DQO-required data. Details of the DQO process are located in Appendix A.1.

1.2 Scope

The scope of the CAU 516 investigation is to generate the information needed to resolve the decision statements identified in the DQO process and includes the following activities to address the criteria for each decision statement:

- Collect biased environmental samples for laboratory analyses to determine if COCs exceeding PALs are present.
- Conduct field-screening activities to determine sample intervals.
- Collect additional environmental samples and submit for laboratory analyses to define the vertical and lateral extent of migration where a COC has been identified.
- Collect quality control (QC) samples for laboratory analyses to evaluate the performance of measurement systems and controls based on the requirements for the data quality indicators (DQIs).
- Comply with regulatory requirements for waste disposal through the collection and analysis of investigation-derived waste (IDW) samples, as needed.

Table 1-1
CASs and Associated Releases and Applicable Conceptual Site Models

CAS Description	Releases Associated with CAS	Conceptual Site Model(s)
03-59-01, Building 3C-36 Septic System	- Septic sewage releases from rest-room drain in Building 3C-36 to leachfield via septic tank and distribution box. Restroom contained one shower, one toilet, one sink, and one floor drain.	- *Septic System* - *Leachfield*
03-59-02, Building 3C-45 Septic System	- Septic sewage releases from Building 3C-45 to leachfield via septic tank and distribution box. - Wastewater releases from photoprocessing trailers into dry well northeast of leachfield. - Unknown type of release to dry well (with an unknown history) connected to the west side of Building 3C-45.	- *Septic System* - *Leachfield* - *Dry Well*
06-51-01, Sump and Piping	- Sewage releases into four floor drains and two sink drains into a 4-in. clay pipe connecting Building 660 to a sump.	- *Septic System* (i.e., piping) - *Sump*
06-51-02, Clay Pipe and Debris	None	Not Applicable
06-51-03, Clean Out Box and Piping	- Sewage releases from CAS 06-51-01 piping via a 6-in. cast-iron pipe protruding into the clean out box.	- *Septic System* (i.e., piping) - *Clean Out Box*
22-19-04, Vehicle Decontamination Area	- Radionuclide releases from decontamination of vehicles and equipment contaminated with radionuclides. - Volatile organic compounds and semivolatile organic compound releases from using high-pressure water and detergents used for decontamination. - Radionuclide releases from atmospheric testing.	- *Sump*

1.3 CAIP Contents

Section 1.0 presents the purpose and scope of this CAIP, and Section 2.0 provides the background information for the CAU. The objectives, including the CSMs, are presented in Section 3.0. Field sampling activities and CAS diagrams are discussed in Section 4.0, and waste management issues are discussed in Section 5.0. General field and laboratory quality assurance (QA) and QC issues (including collection of QC samples) are presented in Section 6.0 of this CAIP and also in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002a). The project schedule and records availability information for this document are discussed in Section 7.0. Section 8.0 provides a list of references. Appendix A.1 provides the DQOs, and Appendix A.2 contains information on the project organization.

The managerial aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994) and the site-specific field management plan that will be developed prior to field activities. The health and safety aspects of this project are documented in the *Environmental Architect-Engineer (A-E) Services Contractor's Health and Safety Plan* (HASP), and will be supplemented with a site-specific health and safety plan (SSHASP) written prior to the start of field work. Public involvement activities are documented in the "Public Involvement Plan," Appendix V, of the FFACO (1996).

2.0 Facility Description

The CAU 516 CASs were grouped together based on their geographical location, technical similarities (releases from septic systems and discharge points), and agency responsibility (Environmental Restoration) for closure. The following sections provide an overview and background information regarding the physical setting and operational history, waste inventory, release information, and investigative background of the site.

2.1 Physical Setting

The following sections describe the general physical setting of the CASs within 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, 1996b).

The geological and hydrological setting described for each of the CASs is detailed in the following sections. Locations of the CASs on the NTS are identified on Figure 1-2.

2.1.1 Hydrogeology of Central Yucca Flat

Both CASs 03-59-01 and 03-59-02 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 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 with up to a 3-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 in the Yucca Flat vicinity range from 530 to 1,900 ft below ground surface (bgs) (DRI, 1988) and within Area 3 the approximate depth to groundwater is 1,610 ft bgs (Wuellner, 1994). The nearest well to Building 3C-36 is the UE-16d Eleana water well at approximately 7 miles to the northwest of this CAS where the static water level is 754 ft (Geomedia, 2002).

Average annual precipitation at rain gauge Station Buster Jangle Wye (BJY) is 6.32 in. for the observation period from 1960 to 2002 (NOAA, 2002). The station is located in Yucca Flat near the intersection of Areas 1, 3, 4, and 7.

2.1.1.1 CAS 03-59-01, Building 3C-36 Septic System

This CAS is located in the former Area 3 Camp south of Road 3-01 and consists of a septic tank, leachfield, distribution box, and septic system piping (see Figure A.1-2). The septic tank has a volume of 1,200 gallons (gal) and is believed to have been pumped and filled with concrete. The leachfield is located approximately 76 ft south of Building 3C-36. The leachfield is approximately 60 by 30 ft and consists of three perforated 4-in. pipes. This septic system was connected to Building 3C-36, which contained seven offices, one blueprint room, one secretarial area, and one rest room that included one shower stall, one toilet, one sink, and one floor drain.

2.1.1.2 CAS 03-59-02, Building 3C-45 Septic System

This CAS is located north of Road 3-01 and west of Angle Road in Area 3 and consists of a septic tank, leachfield, distribution box, and associated piping that serviced Building 3C-45 (see Figure A.1-3). Also included in the CAS is a dry well used for the disposal of photoprocessing chemicals. Engineering drawings indicate that the 1,200-gal septic tank is constructed of precast concrete and located northeast of Building 3C-45 at a depth of approximately 2 ft bgs. The leachfield is approximately 77 ft northeast of the Building 3C-45 and has dimensions of about 98 by 59 ft. The dry well is located about 8 ft northeast of the leachfield, is 4-ft in diameter, has a total depth of approximately 12 ft bgs (Holmes & Narver, 1976), and a volume estimated at 151 cubic feet (ft^3). Building 3C-45 had one rest room.

In addition to the aforementioned CAS components, a borehole located approximately 10 ft west of Building 3C-45 will also be investigated. Historical documentation refers to this borehole as a dry well belonging to LANL. The borehole was drilled on August 24, 1976, to a total depth of 44 ft bgs. The borehole has no casing and has a 72-in. diameter to 15.5 ft bgs and a diameter of 48-in. to 44 ft bgs (DOE/NV, 1990). An engineering drawing shows a 2-in. acid-resistant polypropylene sewer pipe near the base of the borehole and the borehole backfilled to grade (Holmes & Narver, 1985). The purpose of the borehole is unknown.

2.1.2 Hydrogeology of Southern Yucca Flat

The CASs 06-51-01, 06-51-02, and 06-51-03 are located in Area 6. Area 6 is also located within Yucca Flat on the east side of the NTS. Steep Tertiary volcanics and Paleozoic sediments characterize the western edge of the area. Broad Quaternary alluvial plains dominated by Yucca Lake, a large dry lake bed, are found to the east. Structural features include numerous north and northwest trending, high-angle normal faults, predominated by the Yucca Fault. These faults displace the Tertiary and Paleozoic rocks and occasionally younger alluvium, indicating that movement has occurred along the Yucca Fault sometime during the last few thousands to tens of thousands of years (NBMG, 1972). Corrective Action Sites 06-51-01, 05-61-02, and 06-51-03 are located at a surface elevation of approximately 4,025 ft. The local alluvium thickness and the presence of surface bedrock, caliche, or fractured rock remains unknown.

Area 6 is located in the Ash Meadows Groundwater Basin where the groundwater generally moves downward through alluvium and volcanic rocks to the Paleozoic carbonate aquifer. Groundwater within the eastern area of the NTS flows southward toward the Ash Meadows Discharge area (DOE/NV, 1996b). Depth to groundwater in Area 6 ranges from about 535 ft to 2,315 ft bgs with an average depth to groundwater of 1,425 ft (DRI, 1993). Well 3 is the closest water well to the CASs and had a water level of approximately 1,531 ft bgs in 2001 (USGS, 2002).

Average annual precipitation at rain gauge Station UCC (Yucca Dry Lake) is 6.62 in. for observation period 1959 to 2002 (NOAA, 2002). The station is located in Yucca Flat near the intersection of Mercury Highway and Tweezer Road.

2.1.2.1 CAS 06-51-01, Sump and Piping; CAS 06-51-02, Clay Pipe and Debris; and CAS 06-51-03, Clean Out Box and Piping

The CAS 06-51-01 is located in the Well 3 Yard in Area 6 and consists of a 4-in. vitric clay pipe, which trends north from Building 660 approximately 300 ft into a sump (see Figure A.1-4). Four floor drains and two sink drains within Building 660 connect into this pipe. The sump is approximately 25 by 30 ft and is located north of Building 660.

The CAS 06-51-02 consists of surficial debris, including a 6-in. clay pipe and miscellaneous debris, that lies approximately 225 ft west of Building 660.

The associated clean out box and piping resides within CAS 06-51-03 (see Figure A.1-4). This CAS consists of a clean out box made of wood and concrete that measures 2 by 2 by 3 ft with a 6-in. cast-iron pipe with an end cap projecting into it from the west. The cast-iron pipe is believed to serve as an access pipe to the main 4-in. vitric clay pipe that extends north from Building 660 into the CAS 06-51-01 sump. An underground storage tank (UST) and associated piping located north of Building 660 is assigned to CAS 06-02-04 in CAU 330 and is not associated with CAU 516.

2.1.3 Hydrogeology of Mercury Valley

Corrective Action Site 22-19-04 is located in Area 22 on an alluvial fan in the Mercury Valley. The Mercury Valley is underlain by moderately thick alluvium with an interbedded tuff unit. The alluvium is present at the surface to a depth of about 360 ft and again from about 515 to 610 ft bgs. The alluvium consists principally of carbonaceous and tuffaceous fragments eroded from surrounding mountain ranges. A unit of friable, tuffaceous bedrock is located within the alluvium from about 360 to 515 ft bgs. (USGS, 1962 and 1964) Carbonates and shale make up the remaining units from 610 ft to a depth of 1,946 ft bgs (USGS, 1964).

Regional hydraulic gradients based on water-level data indicate that water moves away from recharge areas in the northern, eastern, and southern boundaries toward Frenchman Flat, and then flows southwest through the regional carbonate-rock aquifer to the Ash Meadows sub-basin (Laczniak et al., 1996). Depth to groundwater in the Ash Meadow aquifer below the Mercury Valley is approximately 800 ft bgs within the carbonate rocks (Dodge, 1996). A deeper aquifer was also identified at an approximate depth of 1,360 ft bgs within the undifferentiated carbonate unit (USGS, 1964). Shale may locally act as an aquitard based on differences in the static water level between the two aquifers; however, other data suggests the two aquifers may be hydraulically connected and differences in hydraulic head are due to variations in transmissivity (USGS, 1964).

Army Well No. 1 is the nearest drinking water well and is located 2.2 miles north of CAS 22-19-04. The static water level in Army Well No. 1 is 787 ft bgs (DRI, 1996).

Average annual precipitation at rain gauge Station DRA (Desert Rock) is 5.65 in. for observation period from 1963 to 2002 (NOAA, 2002). The station is located in Mercury Valley in the southernmost area of the NTS.

2.1.3.1 CAS 22-19-04, Vehicle Decontamination Area

The CAS 22-19-04 is a former vehicle decontamination area located approximately 800 ft southwest of the Weather Station in Area 22 (see Figure A.1-5). The vehicle decontamination site consists of a decontamination pad, a drainage trench, and a sump. The decontamination pad consists of a rectangular depression measuring 32-ft long and 15-ft wide, with a bed of gravel ranging from approximately 5 to 10 in. in diameter. The drainage trench measures 30-ft long, 3-ft wide, and 2-ft deep and runs between the decontamination pad and sump. The sump consists of a depression in the soil measuring 11-ft long, 9-ft wide, and 4-ft deep.

2.2 Operational History

The following subsections provide a description of the use and history of each of the CASs in CAU 516 that may have resulted in a potential release to the environment. The following CAS-specific summaries are designed to illustrate any significant, known activities.

2.2.1 CAS 03-59-01, Building 3C-36 Septic System

Building 3C-36 was constructed in 1984 and abandoned in 1992. In 1998, Building 3C-36 was relocated to the Area 3 RWMS. It appears that Building 3C-36 was only used as an office from the time is was constructed in 1984 to the time it was abandoned in 1992. Information obtained during the preliminary assessment indicates that this building was used only as an office building, with one of the offices used as a blueprint room. This site is inactive and abandoned.

2.2.2 CAS 03-59-02, Building 3C-45 Septic System

Building 3C-45 was constructed in 1973 and ceased operating between 1990-1991. The primary uses of Building 3C-45 included fabricating and storing electrical components and supporting the neighboring Diode Facility. During the preliminary assessment, an interviewee stated that the building may have contained nuclear racks, also known as canisters, associated with electronic diagnostics for nuclear tests (Dalson, 2002). This site is inactive and abandoned. A dry well located northeast of the leachfield was used for disposing photoprocessing waste from on-site mobile photoprocessing trailers. In addition, another dry well with an unknown history is connected to the west side of Building 3C-45.

2.2.3 CAS 06-51-01, Sump and Piping, and CAS 06-51-03, Clean Out Box and Piping

No documentation has been identified to indicate the activities at this site before the sump and associated piping were installed and connected to Building 660. The U.S. Public Health Services used Building 660 from 1964 until 1972 as part of the Animal Investigation Program. The building was used as a feed barn, dairy barn, slaughterhouse, and for the preparation of animal tissues for radiological monitoring animal studies. From 1972 to 1989, Building 660 was used by REECo to store tools, parts, and special pipe fittings; and as a calibration laboratory. It appears that the building was abandoned after 1989; however, in 1993, the sinks in Building 660 were designated for hand washing only (Azhikakath, 1994). No documentation has been identified that states what the building was used for from 1989 through 1993. In August 1994, a Stop Work Order was issued by the REECo Environmental Compliance Office while investigating Building 660 for an unpermitted wastewater discharge. Water service was terminated and the sinks and drains were sealed inside and outside the building. In 1995, Building 660 was relinquished to the DOE Environmental Restoration Technology

Development Department for closure. Building 660 has been abandoned and floor drains plugged (REECo, 1994).

2.2.4 CAS 06-51-02, Clay Pipe and Debris

This site has no associated operational history.

2.2.5 CAS 22-19-04, Vehicle Decontamination Area

The site was used as a vehicle decontamination area and was associated with Camp Desert Rock activities. Camp Desert Rock was in operation as an U.S. Army subinstallation from 1951 to 1964 and was associated with nuclear tests conducted in the 1950s. Vehicles and personnel contaminated as a result of these nuclear tests are believed to have been decontaminated at this site (DNA, 1982). This site is inactive and abandoned.

2.3 Waste Inventory

No waste disposal records have been identified for any of the CASs addressed by this CAU; therefore, the specifics of the waste are mostly dependent upon the interviews with former site employees and historical documentation obtained during the preliminary assessment in addition to process knowledge and general historical NTS practices identified in previous investigations. The information was evaluated during the DQO process and is discussed in Section 3.2 and Section A.1.1. The following summarizes the types of waste and associated contaminants expected or suspected to be present at each CAS.

CAS 03-59-01 - The septic system (i.e., septic tank, distribution box, leachfield, and piping) was designed to collect sanitary waste. The presence of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), petroleum hydrocarbons, and *Resource Conservation and Recovery Act* (RCRA) metals are suspected since these constituents are representative of the general characteristics of sewage (Zakrzewski, 1991).

CAS 03-59-02 - The septic system (i.e., septic tank, distribution box, leachfield, and piping) was designed to collect sanitary waste. The presence of VOCs, SVOCs, petroleum hydrocarbons, and RCRA metals are suspected since these constituents are representative of the general characteristics of sewage (Zakrzewski, 1991). The radioisotopes, plutonium (Pu)-238 and Pu-239/240, are suspected contaminants that may have potentially resulted from the storage of racks used for test diagnostics. The 12-ft dry well was constructed to receive photoprocessing waste. Contaminants expected are silver from film processing, hydroquinone from the developing solutions, and aluminum from the rapid fixer. Additional RCRA metals are also suspected in the photoprocessing waste. The types of wastes and associated contaminants in the dry well connected to, and located west of, Building 3C-45 are unknown.

CAS 06-51-01 and CAS 06-51-03 - The septic system (i.e., sump, piping, and clean out box) was designed to collected septic waste. The presence of VOCs, SVOCs, and RCRA metals are suspected since these constituents are representative of the general characteristics of sewage. An investigation of the CAS 06-04-02 UST in CAU 330 in December 2002 verified that drain lines connected to the UST are not connected to either CAS 06-51-01 or 06-51-03 (Urbon, 2003). The analysis of one liquid and one sludge sample collected from the UST in March 2003 detected total petroleum hydrocarbons (TPH) at 191 milligrams per kilogram (mg/kg) in the sludge sample. The radioisotopes Pu-238 and -239/240 were detected below the MDLs in a liquid sample previously collected from the UST (Cowley, 1994; and Latham, 1995). Based on the analytical results and the proximity of the UST to the two CASs, TPH is a suspect contaminant at these two CASs. In addition, Americium (Am)-241 and Pu-238 and -239/240 may have leached out of the radiologically contaminated animal feed used in animal investigation studies conducted at Building 660; therefore, they are also considered suspect contaminants.

CAS 06-51-02 - No known contaminants have been identified for the surface debris.

CAS 22-19-04 - The decontamination system (i.e., rock-lined pad, trench, and sump) was designed to collect wastewater from decontamination activities. Suspected VOCs, SVOCs, RCRA metals, and petroleum hydrocarbons may be present from the decontamination of equipment and vehicles fueled by and/or maintained with petroleum hydrocarbon products. The radioisotopes cesium (Cs)-137; strontium (Sr)-90; Pu-238, and Pu-239/240; and uranium (U)-234, U-235, and U-238 are suspected from the decontamination of vehicles and equipment impacted by fall-out from atmospheric testing.

2.4 Release Information

The CAS-specific release information, migration routes, exposure pathways, and affected media are discussed in this section. Details of the releases are provided in Section A.1.1. The following is a list of known or potential releases associated with CAU 516.

CAS 03-59-01 - Effluent was released into a discharge pipe connected to Building 3C-36. The pipe received waste from a floor drain that connected to one shower, one toilet, and one sink. The effluent transferred through the septic tank and distribution box and discharged into the leachfield via perforated distribution pipes.

CAS 03-59-02 - Effluent was released into a septic line running north from Building 3C-45 and discharged into the sump. The effluent transferred through the septic tank and distribution box and discharged into the leachfield via perforated distribution pipes. In addition, photoprocessing effluent from the on-site mobile photoprocessing trailers was disposed into the dry well located northeast of the leachfield.

CAS 06-51-01 and CAS 06-51-03 - Effluent was released into a pipe servicing four floor drains and two sink drains within Building 660. The effluent traveled in the pipe running north from Building 660 and exited into the sump where it could infiltrate into the shallow subsurface.

During a 1994 investigation of Building 660, a Stop Work Order was issued for an unpermitted wastewater discharge as a result of wastewater discharging into a sump rather than the UST for which it was intended. Water service was terminated and the sinks and drains were sealed inside and outside the building (REECo, 1994).

CAS 06-51-02 - There are no known or suspected releases and the site contains only surface debris.

CAS 22-19-04 - Wastewater was discharged directly onto the washdown pad, traveled through the narrows of the trench, and exited into the sump where it could infiltrate into the shallow subsurface.

The affected medium at all CASs (except CAS 06-51-02) is shallow subsurface soil. In addition, surface soil at CASs 06-51-01 and 22-19-04 is also affected. Release mechanisms, migration routes, and exposure pathways are discussed in Section 3.1.

2.5 Investigative Background

Previous site investigation activities associated with CAU 516 were identified during the preliminary assessment. Details of these investigations are provided in Section A.1.1. The following paragraphs summarize all known investigation activities conducted at each CAS.

CAS 03-59-01 - No analytical results or geophysical surveys have been identified for this CAS. However, a radiological survey was conducted in March 2001 at various points within the leachfield. The survey results for alpha emitters ranged from an alpha reading of 0 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) at the southwest corner of the leachfield to 85.6 dmp/100 cm^2 at the leachfield manhole cover "N." The survey results for beta/gamma emitters ranged from 2,769 dpm/100 cm^2 at the southwest corner of the leachfield to 3,211 dpm/100 cm^2 at the leachfield manhole cover "S." (Adams, 2001)

The survey results of the leachfield and manhole cover determined that there is a low likelihood of any radiological concerns (Adams, 2001).

CAS 03-59-02 - No analytical or geophysical survey results have been identified for this site. However, a radiological survey was conducted in March 2001 at various points in the leachfield. The survey results for alpha emitters ranged from an alpha reading of 5.3 dpm/100 cm^2 at the northwest corner of the leachfield to 32.1 dpm/100 cm^2 at both the southeast corner of the leachfield and the leachfield manhole cover. The survey results for beta/gamma emitters ranged from 2,007 dpm/100 cm^2 at the southeast corner of the leachfield to 4,504 dpm/100 cm^2 at the leachfield manhole cover. (Adams, 2001)

The survey results determined that the radiological readings did not exceed the background readings of the general area (Adams, 2001).

CAS 06-51-01 and CAS 06-51-03 - No previous investigation results have been identified for this CAS, but analytical results exist for a liquid sample collected in 1994 from a nearby UST in CAU 330 and submitted for analysis of toxicity characteristic leaching procedure (TCLP) VOCs, TCLP SVOCs, TCLP metals, TPH (gasoline/diesel/oil-range), pH, Clor-d-tect 4000, gamma spectrometry, isotopic Pu, and tritium. The analytical results reported the detection of chlorine, barium, caustics, corrosives, acids, a pH of 7.94 (Cowley, 1994); Pu-238 and Pu-239/240 below the MDLs; and tritium at concentrations below the background level (Latham, 1995). Further investigation of the CAU 330, CAS 06-04-02, UST was conducted in December 2002. The excavation of the UST verified that the drain lines connected to it are not connected to either CAS 06-51-01 or CAS 06-51-03 (Urbon, 2003). One liquid and one sludge sample was collected from the UST in March 2003 and analyzed for TCLP VOCs, TCLP SVOCs, TCLP RCRA metals, PCBs, TPH, tritium; and alpha, beta, and gamma-emitting radionuclides. Total petroleum hydrocarbons (i.e., gasoline- and diesel-range) were detected at 191 mg/kg (Urbon, 2003).

CAS 06-51-02 - No data has been identified.

CAS 22-19-04 - Radiological surveys were conducted in 1998 (IT, 1998) and 2001 (IT, 2002). All radiological survey readings were below or within background levels. Radiological surface measurements of the soil and rock bed were taken in 2001. A soil sample was collected underneath the rock bed in 2001 and analyzed for radionuclides. Cesium-137 was detected at 0.5 picocuries per gram (pCi/g) (Emer, 2001).

2.5.1 National Environmental Policy Act

In accordance with the NNSA/NSO *National Environmental Policy Act* (NEPA) Compliance Program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 516. This checklist is used by NNSA/NSO project personnel to evaluate their proposed projects against a list of several potential impacts which include, but are not limited to: air quality, chemical use, waste generation, noise level, and land use. Completion of the checklist results in a determination of the appropriate level of NEPA documentation by the NNSA/NSO NEPA Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 516 and the development of the CSMs. Also presented are the COPCs and PALs for the investigation.

3.1 Conceptual Site Models

A 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. Four CSMs have been developed for CAU 516 using assumptions formulated from the physical setting, historical background information, potential contaminant sources/release information, and data from previous efforts. Site-specific information is presented in Section 2.0. A discussion in Section A.1.2.4 also provides information on the CSMs. The CSMs are labeled Septic System (Figure 3-1), Leachfield (Figure 3-2), Clean Out Box (Figure 3-3), Dry Well (Figure 3-4), and Sump (Figure 3-5).

3.1.1 Future Land Use

Future land-use scenarios limit future uses of the CASs to various nonresidential (i.e., industrial) uses. Exposure scenarios for sites located within the NTS boundaries are limited by the future land-use scenarios to site workers who may be exposed to COPCs through oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris (e.g., equipment, concrete) due to inadvertent disturbance of these materials. Alternative 3, *Expanded Use,* is used to consider future land-use scenarios at the NTS that include all currently planned and proposed projects, all ongoing NNSA/NSO and interagency programs and operations described in Alternative 1, *Continue Current Operations (No Action Alternative),* and potential project activities resulting from other DOE environmental impact statements (EISs) (DOE/NV, 1996b).

The CAU 516 CASs are within the following future land-use zones (DOE/NV, 1998):

- ***Nuclear Test Zone*** - CASs 06-51-01, 06-51-02, and 06-51-03 are located within this zone that is reserved for dynamics experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.

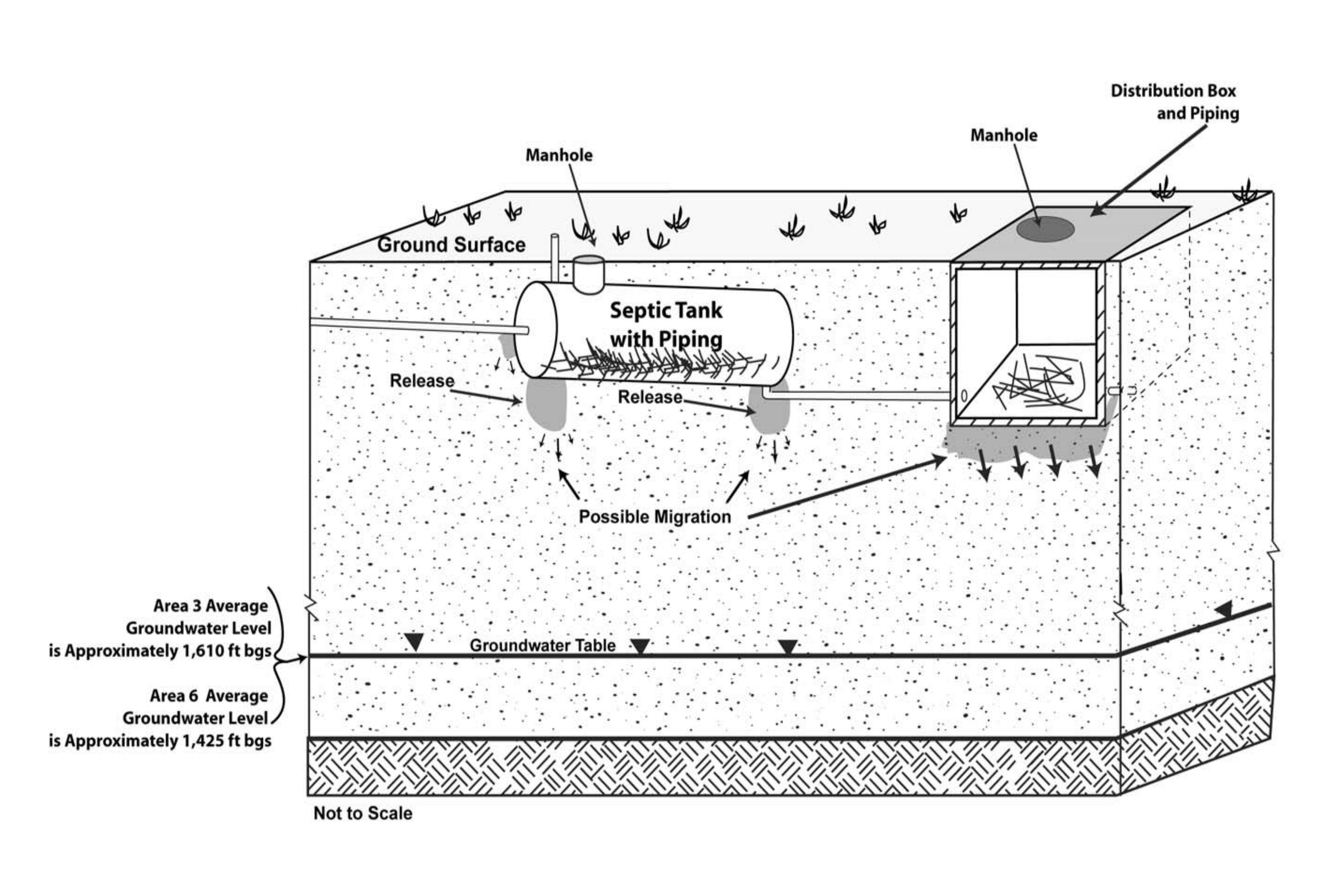

Figure 3-1
Septic System Conceptual Site Model

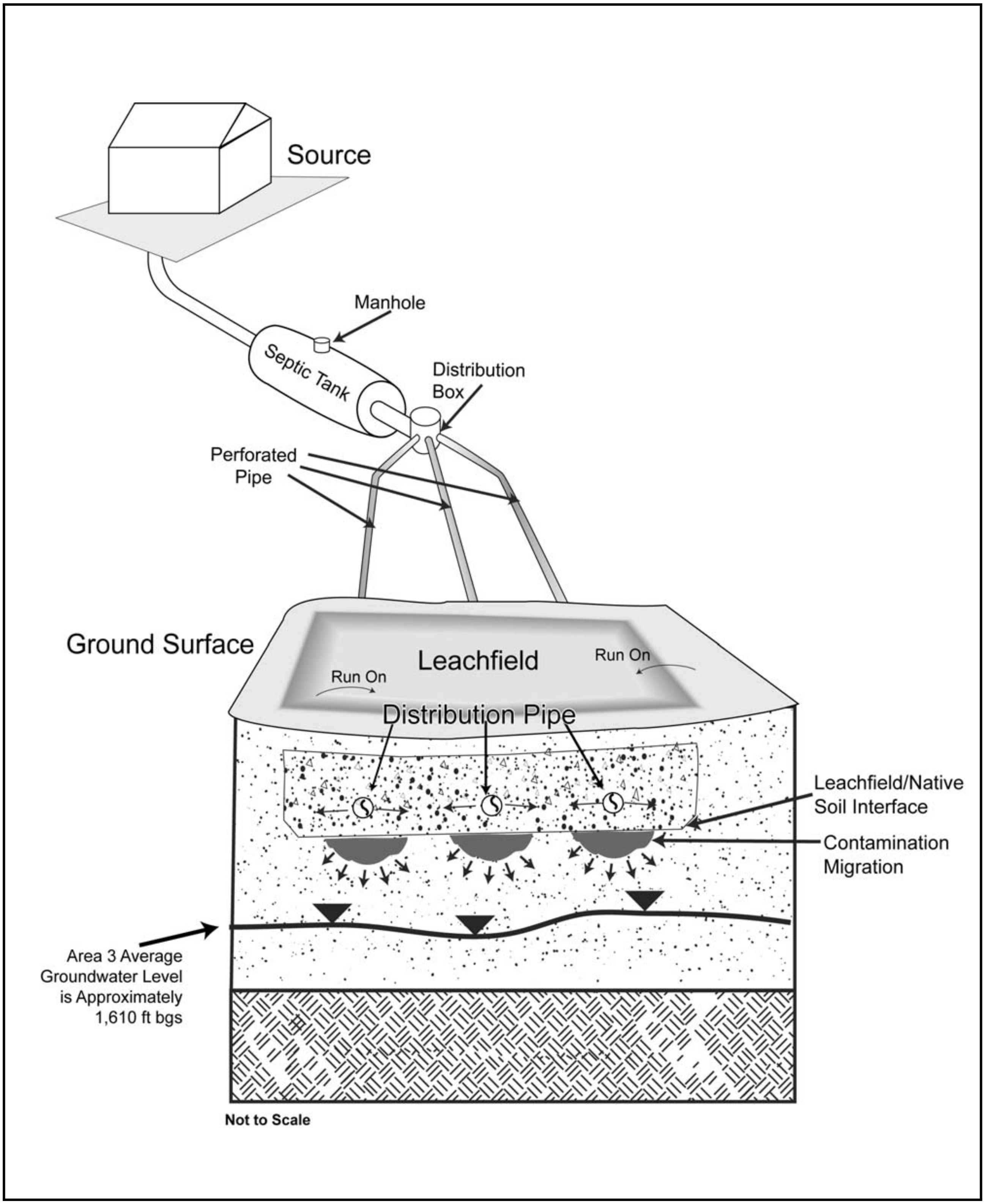

Figure 3-2
Leachfield Conceptual Site Model

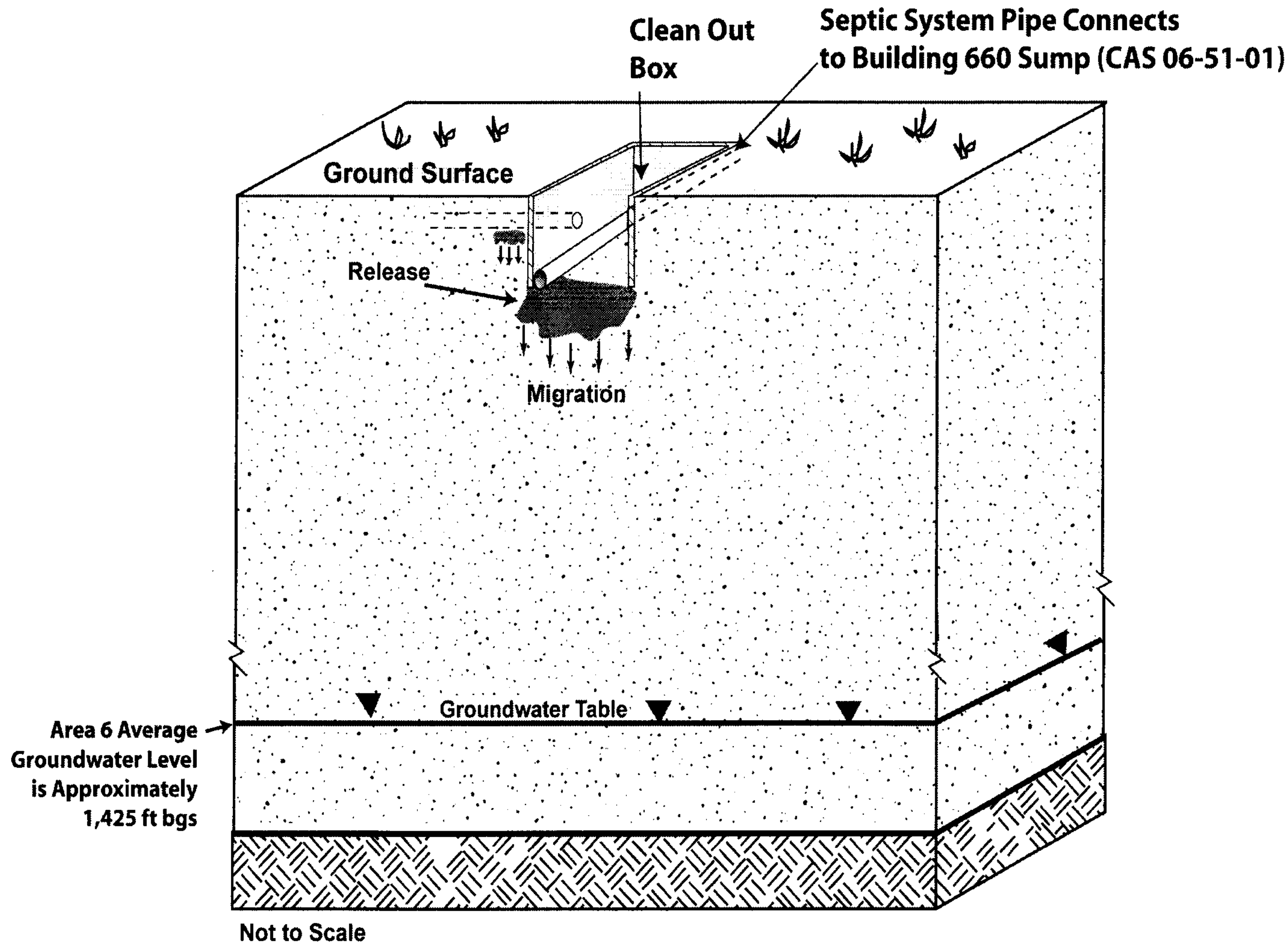

Figure 3-3
Clean Out Box Conceptual Site Model

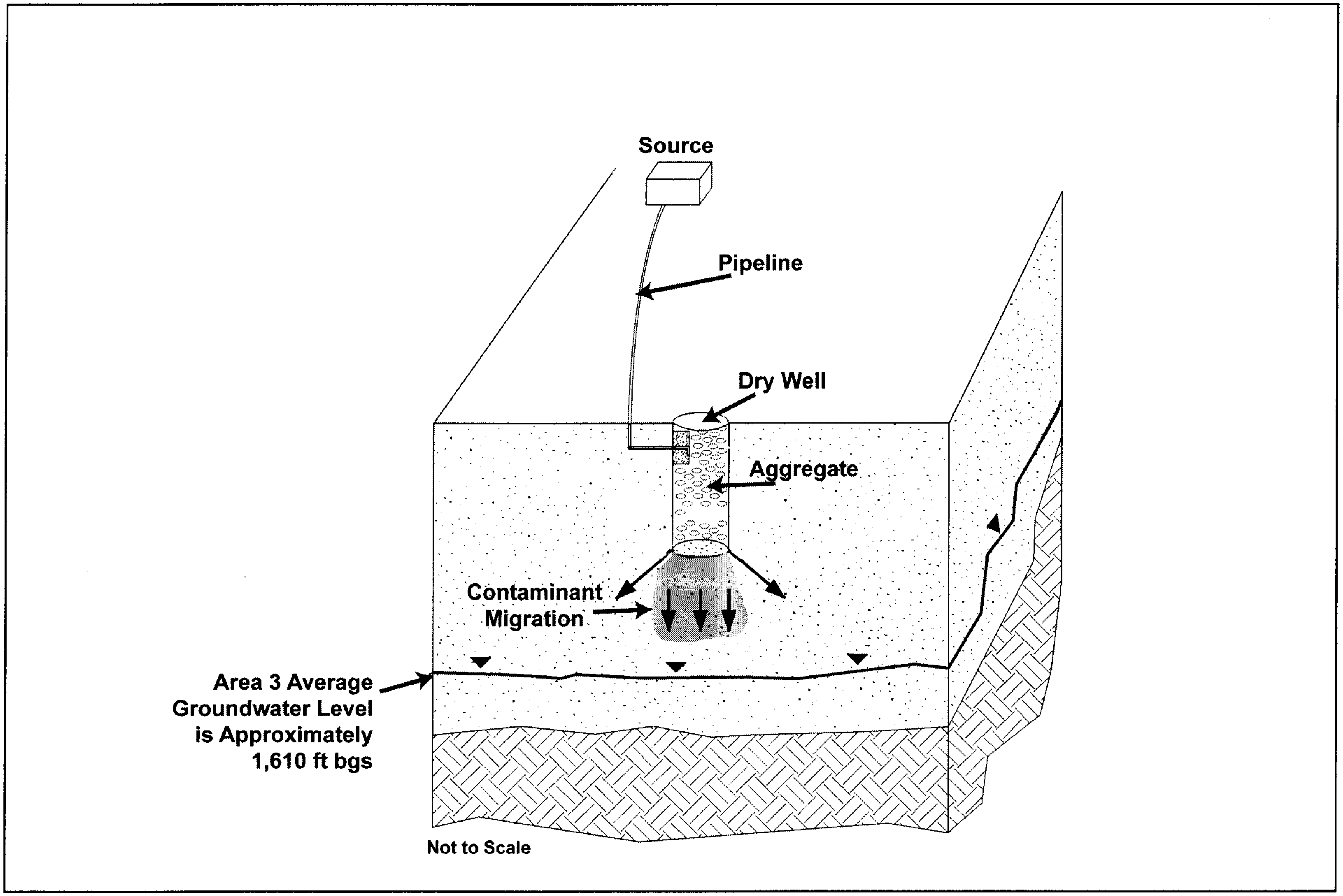

Figure 3-4
Dry Well Conceptual Site Model

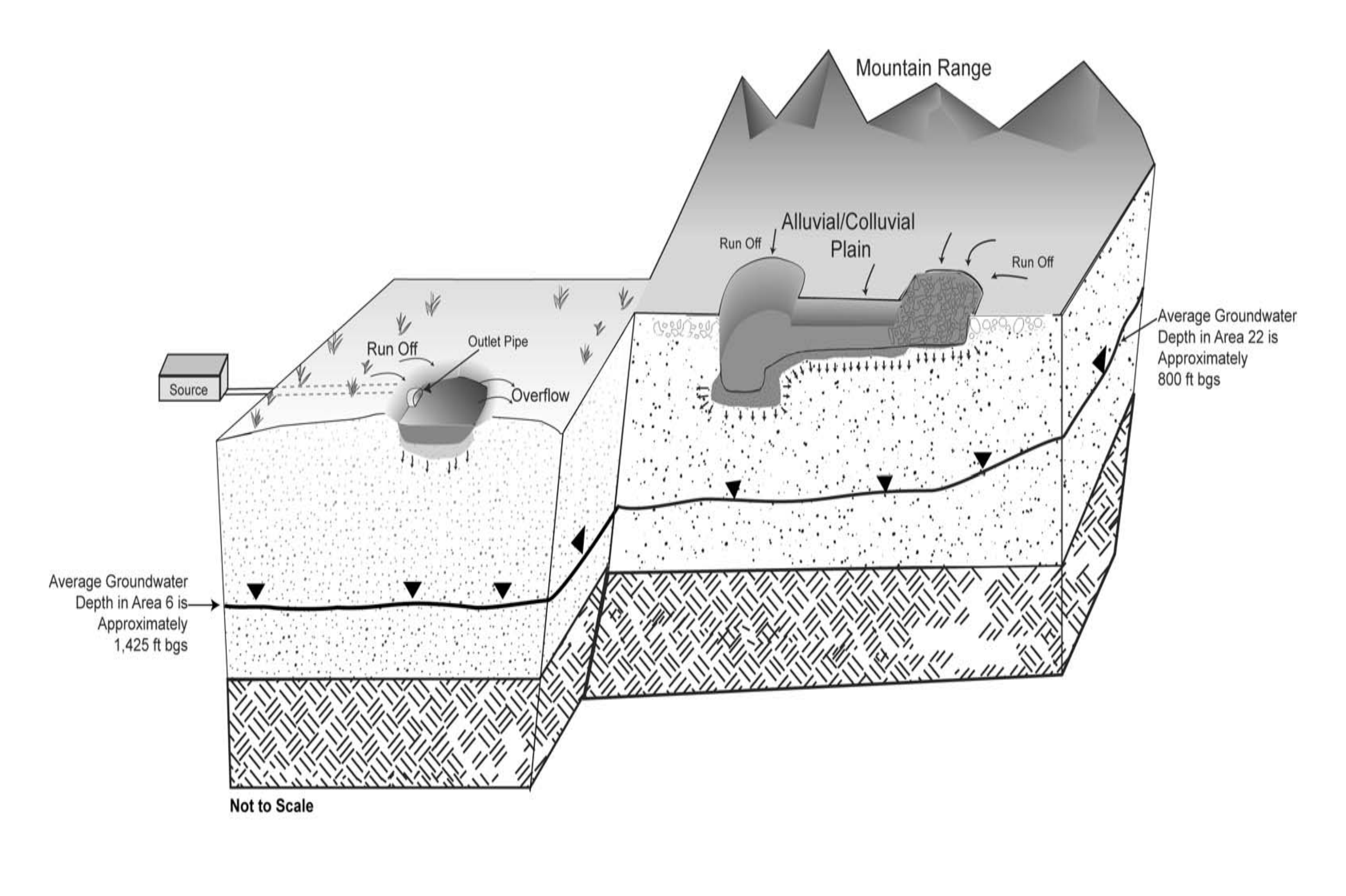

Figure 3-5
Sump Conceptual Site Model

- ***Nuclear and High Explosives Test Zone*** - CASs 03-59-01 and 03-59-03 are located within this zone that is designated 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.

- ***Solar Enterprise Zone*** - CAS 22-19-04 is located within this area that is designated for the development of a solar power generation facility, and light industrial equipment and commercial manufacturing capability.

3.1.2 Potential Contaminant Sources

At CASs 03-59-01 and 03-59-02, potential contaminant sources include material remaining within septic system components (i.e., septic tanks, distribution boxes, and collection and distribution system pipes). Contaminated soils in leachfields and in contact with leaking system components may also be potential sources. At 03-59-02, contaminated soils associated with two dry wells are also potential sources of contamination.

At CASs 06-51-01 and 06-51-03, potential contaminant sources are material remaining within the clean out box and the associated piping leading from Building 660 to a sump. Contaminated soils in the sump and in contact with leaking system components may also be potential sources.

At CAS 22-19-04, contaminated soils underlying the decontamination pad, drainage ditch, and the sump may be potential sources.

3.1.3 Release Mechanisms

Release mechanisms for the CSMs are primarily direct discharge of liquid waste to the surface in sumps or to the subsurface from leachfields and dry wells. Subsurface releases may have also occurred as unintentional leaks from clean out boxes, septic tanks, or pipes.

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, the presence of relatively impermeable layers could modify transport pathways in the subsurface (e.g., caliche layers). Vertical migration of contaminants directly below septic system components (i.e., septic tank, distribution box, and piping) is not expected; however, structural failure of septic waste components may have introduced contamination into the subsurface. Vertical migration of contaminants directly below the leachfields, sumps, dry wells, and clean out box would be likely.

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 516 CSMs, concentrations of contaminants are expected to decrease with horizontal and vertical distance from the location of the release.

Contaminants could be transported in 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 annual potential evapotranspiration at the Area 3 RWMS 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. The 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.

3.1.5 Exposure Points

The exposure points are expected to be locations where visitors and site workers will come in contact with potential contaminants at surface locations such as sumps, a ditch, or the bottom of a clean out box. At the leachfields, dry wells, and other system components (e.g., septic tanks and pipes) exposure points are located in the subsurface and may be accessed during construction and remediation activities. Exposure routes for the CSMs include external (radiological) exposure to, oral ingestion of, inhalation of, and dermal (absorption) contact with soil due to disturbance of contaminated soils by performing activities at the exposure points.

3.1.6 Additional Information

Additional topographic information for CAU 516 will not be necessary because the data available are adequate to make determinations about the sites.

General surface and subsurface soil descriptions will be observed and recorded during the corrective action investigation.

Climatic conditions for the CAU are well documented and have been addressed in the CSM. Average annual precipitation measurements are presented in Sections 2.1.1 through 2.1.3. 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 Sections 2.1.1 through 2.1.3. No further information is required.

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

No buildings or structures will be evaluated during the investigation. However, a utility survey will be conducted at each CAS to avoid underground utilities and to maintain a safe work environment. Active working utilities will not be impacted by the investigation.

3.2 Contaminants of Potential Concern

Suspected contaminants for CAU 516 were identified through a review of site historical documentation, employee interviews, process knowledge, past investigation efforts, and inferred activities associated with the CASs. Table 3-1 presents the analytical program and COPCs for

Table 3-1
Analytical Program and Contaminants of Potential Concern for CAU 516*

Analytical Parameter		CAS 03-59-01	CAS 03-59-02		CAS 06-51-01	CAS 06-51-03	CAS 22-19-04
			Septic System and Dry Well	Photoprocessing Dry Well			
Organics							
Total Volatile Organic Compounds		X	X	X	X	X	X
Total Semivolatile Organic Compounds (to include Hydroquinone at photoprocessing dry well in CAS 03-59-02)		X	X	X	X	X	X
Polychlorinated Biphenyls		X	X	X	X	X	X
Total Petroleum Hydrocarbons	[C_6 - C_{10}] gasoline-range	X	X	X	X	X	X
Total Petroleum Hydrocarbons	[C_{10} - C_{38}] diesel-range	X	X	X	X	X	X
Metals							
Total *Resource Conservation and Recovery Act* metals		X	X	X	X	X	X
Total Beryllium		X	X	X	X	X	X
Total Aluminum		--	--	X	--	--	--
Radionuclides							
Gamma Spectrometry (to include Americium-241 and Cesium-137)		X	X	X	X	X	X
Strontium-90		--	X	--	X	X	X
Isotopic Plutonium		--	X	--	X	X	X
Isotopic Uranium		--	--	--	--	--	X

*Footnotes:
- Critical contaminants of potential concern (i.e., analytes) are listed in Table A.1-1.
- Analytical methods for each analytical parameter are listed in Tables 3-2 and 3-3.
- Laboratory-specific analytes detected by each analytical methods are listed in Table A.1-6.
- CAS 06-51-02 is not included in this table because samples will not be collected.

CAU 516 as developed during the DQO process. Chemical COPCs are defined as the analytes detected using the analytical methods listed in Table 3-2 for which the U.S. Environmental Protection Agency (EPA) Region IX has established Preliminary Remediation Goals (PRGs) (EPA, 2002) for which toxicity data are listed in the EPA Integrated Risk Information System (IRIS) database (EPA, 2003). Radiological COPCs are defined as the radionuclides detected using the analytical methods listed in Table 3-3.

Critical COPCs for Phase I samples are the potential chemical and radionuclide constituents that are reasonably suspected to be present at the site based on documented use or process knowledge. These critical analytes are given greater importance in the decision-making process relative to other COPCs and have a completeness goal of 100 percent. When data for critical COPCs are not available, a final decision on the CAS cannot be made without further evaluation and justification.

Phase I noncritical and critical COPCs associated with each CAS are discussed below.

CAS 03-59-01 - Petroleum hydrocarbons (e.g., gasoline, diesel fuel, oil and grease from vehicles); VOCs and SVOCs (e.g., cleaning fluids, paints); and RCRA metals (e.g., metal-based paints) are representative of the general characteristics of municipal sewage (Zakrzewski, 1991). Beryllium and polychlorinated biphenyls (PCBs) are common concerns at the NTS as these contaminants have been detected in unlikely scenarios previously investigated.

CAS 03-59-02 - For the dry well associated with the photoprocessing trailers, silver was released from film during photoprocessing, hydroquinone is in the developing agent used in photoprocessing, and aluminum is a component of a rapid fixer used in photoprocessing. Silver, aluminum, and hydroquinone are critical COPCs for the dry well portion of CAS 03-59-02. Petroleum hydrocarbons (e.g., oil and grease from vehicles [e.g., gasoline and diesel fuel], construction site activities); VOCs and SVOCs (e.g., cleaning fluids, paints); and RCRA metals (e.g., metal-based paints [e.g., lead-based paint]) are representative of the general characteristics of municipal sewage (Zakrzewski, 1991). Beryllium and PCBs are common concerns at the NTS as these contaminants have been detected in unlikely scenarios previously investigated. The radioisotopes Cs-137, Sr-90, and Pu-238, Pu-239/240 are potential contaminants resulting from the storage of nuclear racks used for nuclear test diagnostics.

Table 3-2
Analytical Requirements for Nonradiological Analytes for CAU 516*
(Page 1 of 3)

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

Table 3-2
Analytical Requirements for Nonradiological Analytes for CAU 516*
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Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision[a]	Percent Recovery (%R)[b]
INORGANICS						
Total RCRA Metals, plus Beryllium and Aluminum						
Aluminum	Water	6010B[c]	0.02mg/L[i]	NA	20[i]	Matrix Spike Recovery 75-125i Laboratory Control Sample Recovery 80 - 120i
	Soil	6010B[c]	20 mg/kg[i]		35[h]	
Arsenic	Water	6010B[c]	0.01 mg/L[h, i]		20[i]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[h]	
Barium	Water	6010B[c]	0.20 mg/L[h, i]		20[i]	
	Soil	6010B[c]	20 mg/kg[h, i]		35[h]	
Beryllium	Water	6010B[c]	0.005 mg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[h]	
Cadmium	Water	6010B[c]	0.005 mg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/L[h, i]		35[h]	
Chromium	Water	6010B[c]	0.01 mg/L[h, i]		20[i]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[h]	
Lead	Water	6010B[c]	0.003 mg/L[h, i]		20[i]	
	Soil	6010B[c]	0.3 mg/kg[h, i]		35[h]	
Mercury	Water	7470A[c]	0.0002 mg/L[h, i]		20[i]	
	Soil	7471A[c]	0.1 mg/kg[h, i]		35[h]	
Selenium	Water	6010B[c]	0.005 mg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[h]	
Silver	Water	6010B[c]	0.01 mg/L[h, i]		20[i]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[h]	
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B[c] 1311/7470A[c]	0.10 mg/L[h, i]	5 mg/L[f]	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80 - 120[i]
Barium			2 mg/L[h, i]	100 mg/L[f]		
Cadmium			0.05 mg/L[h, i]	1 mg/L[f]		
Chromium			0.1 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			0.1 mg/L[h, i]	5 mg/L[f]		

*Footnotes:
1. See Table 3-3 for the analytical requirements for radionuclides.
2. See Table 4-3 for the analyses of geotechnical and hydrological properties.
3. See Table 4-4 for tests for bioassessments.

Table 3-2
Analytical Requirements for Nonradiological Analytes for CAU 516*
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[a] Relative percent difference (RPD) is used to calculate precision. Precision is estimated from the RPD of the concentrations measured for the matrix spike and matrix spike duplicate or of laboratory, or field duplicates of unspiked samples. It is calculated by: RPD = 100 x $\{(|A_1-A_2|)/[(A_1+A_2)/2]\}$, where A_1 = Concentration of the parameter in the initial sample aliquot, A_2 = Concentration of the parameter in the duplicate sample aliquot.
[b] The %R is used to calculate accuracy. Accuracy is assessed from the recovery of parameters spiked into a blank or sample matrix of interest, or from the recovery of surrogate compounds spiked into each sample. The recovery of each spiked parameter is calculated by: %R = 100 x (A_s-A_u/A_n), where A_s = Concentration of the parameter in the spiked sample, A_u = Concentration of the parameter in the unspiked sample, A_n = Concentration increase that should result from spiking the sample.
[c] The EPA *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, 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* (CFR) Part 261, "Identification and Listing of Hazardous Waste" (CFR, 2002a)
[g] EPA *Contract Laboratory Program (CLP) 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)

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

CAS 06-51-01 and CAS 06-51-03 - The radioisotopes Cs-137, Sr-90, and Pu-238 and -239/240 were detected at below the MDLs in liquid sampled from the CAS 06-04-02 UST. Americium-241 and Pu-238 and -239/240 may have leached out of the radiologically contaminated animal feed used in animal investigation studies. The radionuclides discussed above are the critical COPCs for CASs 06-51-01 and 06-51-03. Petroleum hydrocarbons, VOCs, SVOCs, and RCRA metals are representative of the general characteristics of sewage. Beryllium and PCBs are common concerns at the NTS as these contaminants have been detected in unlikely scenarios previously investigated.

CAS 06-51-02 - No COPCs are associated with the clay pipe and construction debris at this site.

CAS 22-19-04 - VOCs and SVOCs may have been used in the decontamination process. The RCRA metals and petroleum hydrocarbons may be potential contaminants from the decontamination of equipment and vehicles fueled by and/or maintained with petroleum hydrocarbon products. Beryllium and PCBs are common concerns at the NTS for these contaminants have been detected in

Table 3-3
Analytical Requirements for Radionuclides for CAU 516

Parameter/Analyte	Matrix	Analytical Method	MDC[a]	PAL[b]	MRL[e]	Laboratory Precision	Percent Recovery
Gamma Spectrometry							
Americium-240	water	EPA 901.1[f]	50 pCi/L[g]	50 pCi/L	50 pCi/L	Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2<ND<2[i]	Laboratory Control Sample Recovery 80-120[j] Percent Recovery (%R)
	soil	HASL-300[h]	2.0 pCi/g[g]	2.0 pCi/g	2.0 pCi/g		
Cesium-137	water	EPA 901.1[f]	10 pCi/L[g]	10 pCi/L	10 pCi/L		
	soil	HASL-300[h]	0.5 pCi/g[g]	7.0 pCi/g	2.5 pCi/g		
Other Radionuclides							
Plutonium-238	water	ASTM D3865-02[k]	0.1 pCi/L	0.16 pCi/L	0.1 pCi/L	Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2<ND<2[i]	Laboratory Control Sample Recovery 80-120[j] Percent Recovery (%R) Chemical Yield 30-10l[j] %R
	soil	ASTM C1001-00[m]	0.05 pCi/g	0.05 pCi/g	0.05 pCi/g		
Plutonium-239/240	water	ASTM D3865-02[k]	0.1 pCi/L	9.0 pCi/L	0.5 pCi/L		
	soil	ASTM C1001-00[m]	0.05 pCi/g	0.106 pCi/g	0.05 pCi/g		
Strontium-90	water	ASTM D5811-00[p]	1.0 pCi/L	1.0 pCi/L	1.0 pCi/L		
	soil	HASL 300[h]	0.5 pCi/g	1.17 pCi/g	0.5 pCi/g		
Uranium-234	water	ASTM D3972-02[n]	0.1 pCi/L	8.92 pCi/L	0.5 pCi/L		
	soil	C1000-02[o]	0.05 pCi/g	3.47 pCi/g	0.25 pCi/g		
Uranium-235	water	ASTM D3972-02[n]	0.1 pCi/L	0.36 pCi/L	0.1 pCi/L		
	soil	C1000-02[o]	0.05 pCi/g	0.07 pCi/g	0.05 pCi/g		
Uranium-238	water	ASTM D3972-02[n]	0.1 pCi/L	9.39 pCi/L	0.5 pCi/L		
	soil	C1000-02[o]	0.05 pCi/g	3.47 pCi/g	0.25 pCi/g		

[a]The MDC is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.
[b]The PALs for soil (with the exception of Am-241) are isotope-specific and defined as the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991; DOE/NV, 1996a).
[c]The PALs for Am-241 in soil are set equal to the MDC.
[d]The PALs for liquids are set equal to the MDC.
[e]The MRL is set equal to 5 times the MDC, or if 5 times the MDC is greater than the PAL, the MRL is set equal to the MDC.
[f]*Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)
[g]MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.
[h]*Environmental Measurements Laboratory Procedures Manual*, HASL-300 (DOE, 1997)
[i] ND is not RPD, it is another measure of precision used to evaluate duplicate analyses. The ND is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)
[j]EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)
[k]*Standard Test Method for Plutonium in Water* (ASTM, 2002b)
[l] General Radiochemistry and Routine Analytical Services Protocol (GRASP) (EG&G Rocky Flats, 1991). The chemical yield only applies to plutonium, uranium, and strontium.
[m]*Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy* (ASTM, 2000a)
[n]*Standard Test Method for Isotopic Uranium in Water by Radiochemistry* (ASTM, 2002a)
[o]*Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry* (ASTM, 2002c)
[p]*Standard Test Method for Strontium-90 in Water* (ASTM, 2000b).

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

unlikely scenarios previously investigated. The radioisotopes Cs-137; Sr-90; Pu-238, and Pu-239/240; and U-234, U-235, and U-238 are potential contaminants from the decontamination of vehicles and equipment; or may be the result from atmospheric testing.

3.3 Preliminary Action Levels

Laboratory analytical results for soil samples will be compared to the following PALs to evaluate if COCs are present or migrating:

- EPA *Region 9 Risk-Based Preliminary Remediation Goals* for chemical constituents in industrial soils (EPA, 2002).
- Background concentrations for RCRA metals, aluminum, and beryllium will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic on the NTS. Background is considered the mean plus two standard deviations of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999).
- The TPH action limit of 100 parts per million (ppm) per the *Nevada Administrative Code* (NAC) 445A.2272 (NAC, 2002e).
- 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; DOE/NV, 1996a). 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 (see Table 3-3).

The comparison of laboratory results to PALs will be discussed in the Corrective Action Decision Document (CADD). Laboratory results above action levels indicate the presence of COCs at levels that may require corrective action, these are not necessarily the final cleanup criteria. 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.

3.3.1 Field-Screening Levels

Field screening may be instituted to assist in providing additional semiquantitative measurements. The field-screening results (FSRs), along with other biasing factors, may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following action levels may be used for on-site field screening:

- Headspace field screening for VOC headspace screening levels at 20 ppm or 2.5 times background, whichever is greater
- TPH field-screening results greater than 75 ppm measured using an appropriate field-screening method (e.g., gas chromatography or an equivalent method)
- Radiological (alpha and beta/gamma) field-screening level (FSL) for soil samples is the mean background activity plus two times the standard deviation of the mean background activity

Field-screening concentrations exceeding FSLs indicate potential contamination at that sample location. This information will be documented and the investigation will be continued in order to delineate the extent of contamination. Additionally, this data may also be used to select samples to be submitted for laboratory analysis.

3.4 Data Quality Objectives Process Discussion

The DQOs are qualitative, semiquantitative, and quantitative statements that define the type, quantity, and quality of data required to support evaluations of potential closure alternatives for CAU 516. The DQOs were developed to identify data needs and clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes.

Details of the DQO process are presented in Appendix A.1. During the DQO discussion for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented. Criteria for data collection activities were assigned. The analytical methods and reporting limits prescribed through the DQO process, as well as the DQIs for laboratory analysis such as precision and accuracy requirements, are provided in more detail in Section 6.0 of this CAIP. Laboratory data will be assessed to confirm or refute the conceptual model and determine if the DQOs were met based on the DQIs of precision, accuracy, representativeness, completeness, and comparability. Other DQIs, such as sensitivity, may be used.

This decision process starts with a Phase I investigation for all CASs. If laboratory data indicates the presence of COCs, Phase II extent data will be generated. The process ends with no further investigation of the site based on having all the data required for selection of a corrective action. The corrective action alternatives, closure in place and clean closure, will be evaluated for each CAS containing COCs, as appropriate.

During the DQO process, it was determined that CAS 06-51-02 requires only a housekeeping action to clean up debris. Therefore, no investigation is necessary for closure of the CAS.

Analytical methods and minimum reporting limits (MRLs) for each chemical parameter are provided in Table 3-2. The MRL is a practical reporting limit that ensures data generated by the laboratory will be usable by the investigation.

Radiation MRLs were developed considering both the MDCs and the PALs (Adams and Dionne, 2000). The MDCs, PALs, and MRLs for radionuclides are provided in Table 3-3. The MDC is the lowest concentration of a particular parameter that can be detected in a sample with an acceptable level of error. The MDCs listed in Table 3-3 are typical default levels available for a commercial radioanalytical laboratory.

4.0 Field Investigation

This section of the CAIP contains the approach for investigating CAU 516.

4.1 Technical Approach

The technical approach for CAU 516 consists of activities to be conducted prior to and during the corrective action investigation. This technical approach consists of, but is not limited to, the following activities:

- Conduct exploratory excavations to inspect discrete portions of the septic system for residual sediment.

- Field screen soil samples for VOCs, TPH, and radiological activity as appropriate in accordance with Section 3.3.1 to guide the field investigation and sample selection.

- Inspect septic tanks for liquid, sludge, and sediment indicative of system use. If these matrices are present:

  - Collect samples of each matrix and analyze for the COPCs identified in Section 3.2 of this CAIP. Additional samples will be collected and analyzed in accordance with Section 4.2.5, and the results used for waste management purposes.

    Note: Septic tank closure material (e.g., concrete, sand) will not be sampled.

  - Document (i.e., photograph, sketch, and measure) the physical specifications of septic system components, such as the septic tanks and distribution boxes (e.g., openings, configuration, dimensions, depth, capacity, content volume) for future corrective action considerations.

- Conduct visual inspection (i.e., video mole survey) of septic system piping for sediment and breaches in the piping. Collect and analyze samples of residual sediments from piping, if adequate and appropriate material is present, to characterize the contents. Collect and analyze soil samples below any breaches in the piping.

- Verify depth of the dry wells at CAS 03-59-02 and document any additional physical specifications as best as possible.

- Plug (e.g., grout) any septic system piping that could potentially release material into the septic system or directly into the environment.

- Collect biased subsurface soil samples using excavation in areas of the collection system including the septic tanks and the outfall end of the distribution boxes to confirm collection system integrity.
- Collect biased subsurface samples via excavation from the leachfield material/native soil interface underneath the leachfield distribution pipes.
- Analyze soil samples for COPCs identified in Section 3.2 and Table A.1-1.
- Collect biased soil samples using drilling to define the vertical extent of potential contamination, if the vertical extent cannot be reach via excavation (e.g., at dry wells).
- Collect required QC samples as described in Section 6.0.
- Collect waste characterization samples, as needed.
- Collect biased samples from native soils beneath the septic system components for which analytical results or FSRs confirm that contamination is not present, and submit for the analysis of geotechnical and hydrological parameters.
- Bioassessment samples may be collected and submitted for analysis, if VOCs or TPH FSRs exceed FSLs, or at the discretion of the Site Supervisor.
- Mark sample locations and collect coordinates in Universal Transverse Mercator (UTM), Zone 11, North American Datum 1927, meters coordinate system.
- Collect Phase II samples based on Phase I analytical results to define lateral and vertical extent of contamination, if necessary.
- Remove surface debris at CAS 06-51-02 (Section 4.2.4).
- Conduct decontamination activities.

4.2 Field Activities

This section provides a description of the field activities for CAU 516. Biased sampling will be conducted during the investigation to address the information needs to resolve the Phase I and Phase II decisions presented in Table A.1-4. Process knowledge indicates that contamination, if any, is confined to the spatial boundaries of the sites as defined in the DQO process and the CSM. If Phase I analytical results determine that COCs are present in a CAS, the extent of contamination will be determined by Phase II sampling. Only COCs identified by Phase I analytical results will be considered during Phase II.

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). The Nevada Division of Environmental Protection (NDEP's) concurrence with the ROTC is required prior to proceeding with investigation activities significantly different from those described in this document. If contamination is more extensive than anticipated, and the maximum investigation depth is limited by the capabilities of the equipment used to collect subsurface soil samples, the investigation will be rescoped.

Samples will be collected at biased sampling locations by rotary-sonic drilling, hollow-stem auger drilling, direct-push, and/or excavation, as appropriate. Table 3-2 and Table 3-3 provide the analytical methods to be used when analyzing for the COPCs. All sampling activities and QA/QC requirements for field and laboratory environmental sampling will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable procedures. Other governing documents include a current version of the contractor-specific HASP and an approved SSHASP prepared 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 procedures for protecting the environment. The ISMS program requires that site personnel take every reasonable step to reduce or eliminate the possibility of injury, illness, or accidents, and to protect the environment during all project activities. The following safety issues will be taken into consideration when evaluating the hazards and associated control procedures for field activities discussed in the SSHASP:

- Potential hazards to site personnel and the public include, but are not limited to: radionuclides, chemicals (e.g., heavy metals, VOCs, SVOCs, PCBs, 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 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).

- Emergency and contingency planning and communications to include medical care and evacuation, decontamination, and spill control measures, and appropriate notification of project management.

4.2.1 Site Preparation Activities

Site preparation will be performed by the NTS Management and Operating (M&O) Contractor prior to the investigation. Site preparation may include, but not be limited to, the construction of Hazardous Waste Accumulation Areas (HWAAs), work zones, and decontamination pads; and moving and/or staging of surface debris within CAS boundaries to facilitate the investigation of the CAS.

4.2.2 Phase I Activities

A comparison of laboratory analytical results from this phase against PALs will be used to confirm the presence or absence of COCs. Biased sampling locations were determined based on biasing factors. The Site Supervisor has the ability to modify these locations and minimize samples submitted for laboratory analyses, but only if the decision needs and criteria stipulated in Section A.1.4 are satisfied.

The Phase I sampling strategy targets locations and media most likely to be contaminated by COCs. Appendix A.1 lists the target populations for Phase I. Section A.1.4.1 identifies the primary biasing factors and information needs in selecting data collection locations for Phase I decisions. The planned sample locations are shown in Figures 4-1 through 4-4, which are provided following the sampling description for each CAS.

4.2.2.1 Intrusive Activities

Intrusive investigation activities such as mechanical drilling (e.g., rotary-sonic, hollow-stem auger), direct-push (e.g., geoprobe), hand sampling, mechanical excavation (e.g., backhoe), or other appropriate collection techniques will be used to collect biased surface and subsurface soil samples for laboratory analysis at select locations to determine if a COC is present or migrating. Biased locations for these activities are based on the biasing factors discussed in Section A.1.4.1. The sampling locations relative to the COC target populations for each CAS are summarized in Table 4-1. The sampling strategy for each CSM component is listed in Table 4-2.

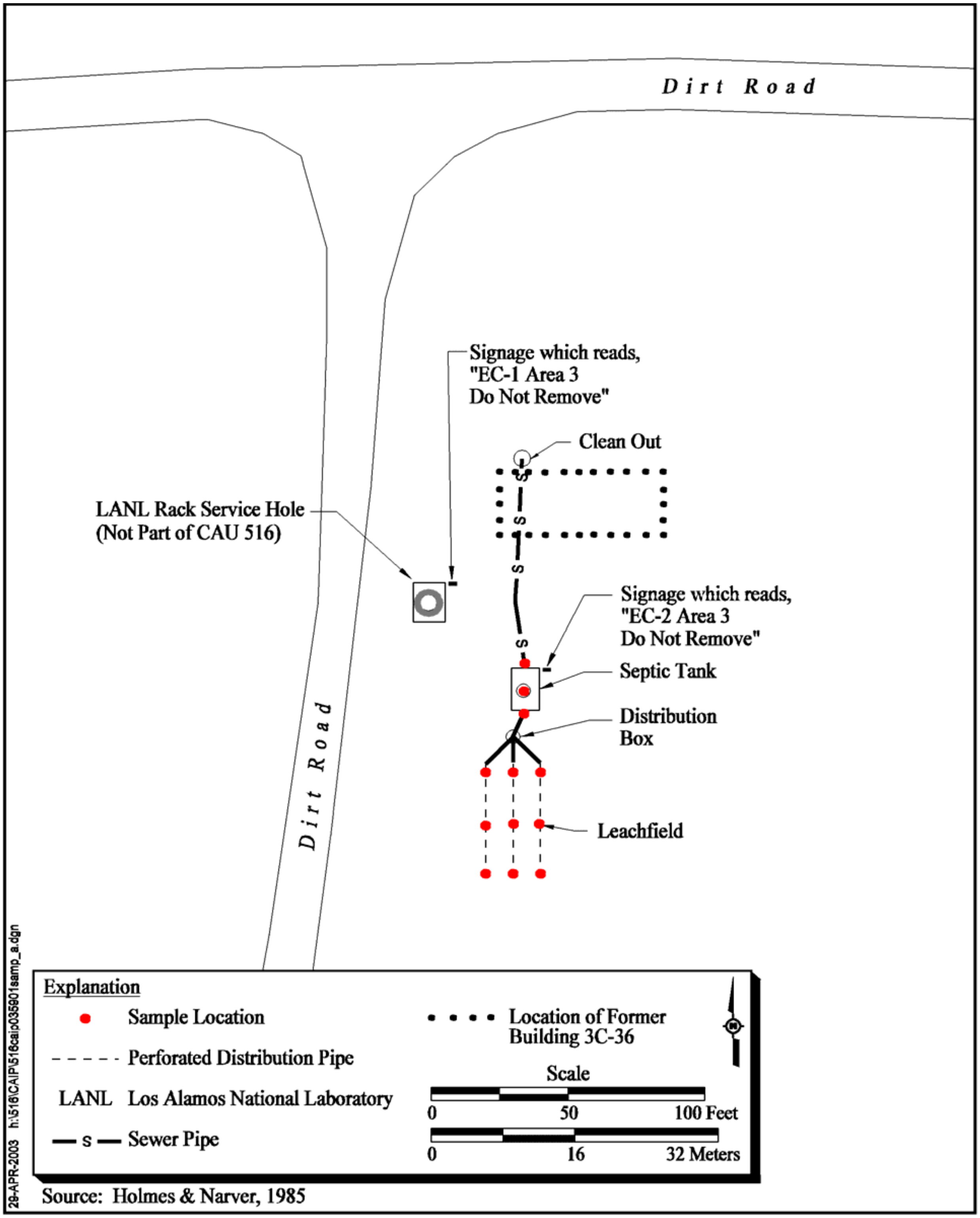

Figure 4-1
CAS 03-59-01, Planned Sampling Locations

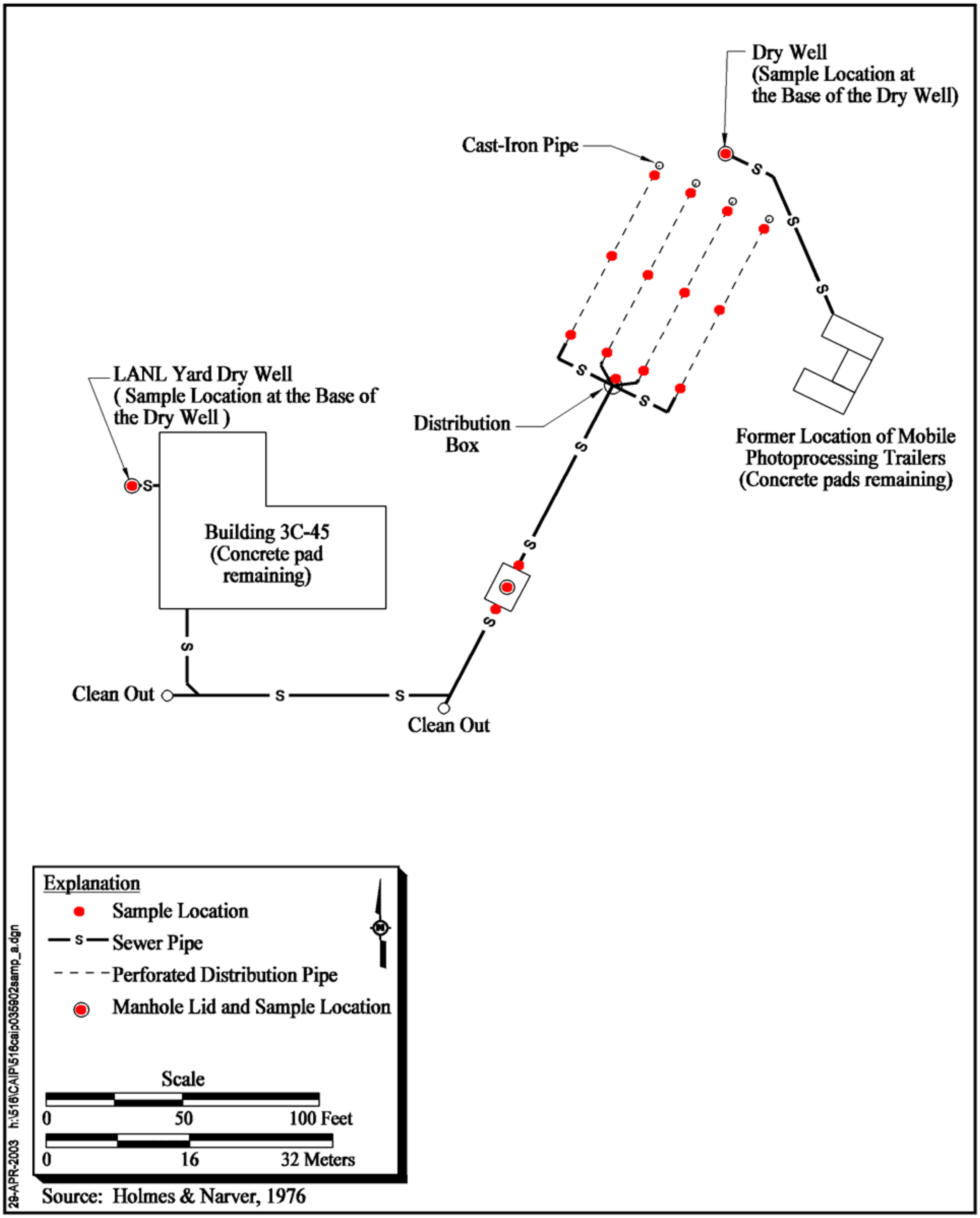

Figure 4-2
CAS 03-59-02, Planned Sampling Locations

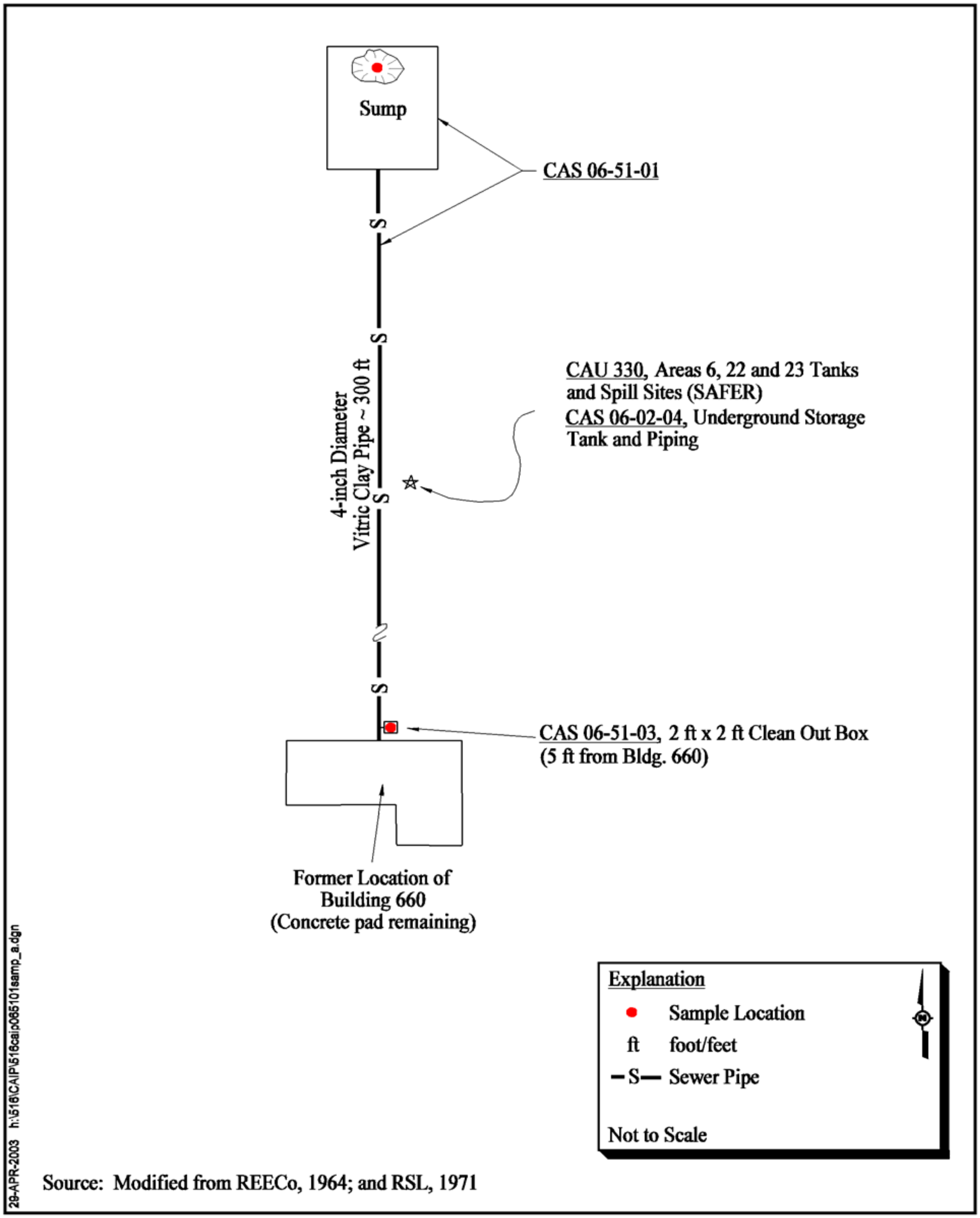

Figure 4-3
CAS 06-51-01 and CAS 06-51-03, Planned Sampling Locations

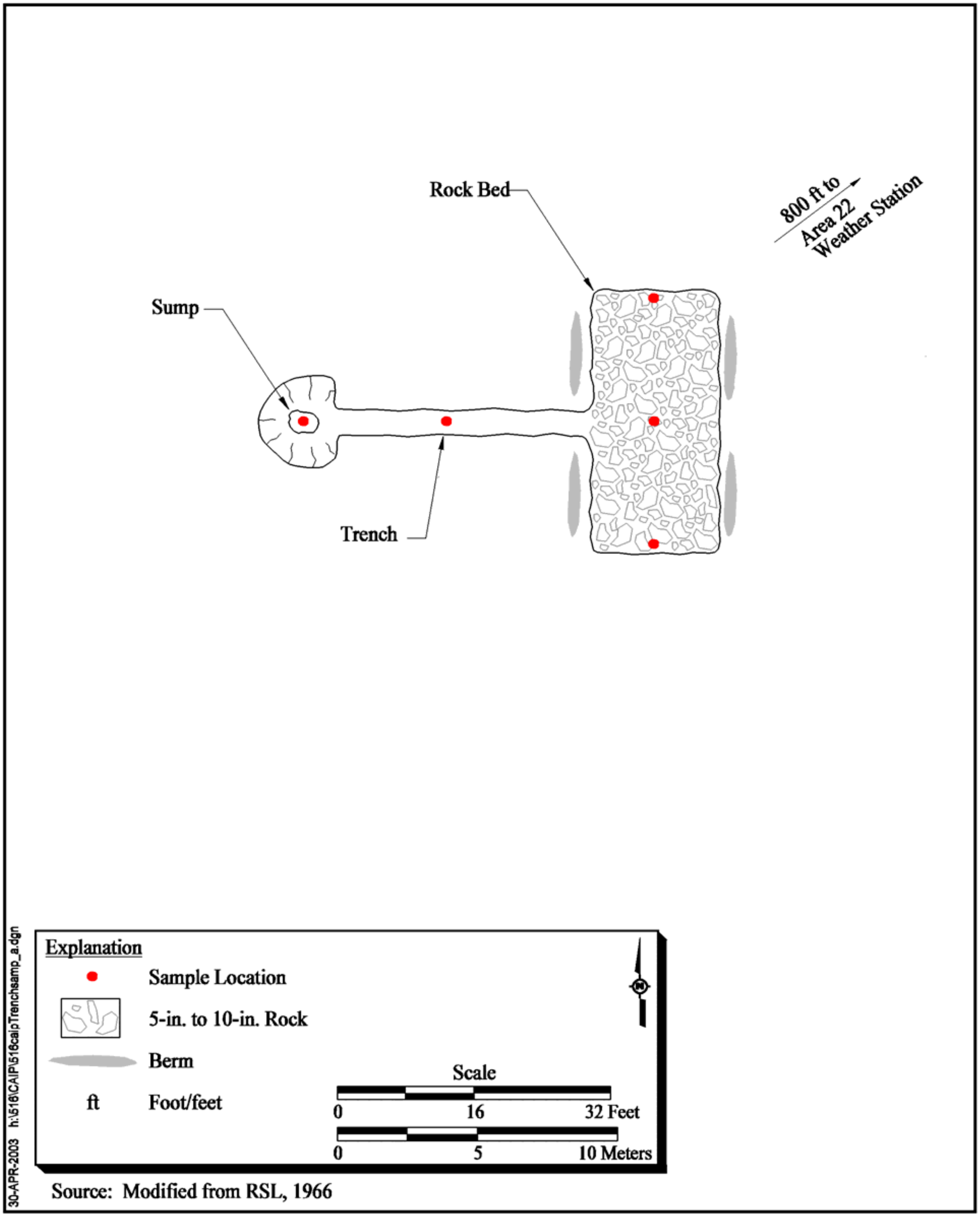

Figure 4-4
CAS 22-19-04, Planned Sampling Location

Table 4-1
COC Target Populations for Each CAS*

CAS	COC Target Populations
03-59-01 and 03-59-02	Residual material in septic system piping (including leachfield distribution pipes)
	Soil beneath detectable breaches in septic system piping
	Septic tank contents
	Soil horizon underlying the base of the septic tank ends and underneath the inlet and outlet end pipes.
	Soil horizon underlying the base of the distribution box and position underneath the outlet end pipe
	Residual material in dry well(s)
	Soil at the leachrock/native soil interface of the dry well(s)
	Soil beneath leachrock/native soil interface at the midpoint, and the proximal and distal ends of the leachfield distribution pipes
06-51-01	Residual material in septic system piping
	Soil beneath detectable breaches in septic system piping
	Soil at the lowest point in the sump
06-51-03	Residual material in septic system piping
	Soil beneath detectable breaches in septic system piping
	Residual material in the clean out box
	Soil horizon underlying the base of the clean out box
22-19-04	Soil at the rock bed/native soil interface at the center and north and south ends of the decontamination pad
	Soil at the midpoint of the trench
	Soil at the lowest point in the sump

*Footnotes:
-The sampling locations are tentative and may be altered based upon additional information and/or the presents of biasing factors per Section A.1.4.1.
-Leachrock material will not be analyzed; only material indicative of septic waste will be collected and analyzed.
-CAS 06-51-02 is not included in this table because samples will not be collected.

Select samples will be submitted for off-site laboratory analysis of the Phase I chemical and radiological parameters identified for each CAS in Section 3.2. Analytical requirements are listed in Table 3-2 and Table 3-3. Laboratory volume requirements are laboratory-specific and will be described in the contractor's CAU 516 field instructions. Quality assurance and QC requirements for sample collection are discussed in Section 6.0. The planned sampling locations are discussed in the following section.

Table 4-2
Sample Collection Strategy For Field Screening and Laboratory Analysis*
(Page 1 of 2)

CAS Component	COC Target Populations	Field-Screening Interval Requirements	Samples Submitted for Analysis
Septic System Piping	Residual material (including leachfield distribution pipes)	--------	all
	Soil beneath detectable breaches	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 -1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs
Septic Tank	Residual material	--------	all
	Soil horizon underlying the base of the septic tank ends and soil underneath the inlet and outlet end pipes	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 - 1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs
Distribution Box	Residual material	--------	all
	Soil horizon underlying the base of the distribution box at the outlet end	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 - 1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs
Leachfield	Soil at the leachrock/native soil interface of the midpoint, and the proximal and distal ends of the distribution pipes	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 - 1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs
Dry Well	Residual material	--------	all
	Soil at the rock/native soil interface	0 - 1 ft and If, FSRs > FSLs, sample every 5 ft until 2 consecutive samples have FSRs < FSLs	Submit 0 - 1 ft and sample with the highest FSRs > FSLs and deepest sample with FSRs < FSLs (a minimum of 2 samples will be submitted)
Clean Out Box	Residual material	--------	all
	Soil horizon underlying the base of the clean out box	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 -1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs (a minimum of 2 samples will be submitted)
Sump	Soil at the lowest point	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 -1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs (a minimum of 2 samples will be submitted)

Table 4-2
Sample Collection Strategy For Field Screening and Laboratory Analysis*
(Page 2 of 2)

CAS Component	COC Target Populations	Field-Screening Interval Requirements	Samples Submitted for Analysis
Decontamination Pad Sump	Soil at the rock bed/native soil interface at the center and the north and south ends of the decontamination pad	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 -1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs
	Soil at the midpoint of the trench	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 -1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs
	Soil at the lowest point in the sump	0 - 1 ft and If, FSRs > FSLs, sample every 2.5 ft until FSRs < FSLs	Submit 0 -1 ft and If, FSRs > FSLs, the first sample with FSRs < FSLs

* Footnotes:
-The sampling locations are tentative and may be altered based upon additional information and/or the presents of biasing factors per Section A.1.4.1.
-Leachrock material will not be analyzed; only material indicative of septic waste will be collected and analyzed.

4.2.2.2 Sampling Strategy

All CASs, with the exception of CASs 06-51-02 and 22-19-04, have septic system piping. Phase I activities will consist of excavating to locate the discharge piping and collecting biased samples for laboratory analysis from residual material in the septic system piping, if present, and soil beneath any detectable breaches in the septic system piping.

The septic system piping will be visually inspected for sediment. Entry points may be accessed by excavating pipes, as necessary. If an adequate volume of sediment is present and accessible at the inspected locations, samples will be collected and analyzed for site-specific COPCs. Only material related to the operation of the septic system will be collected. Animal droppings and nests, plant matter, and native soil in pipes will not be sampled.

The CASs 03-59-01 and 03-59-02 each have a septic tank. Phase I activities at these CASs will consist of excavating to locate the septic tank, inspecting inside the septic tank, and collecting biased samples for laboratory analysis from the following target populations:

- Content of the septic tanks, if present

- Soil underneath the inlet and outlet end pipes of the septic tanks
- Soil horizon underlying the base of the septic tank ends

The CASs 03-59-01 and 03-59-02 each have one distribution box where the effluent is directed to a leachfield. Phase I activities at these CASs will consist of excavating to locate the distribution boxes, inspecting inside the distribution boxes, and collecting biased samples for laboratory analysis from the following target populations:

- Content of the distribution boxes, if present
- Soil horizon underlying the base of the distribution boxes

The CASs 03-59-01 and 03-59-02 each have a leachfield. Phase I activities at these CASs will consist of excavating to locate the boundaries of each leachfield, expose the midpoint, and proximal and distal ends of the associated perforated distribution pipes, and collect biased samples for laboratory analysis from the following target populations:

- Soil beneath the leachrock/native soil interface at the midpoint, and proximal and distal ends of the distribution pipes. If the interface cannot be identified, then samples will be collected directly beneath the distribution pipes.

The clean out box in CAS 06-51-03 is located directly east of the discharge pipe in CAS 06-51-01. Phase I activities at this CAS will consist of using excavation and/or hand tools to determine the relationship of the clean out box and access pipe to the discharge pipe in CAS 06-51-01, and to collect biased samples for laboratory analysis from the following target populations:

- Residual material in the clean out box, if present
- Soil underneath the access pipe into the clean out box
- Soil horizon underlying the base of the clean out box

Corrective Action Site 03-59-02 has a dry well located 8 ft northeast of the leachfield for disposal of photographic waste and a dry well connected to Building 3C-45 by a sewer line. Phase I activities will consist of confirming the presence of the dry wells and collecting samples for laboratory analysis from the following target populations:

- Residual material in the dry wells, if present
- Soil at the leachrock/native soil interface of the dry wells

If the interface is not distinguishable, a sample will be collected at the base as shown in as-built engineering drawings, if available.

The CAS 22-19-04 consists of a vehicle decontamination pad, trench, and sump. Phase I activities at this CAS will consist of locating the base of the sump via excavation and collecting biased samples for laboratory analysis from the following target populations:

- Rock bed/native soil interface at the center and the north and south ends of the decontamination pad
- Soil at midpoint of trench between pad and sump
- Soil at the lowest point in the sump

The CAS 06-51-03 includes a sump. Phase I activities will consist of collecting a biased soil sample from the lowest point in the sump and other locations, if appropriate, based on biasing factors.

4.2.3 Phase II Activities

Phase II efforts will consist of defining the extent of contamination where COCs have been confirmed to be present or migrating. Only the COCs confirmed to be present/migrating will require analysis during Phase II. This parameter selection process will be applied independently to each CAS.

For all CASs in Phase II, the lateral and vertical extent of contamination will be bounded by a minimum of one laboratory analytical soil sample showing COC concentrations below PALs.

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.1.5.2, work will be temporarily suspended, NDEP will be notified, and the investigation strategy will be reevaluated. As long as contamination is consistent with the CSM and is within the spatial boundaries, sampling will continue to define extent.

Step-out sample locations will be selected approximately 15 ft from outer boundary Phase I sample locations where COCs were detected. If biasing factors indicate COCs extend beyond the proposed Phase II sample locations, further step-out locations may be necessary. As field data are generated, the Site Supervisor has the authority to modify these locations but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.4. If the step-out locations from different original locations approach each other, then the Site Supervisor may consider this as one area and collect samples only in an outward direction. Also, existing Phase I locations may serve to bound the extent of contamination if COCs are not present at these locations. In general, samples submitted for off-site laboratory analysis would be those that define the lateral and vertical extent of COCs.

4.2.4 Housekeeping at CAS 06-51-02

A housekeeping action will be performed at CAS 06-51-02 to remove construction and clay pipe debris at the site. Material to be removed will be identified by the A-E contractor and removed by the M&O contractor. The process will be photodocumented.

4.2.5 Additional Sample Collection

Additional samples will be collected at the discretion of the Site Supervisor with guidance from the Waste Management Lead or Health and Safety Officer, as appropriate, and analyzed to obtain data for the purpose of managing and disposing IDW, protecting the health and ensuring the safety of field and laboratory personnel, and developing corrective action alternatives (e.g., risk assessments, remediation potential) for contaminated sites. Samples may be collected and analyzed for the following purposes.

Investigation-derived waste management and disposal:

- Asbestos analysis for potential asbestos-containing material (e.g., transite pipe) or an inspection by a certified asbestos inspector, as appropriate
- TCLP RCRA metals, TCLP VOCs, TCLP SVOCs, and gamma spectrometry on sludge and sediment samples collected from septic tanks, distribution boxes, and associated piping
- Gamma spectrometry on select soil samples from each site, including one sample from each of the two dry wells at CAS 03-59-02, to verify the absence of gamma-emitting radionuclides
- Tritium, and gross alpha and beta on rinsate samples, at the discretion of the Waste Management Lead
- Tritium, and gross alpha and beta on liquid contents of septic tank, when found

Worker health and safety:

- Total and fecal coliform bacteria on-site analysis on sludge and sediment in distribution boxes and associated septic system piping only if septic tank sample results show coliform bacteria.

Corrective action decision making:

- Geotechnical and hydrological samples will be collected at a minimum below the base of each leachfield and discharge point and archived. If analytical results show the presence of contamination, then the geotechnical and hydrological samples may be submitted for analysis.

4.2.5.1 Geotechnical/Hydrological Analysis

Samples will be collected from below the base of the leachfields and sumps and may be submitted for analyses to measure the geotechnical/hydrological parameters. These samples will be collected within brass sleeves (or other containers, as appropriate) to maintain the natural physical characteristics of the soil. Table 4-3 lists general geotechnical and hydrological parameters of interest. The testing methods shown are minimum standards. Other equivalent or superior testing methods may be used.

Table 4-3
General Geotechnical and Hydrological Analysis

Geotechnical Parameter	Methods
Moisture content	ASTM D2216-92/D4643-93[a]
Bulk density[b]	ASTM D2937-94[a]; MOSA Chapter 13[b]
Calculated total porosity[b]	MOSA Chapter 18[c]
Saturated hydraulic conductivity	ASTM D2434-68(94)[a]; MOSA Chapter 28[c]
Calculated unsaturated hydraulic conductivity	van Genuchten[d]
Particle-size analysis/soil classification	ASTM D422-63(90)[a]
Moisture characteristics	ASTM D2325-68(94)[a]; MOSA Chapter 26[c]

[a]*Annual Book of ASTM Standards*: "Construction" (ASTM, 1996)
[b]Analysis can only be conducted on samples collected using a drilling method able to collect samples in 2.5- by 6-in. brass sleeves (Smith, 2001).
[c]*Method of Soil Analysis* (Soil Science Society of America, 1986)
[d]*Soil Science Society of America Journal*, "A Closed Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils" (1980)

MOSA = Methods of Soil Analysis

4.2.6 Bioassessment Tests

Bioassessment samples may be collected from sample intervals that significantly exceed FSLs for TPH and VOCs, or if other biasing factors suggest a hydrocarbon or solvent plume may be present. Bioassessment is a series of tests (Klens, 2001) designed to evaluate the physical, chemical, and microbiological characteristics of a site. This type of analysis is most appropriate for hydrocarbon contamination sites where bioremediation is a potential corrective action. Table 4-4 lists the determinations to be included in bioassessments.

Table 4-4
Bioassessment Tests for Soils

Parameter	Method	Minimum Detection Limit
Heterotrophic Microbial Population	Standard Methods 9215A[a]	<10
Degrading Microbial Population	Standard Methods 9215A[a]	<10
pH	Standard Methods 4500H+[a]	NA
Moisture	ASTM - D2216-98[b]	NA
Phosphate	Standard Methods PE - Ascorbic Acid[a]	Soil: 2.5 mg/kg
Ammonia	Standard Methods 4500-NH3[a]	Soil: 4.0 mg/kg
Simulation	IT BAC016[c]	NA

[a]*Standard Methods for the Examination of Water and Wastewater* (APHA, 1998)
[b]*Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures* (ASTM, 1998)
[c]IT Corporation proprietary

NA = Not applicable
mg/kg = Milligrams per kilogram

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 516 investigation samples.

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

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

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

5.1 Waste Minimization

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

5.2 Potential Waste Streams

Waste generated during the investigation activities may include the following:

- PPE and disposable sampling equipment (e.g., plastic sheeting, paper, glass and plastic sample jars, sampling scoops, aluminum foil, bowls)
- Decontamination rinsate
- Environmental media (e.g., soil, sludge, liquids, sediment)
- Field-screening waste (e.g., soil, spent solvent, rinsate, disposal sampling equipment, and contaminated PPE)
- Asbestos-containing material (i.e., transite septic system pipe)

Waste will be segregated at the time of generation.

5.3 Investigation-Derived Waste Management

The on-site management and ultimate disposition of IDW may be guided by several factors, including, but not limited to: the analytical results of samples either directly or indirectly associated with the waste, historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring/screening results, and/or radiological survey/swipe results. Table 4-2 of the *NV/YMP Radiological Control (RadCon) Manual* (DOE/NV, 2000) shall be used to determine if such materials may be declared nonradioactive. On-site IDW management requirements by waste type are detailed in the following sections. Applicable waste management regulations and requirements are listed in Table 5-1.

5.3.1 Sanitary Waste

Investigation-derived waste will be visually inspected and radiologically surveyed, as necessary, at the port of generation. It will be segregated and dispositioned if it meets the waste acceptance criteria for sanitary waste disposal facilities. Sanitary IDW generated at each CAS will be collected in plastic bags, sealed, labeled with the CAS number from each site in which it was generated, and dated. The waste will then be placed in a rolloff box located in Mercury, or other approved rolloff box location. The number of bags of sanitary IDW placed in the rolloff box will be counted as they are placed in the

Table 5-1
Waste Management Regulations and Requirements

Waste Type	Federal Regulation	Additional Requirements
Solid (nonhazardous)	NA	NRS 444.440 - 444.620[a] NAC 444.570 - 444.7499[b] NTS Landfill Permit SW13.097.04[c] NTS Landfill Permit SW13.097.03[d]
Liquid/Rinsate (nonhazardous)	NA	Water Pollution Control General Permit GNEV93001, Rev. 3iii[e]
Hazardous	RCRA[f]	NRS 459.400 - 459.600[g] NAC 444.850 - 444.8746[h] POC[i]
Low-Level Radioactive	NA	DOE Orders and NTSWAC[j]
Mixed	RCRA[f]	NTSWAC[j] POC[i]
Hydrocarbon	NA	NAC 445A.2272[k] NTS Landfill Permit SW13.097.02[l]
Polychlorinated Biphenyls	TSCA[m]	NRS 459.400 - 459.600[g] NAC 444.940 - 444.9555[o]
Asbestos	TSCA[n]	NRS 618.750-618.801[p] NAC 444.965-444.976[q]

[a]*Nevada Revised Statutes* (2001a)
[b]*Nevada Administrative Code* (2002a)
[c]Area 23 Class II Solid Waste Disposal Site (NDEP, 1997a)
[d]Area 9 Class III Solid Waste Disposal Site (NDEP, 1997c)
[e]Nevada Test Site Sewage Lagoons (NDEP, 1999)
[f]*Resource Conservation and Recovery Act* (CFR, 2002a)
[g]*Nevada Revised Statutes* (2001b)
[h]*Nevada Administrative Code* (2002b)
[i]*Performance Objective for the Certification of Nonradioactive Hazardous Waste* (BN, 1995)
[j]Nevada Test Site Waste Acceptance Criteria, Revision 4 (NNSA/NV, 2002b)
[k]*Nevada Administrative Code* (2002e)
[l]Area 6 Class III Solid Waste Disposal Site for Hydrocarbon (NDEP, 1997b)
[m]*Toxic Substance Control Act* (CFR, 2002b)
[n]*Toxic Substance Control Act* (CFR, 2002c)
[o]*Nevada Administrative Code* (2002c)
[p]*Nevada Revised Statutes* (1998)
[q]*Nevada Administrative Code* (2002d)

NA = Not applicable
NAC = *Nevada Administrative Code*
NRS = *Nevada Revised Statutes*
NTS = Nevada Test Site
RCRA = *Resource Conservation and Recovery Act*
NTSWAC = Nevada Test Site Waste Acceptance Criteria
TSCA = *Toxic Substance Control Act*
POC = *Performance Objective for the Certification of Nonradioactive Hazardous Waste*

rolloff box, and noted in the log, as well as documented in the field activity daily log (FADL). These logs will provide necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill, or other approved landfill.

5.3.2 Low-Level Waste

Radiological swipe surveys and/or direct-scan surveys may be conducted on reusable sampling equipment and the PPE and disposable sampling equipment waste streams exiting the exclusion zone. This allows for the immediate segregation of radioactive waste from waste that may be unrestricted regarding radiological release. Removable contamination limits, as defined in Table 4-2 of the current version of the NV/YMP RadCon Manual (DOE/NV, 2000), will be used to determine if such waste may be declared unrestricted regarding radiological release versus being declared radioactive waste. Direct sampling of the waste may be conducted to aid in determining if a particular waste unit (e.g., drum of soil) contains low-level radioactive waste, as necessary. Waste that is determined to be below the values of Table 4-2 by either direct radiological survey/swipe results or through process knowledge will not be managed as potential radioactive waste, but will be visually inspected and managed in accordance with Section 5.3.1. Wastes in excess of Table 4-2 values will be managed as potential radioactive waste and be managed in accordance with this section and any other applicable section of this document.

Low-level radioactive waste, if generated, will be managed in accordance with the contractor-specific waste certification program plan, DOE Orders, and the requirements of the current version of the Nevada Test Site Waste Acceptance Criteria (NTSWAC) (NNSA/NV, 2002b). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated radioactive material area (RMA) or radiologically controlled area (RCA) when full or at the end of an investigation phase. The waste drums will remain in an appropriate storage area pending certification and disposal under NTSWAC requirements (NNSA/NV, 2002b).

5.3.3 Hazardous Waste

The CAU will have waste storage areas that are properly controlled for access and equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers (CFR, 2002a). All containerized waste will be handled, inspected, and managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 265, Subpart I (CFR, 2002a). These provisions include managing the waste in containers compatible with the waste type, and segregating incompatible waste types so that in the event of a spill, leak, or release, incompatible wastes shall not contact one another. Satellite accumulation areas will be managed consistent with the requirements of 40 CFR 262.34(c)(1) (CFR, 2002a).

Hazardous waste accumulation areas 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 storage area. Hazardous wastes will be managed and characterized in accordance with federal and state requirements and DOE Orders (CFR, 2002a and b). Analyses that may be required for the disposal of IDW and respective regulatory levels are identified in Table 3-2.

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 in accordance with the appropriate section of this document.

On radiological sites, this may increase the potential to generate mixed-waste; however, the generation of a mixed waste will be minimized as much as practicable. In the event a mixed waste is generated, the waste will be managed in accordance with Section 5.3.5 of this document.

5.3.4 Hydrocarbon Waste

Hydrocarbon waste is defined as waste exceeding the action level of 100 mg/kg TPH (NAC, 2002e). Hydrocarbon waste will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed of at a designated hydrocarbon landfill (NDEP, 1997b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with applicable regulations.

5.3.5 Mixed Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of DOE, RCRA, and subject to agreements between NNSA/NSO and the State of Nevada.

5.3.6 Polychlorinated Biphenyls and Radioactive Polychlorinated Biphenyls Waste

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) (USC, 1976) and its implementing regulations at 40 CFR 761 (CFR, 2002b). The IDW will initially be evaluated using analytical results for media samples from the investigation. If any type of PCB waste is generated, it will be managed according to 40 CFR 761 (CFR, 2002b) as well as other federal requirements, State of Nevada requirements, guidance, and agreements with NNSA/NSO.

5.3.7 Asbestos-Containing Materials

Asbestos-containing materials will be managed and disposed of in accordance with appropriate federal (i.e., TSCA [USC, 1976]) and State of Nevada (NAC, 2002d) regulations.

5.4 Decontamination Activities

Sampling equipment (e.g., core barrel, split spoon, hand augers, backhoe bucket) and heavy equipment (e.g., drill rig, backhoe) will be decontaminated in accordance with the appropriate procedure. At a minimum, equipment will be decontaminated prior to initial use, between sampling locations (applicable to core barrels, split spoons, hand augers, sampling tools) and between trenches (applicable to backhoe buckets).

6.0 Quality Assurance/Quality Control

The primary objective of the corrective action investigation 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 516. The following two subsections (Section 6.1 and Section 6.2) discuss the QA and QC of the field sampling performance, including the collection of field QC samples, and the QA/QC requirements for laboratory performance and data quality (i.e., acceptability and usability) for use in the decision-making process to achieve closure. Data collected during the corrective action investigation will be evaluated against DQI-specific performance criteria to verify that the DQOs established during the DQO process (Appendix A.1) have been satisfied.

Unless otherwise stated in this CAIP or required by the results of the DQO process (Appendix A.1), this investigation will adhere to the QA/QC requirements in the Industrial Sites QAPP (NNSA/NV, 2002a).

The discussion of the DQIs, including the datasets, will be provided in the CAU 516 CADD to be developed at the completion of the corrective action investigation.

6.1 Quality Control Field Sampling Activities

Field QC samples will be collected in accordance with approved 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 investigation (i.e., environmental and waste characterization) samples collected. The minimum frequency of collecting and analyzing QC samples established for this investigation 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)
- Field blanks (minimum of 1 per 20 environmental samples)

- Matrix spike (MS)/matrix spike duplicate (MSD) (minimum of 1each per matrix per 20 environmental samples), as required by the method

Additional QC samples may be submitted based on site conditions and technical judgement 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 and Analytical Quality Assurance

Criteria for Phase I and Phase II, as stated in the DQOs (Appendix A.1) (except where noted), require valid 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 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 organic and inorganic laboratory data from samples collected and analyzed will be evaluated for data quality according to *EPA Contract Laboratory Program National 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 and analyzed, and that the results met data validation criteria. Validated data 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 CAU 516 CADD. If the DQOs are not met, impact to the corrective action alternatives for closure will be evaluated. Based on the evaluation, the appropriate corrective action will be selected and implemented (e.g., refine CSM or resample) to fill data gaps.

6.2.2 Data Quality Indicators

Data quality indicators are quantitative and qualitative descriptors used in determining the degree of acceptability or usability of data. The DQIs established to evaluate the quality of CAU 516 data are precision, accuracy, representativeness, comparability, completeness, and sensitivity. Data quality indicators are used to evaluate the entire measurement system, the laboratory measurement processes (i.e., analytical method performance), and individual analytical results (i.e., parameter performance).

Representativeness and comparability are qualitative measures. Completeness, accuracy, and precision are quantitative measures. Precision and accuracy are used to assess the overall analytical method and field-sampling performance as well as to assess the need to qualify the usability of 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. Based on an assessment of the data, data qualified as estimated for reasons of precision or accuracy may also be considered to meet the parameter performance criteria.

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) requires conditions that adversely affect data quality (i.e., nonconformances), both in the field and the laboratory, be documented. Corrective actions required to mitigate adverse field conditions shall be tracked to verify successful implementation. 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 CAU 516 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 sample collection, handling, preservation, and storage along 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 (EPA, 1996).

Determinations of precision will be made for field duplicate samples and/or laboratory duplicate samples. Field duplicate samples will be collected simultaneously with samples from the same

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 516 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 evaluating 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 Section 6.2.4 and surrogates.	Data that do not meet the performance criteria will be evaluated for purposes of evaluating 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	Consistent sampling, handling, preparation, analysis, reporting, and validation criteria will be used. Approved standard methods and procedures will be used to analyze and report the data.	Inability to compare investigation results to established databases and PALs.
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.
Phase I Completeness	Critical COPCs have valid results on 90% of the samples. The remaining COPCs have valid results on 80% of the CAS-specific samples.	Cannot make decision on whether COCs are present or migrating above PALs with high confidence.
Phase II Completeness	90% of the CAS-specific samples and analyses used to define extent of COCs.	Decision of whether or not extent of contamination has been bounded cannot be determined.

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 or QC sample generated in the laboratory. They are not a separate sample but a split, or portion, of an existing sample. Typically, laboratory duplicate QC samples include MSDs or laboratory control sample duplicates (LCSDs) for organic and radiological analyses. Duplicate, MSDs, and LCSD are typically used for inorganic analyses.

6.2.3.1 Precision for Chemical Analysis

The RPD criteria for precision of organics are based on laboratory-specific control limits and are evaluated at the laboratory on a quarterly basis by monitoring the historical data and performance for each method. The precision criteria for inorganics is 20 percent for water samples and 35 percent for solid samples. No review criteria for field duplicate RPD comparability have been established; therefore, the laboratory sample duplicate criteria for RPD will be applied to the review of field duplicates as a guideline.

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. However, inorganic laboratory sample duplicate RPD values outside the established control criteria may result in the qualification of associated analytical results as estimated. Qualified data does 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 potential impact on data applicability in meeting the DQOs.

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 reported as a range and mean of the RPD criteria, or other appropriate reporting method. Each analytical method-specific precision measurement will be assessed for potential impacts on meeting the DQOs, and results of the assessment will be documented in the CADD.

6.2.3.2 Precision for Radiological Analysis

The parameter performance criteria for precision will be compared to the RPD or normalized difference (ND) results of duplicate samples. This assessment will be accomplished as part of the data validation process. Precision values that are within the established control limit indicate that analytical results for associated samples are valid. The RPD control limit for radiological measurements has been set at 35 percent for soil and 20 percent for water. 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:

Normalized Difference = $$S - D / \sqrt{(TPU_S)^2 + (TPU_D)^2}$$

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 ND is -1.96 to 1.96, which represents a confidence level of 95 percent.

The criteria to evaluate analytical method performance for precision will be based on the analytical method-specific (e.g., gamma spectrometry) precision measurements. Analytical method-specific precision measurement is reported as a range and mean of the RPD or ND criteria, or other appropriate reporting method.

Each analytical method-specific precision measurement will be assessed for potential impacts on meeting the DQOs, 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. Accuracy 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, 2002a). 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

For organics, limits are developed by the laboratory and 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 a laboratory audit. Similar procedures are followed in order to generate acceptable criteria for precision measurements. The acceptable control limits for inorganic analyses are established in the

EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994a). Accuracy for chemical analyses will be evaluated based on results from three types of spiked samples including MS, laboratory control samples (LCS), and surrogates.

The %R parameter performance criteria for accuracy will be compared to %R results of spiked samples. Surrogate %R is used to evaluate the individual sample accuracy; therefore, is not used to evaluate overall method performance accuracy. 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 accuracy (Table 6-1) will be based on the analytical method-specific (e.g., VOCs) MS, LCS, and surrogate accuracy measurements. The analytical method-specific accuracy measurement is reported as a range and mean of the %R criteria appropriate reporting method.

6.2.4.2 Accuracy for Radiological Analysis

Accuracy for radiological 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 radiological analyses listed in Table 3-3. 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.

The criteria to evaluate accuracy (Table 6-1) will be assessed based on the analytical method-specific (e.g., gamma spectrometry) accuracy measurements.

6.2.5 Representativeness

Representativeness is the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Representativeness is assured by a carefully developed sampling strategy, collecting the specified number of samples from proper sampling locations, and analyzing them by the approved analytical methods. Representativeness may be assured by reviewing field documentation, operating in accordance with approved procedures and plans, conducting field surveillances, and field collected blank data. Biased samples are designed to be representative of the target population being investigated as opposed to the entire population. Therefore, during the DQO process, the target populations identified are those locations deemed most likely to contain contaminants.

6.2.6 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). For this investigation, comparability must exist with the PAL and regulatory level datasets. To ensure comparability, all samples will be subjected to the same sampling, handling, preparation, and validation criteria in accordance with approved procedures. Approved standard methods and procedures will also be used to analyze and report the data (e.g., CLP and/or CLP-like data packages). An evaluation of this qualitative criterion will be presented in the CAU 516 CADD.

6.2.7 Completeness

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 sample locations sampled, percentage of samples analyzed, and the measurements made that are judged to be valid. Percent completeness for measurement usability (not rejected) is determined by dividing the total number of valid analyses by the total number of analyses per CAS 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 datasets will be assessed for potential impacts on meeting DQOs.

6.2.8 Sensitivity

Sensitivity is a quantitative parameter that evaluates the capability of a method or instrument to measure parameter concentrations at or near decision levels. The evaluation criteria for this parameter will be that measurement detection limits are lower than 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.

7.0 Duration and Records Availability

7.1 Duration

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

- Day 0: Preparation for field work will begin.
- Day 169: The field work, including sample collection activities, will commence. Samples will be shipped to meet laboratory holding times.
- Day 238: The field investigation will be completed.
- Day 308: The quality-assured laboratory analytical data will be available for NDEP review.
- The FFACO date for the CADD is August 31, 2004.

7.2 Records Availability

Historic information and documents referenced in this plan are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Project Manager. This document is available in the DOE public reading facilities located in Las Vegas and Carson City, Nevada, or by contacting the appropriate DOE Project Manager. The NDEP maintains the official Administrative Record for all activities conducted under the auspices of the FFACO.

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Appendix A.1

Data Quality Objectives

A.1 Data Quality Objectives Process

The DQO process is a seven-step 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 potentially viable corrective actions (i.e., no further action, closure in place, or clean closure). With the exception of CAS 06-51-02, existing information about the nature and extent of contamination at the CASs in CAU 516 is insufficient to evaluate and select preferred corrective actions; therefore, a corrective action investigation will be conducted.

The CAU 516 investigation will be based on DQOs developed by representatives of the NNSA/NSO. Corrective Action Site 06-51-02, Clay Pipe and Debris, does not require characterization, so the debris will be removed from the site during the field investigation. Therefore, this DQO process will not apply to CAS 06-51-02. The seven steps of the DQO process developed for the remaining CASs in CAU 516 and presented in Sections A.1.2 through A.1.8 were developed based on the CAS-specific information presented in Section A.1.1.

A.1.1 CAS-Specific Information

The five CASs addressed herein are located in Areas 3, 6, and 22 of the NTS as shown in Figure A.1-1. Two CASs are in Area 3, two CASs are in Area 6, and one CAS is in Area 22. The five CASs are:

- 03-59-01, Building 3C-36 Septic System
- 03-59-02, Building 3C-45 Septic System
- 06-51-01, Sump and Piping
- 06-51-03, Clean Out Box and Piping
- 22-19-04, Vehicle Decontamination Area

The COPCs specific to each CAS are described in the following CAS descriptions and listed in Table A.1-1. Critical COPCs are defined as those contaminants that are known or expected to be present within a CAS. Noncritical COPCs are defined as classes of contaminants (e.g., VOCs) that include all the analytes reported from the respective analytical methods that have PALs listed in Section A.1.4.2. If a COPC is detected in any sample at a concentration above a PAL, the COPCs

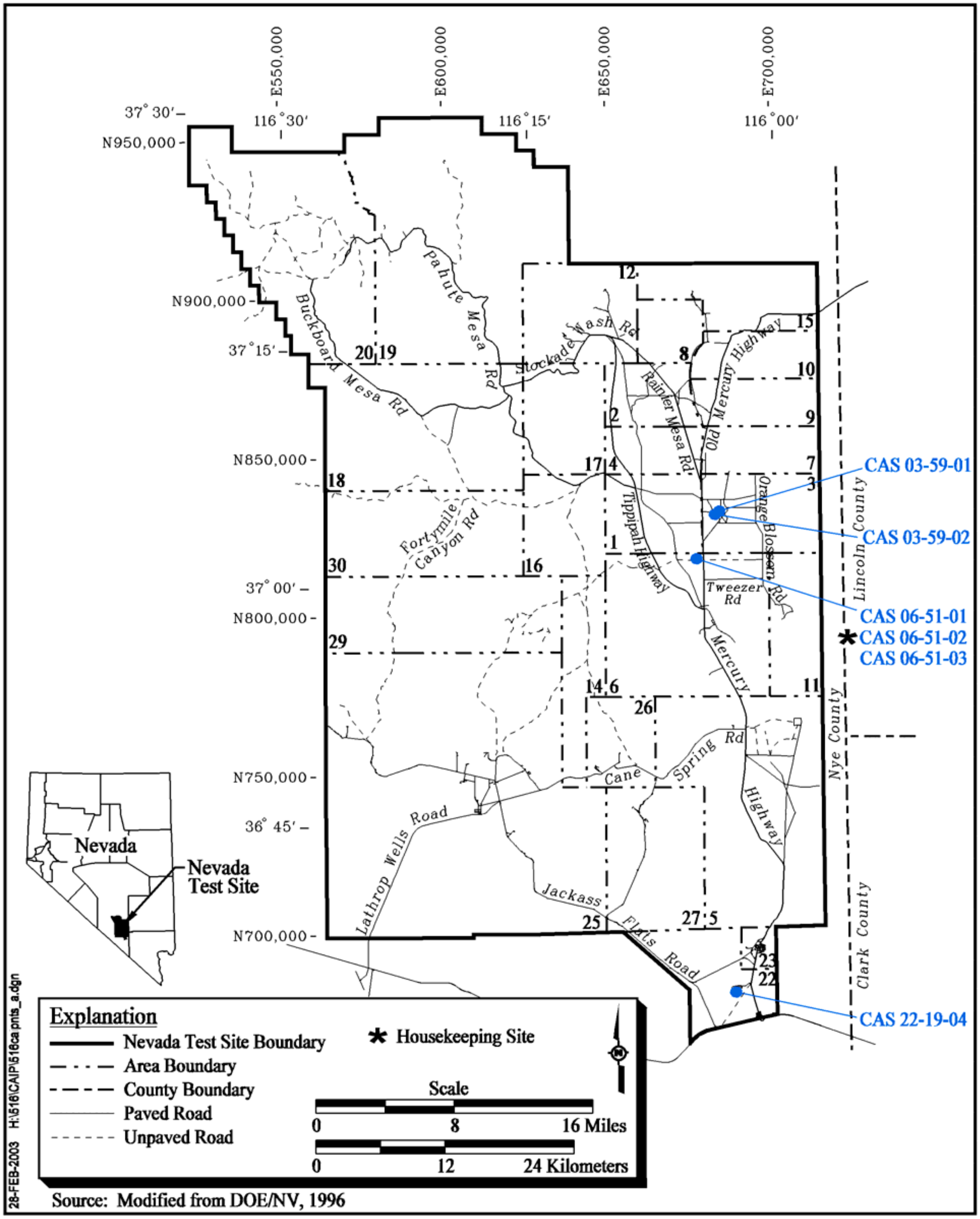


Figure A.1-1
Nevada Test Site and CAU 516 Location Map

Table A.1-1
Phase I Contaminants of Potential Concern Per CAS*

COPC		CAS 03-59-01	CAS 03-59-02		CAS 06-51-01	CAS 06-51-03	CAS 22-19-04
			Septic System and Dry Well	Photoprocessing Dry Well			
Organics							
VOCs		X	X	X	X	X	X
SVOCs		X	X	X	X	X	X
Hydroquinone		--	--	C	--	--	--
PCBs		X	X	X	X	X	X
Petroleum hydrocarbons	[C_6 - C_{10}] gasoline-range	X	X	X	X	X	X
	[C_{10} - C_{38}] diesel-range	X	X	X	X	X	X
Metals							
RCRA metals		X	X	C - silver X - others	X	X	X
Beryllium		X	X	X	X	X	X
Aluminum		--	--	C	--	--	--
Radionuclides							
Americium-241		--	--	--	C	C	--
Cesium-137		--	X	--	C	C	X
Strontium-90		--	X	--	C	C	X
Plutonium-238 and -239/240		--	X	--	C	C	X
Uranium-234, -235, -238		--	--	--	--	--	X

*Footnote:
-For those COPCs identified that include multiple parameters, the parameters with PALs will be evaluated.

C = Critical COPCs   X = Noncritical COPCs   -- = Not Applicable will be identified as a COC. If a COC is identified, the CAS containing that COC will be further investigated to determine the extent of the contamination.

As discussed above, CAU 516 also includes CAS 06-51-02 located in Area 6. However, this site is not included in the DQO process because characterization data are not required to support the housekeeping action.

A.1.1.1 CAS 03-59-01, Building 3C-36 Septic System

Physical Setting and Operational History - This CAS is located in the former Area 3 Camp south of Road 3-01 and consists of a septic tank, leachfield, distribution box, and septic system piping (see Figure A.1-2). The septic tank has a volume of 1,200 gal and is believed to have been pumped and filled with concrete. The leachfield is located approximately 76 ft south of Building 3C-36 leachfield. The leachfield is approximately 60 by 30 ft and consists of three perforated 4-in. pipes. This septic system was connected to Building 3C-36, which contained seven offices, one blueprint room, one secretarial area, and one rest room that included one shower stall, one toilet, one sink, and one floor drain. The septic system was constructed in 1985 and most likely used until Building 3C-36 was abandoned in 1992.

Sources of Potential Contamination - According to three interviewees, the septic system for Building 3C-36 received only sewage from one rest room within the building (Marshall, 2002; Boyd, 2002; and Dalson, 2002a).

Previous Investigation Results - A radiological survey was conducted at various exterior points within the leachfield. Based on this survey and historical documentation, there is little likelihood of any radiological concerns at this site. (Adams, 2001)

Contaminants of Potential Concern - No critical COPCs were identified for this CAS. The following noncritical COPCs identified for this CAS are based on interviews, common NTS concerns, and process knowledge:

- VOCs, SVOCs, petroleum hydrocarbons, and RCRA metals are representative of general characteristics of sewage (Boyd, 2002; Dalson, 2002a; Marshall, 2002; and People for Puget Sound, 2001).

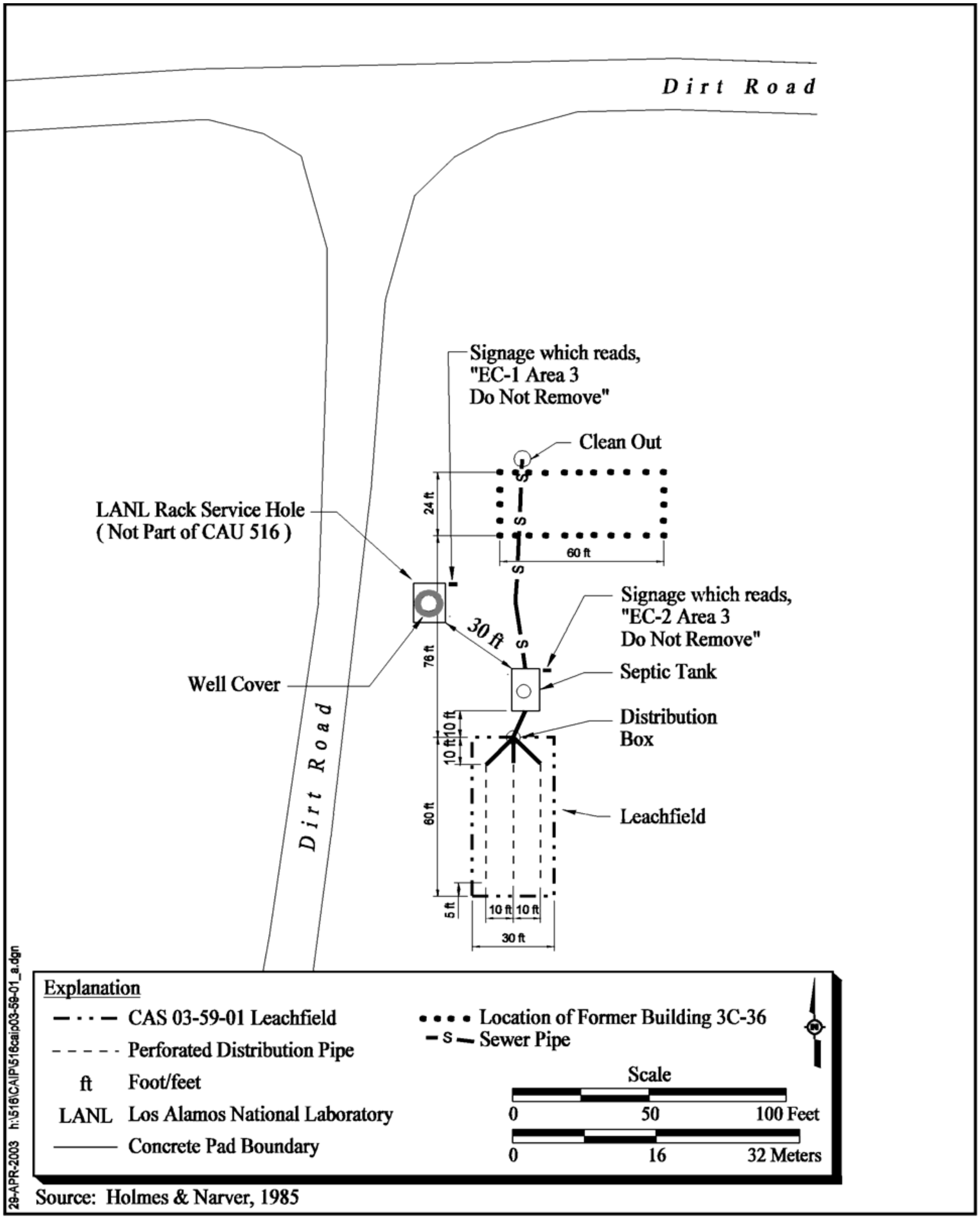


Figure A.1-2
CAS 03-59-01, Building 3C-36 Septic System

- Beryllium and PCBs are common concerns at the NTS and have not been ruled out at this CAS based upon process knowledge.

A.1.1.2 CAS 03-59-02, Building 3C-45 Septic System

Physical Setting and Operational History - This CAS is located north of Road 3-01 and west of Angle Road in Area 3 and consists of a septic tank, leachfield, distribution box, and associated piping that serviced Building 3C-45 (see Figure A.1-3). Also included in the CAS is a dry well used for the disposal of photoprocessing chemicals. Engineering drawings indicate that the 1,200-gal septic tank is constructed of precast concrete and located northeast of Building 3C-45 at a depth of approximately 2 ft bgs. The leachfield is approximately 77 ft northeast of the Building 3C-45 and has dimensions of about 98 by 59 ft (IT, 2001). The dry well is located about 8 ft northeast of the leachfield, is 4 ft in diameter, has a total depth of approximately 12 ft bgs (Holmes & Narver, 1978), and a volume estimated at 151 ft^3 (IT, 2001). Building 3C-45 was in operation from 1974 until 1990 or 1991, had one rest room, and was used for electrical component fabrication, storage, and as a support facility for the neighboring Diode Facility. One interviewee reported the storage of nuclear racks within Building 3C-45 (Dalson, 2002b). Another interviewee commented on the fabrication, use, and storage of electrical components within Building 3C-45 (Marshall, 2002).

In addition to the aforementioned CAS components, a borehole located approximately 10 ft west of Building 3C-45 will also be investigated. Historical documentation refers to this borehole as a dry well belonging to LANL. The borehole was drilled on August 24, 1976, to a total depth of 44 ft bgs. The borehole has no casing and has a 72-in. diameter to 15.5 ft bgs and a 48-in. diameter to 44 ft bgs (DOE/NV, 1990). An engineering drawing shows a 2-in. acid-resistant polypropylene sewer pipe near the base of the borehole and the borehole backfilled to grade (Holmes & Narver, 1985). The purpose of the borehole is unknown.

Sources of Potential Contamination - The septic system was designed to receive domestic sewage from Building 3C-45. One interviewee stated that nuclear racks associated with electronic diagnostic activities were stored in Building 3C-45 (Dalson, 2000b). Photoprocessing took place in the mobile photoprocessing trailers and the waste chemicals from this process were reportedly disposed of in the dry well.

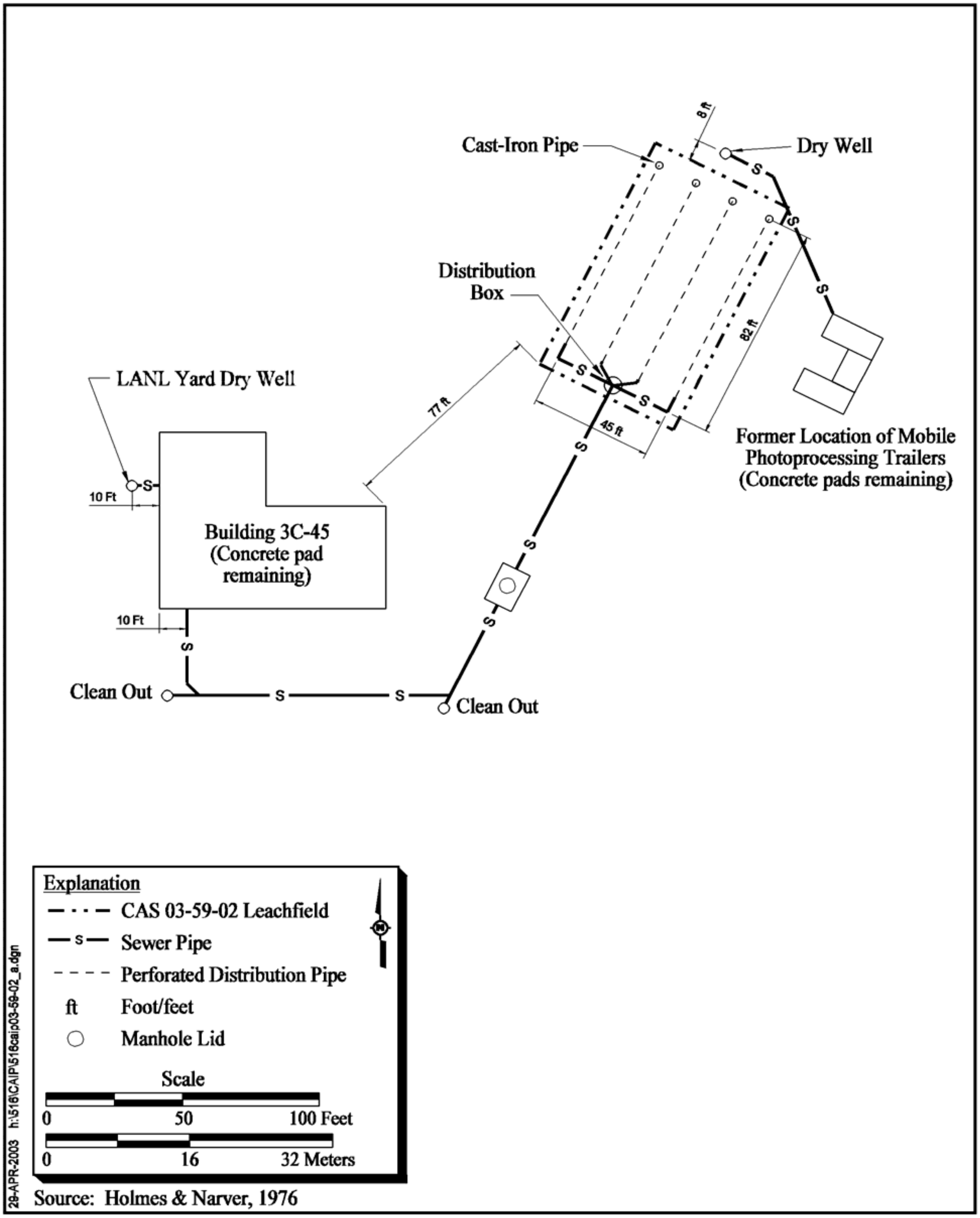


Figure A.1-3
CAS 03-59-02, Building 3C-45 Septic System

Previous Investigation Results - Although documentation was found with a characterization plan for the Building 3C-45 septic tank (REECo, 1995), it is unknown as to whether or not this was done. A radiological survey (IT, 2002) conducted at various points of the leachfield showed radiological readings did not exceed the background readings of the general area (Adams, 2001).

Contaminants of Potential Concern - The following critical COPCs identified for this CAS are based on an interview, product documentation, and process knowledge:

- Silver is released from the film during photograph developing (Phellan, 2002; and Sunspot Productions, 2002).
- Hydroquinone is in the developing agent used in photoprocessing (Kodak, 1998a; and Sunspot Productions, 2002).
- Aluminum is a component of a rapid fixer used in photoprocessing (Kodak, 1998b).

The noncritical COPCs identified below are based on interviews, common NTS concerns, and process knowledge:

- VOCs, SVOCs, petroleum hydrocarbons, and RCRA metals are representative of general characteristics of sewage (People for Puget Sound, 2001).
- Beryllium and PCBs are common concerns at the NTS and have not been ruled out based upon process knowledge.
- Cs-137, Sr-90, and Pu-238, -239/240 based on nuclear racks used for nuclear tests diagnostics stored in Building 3C-45 (Dalson, 2002b). There is insufficient information as to what capacity the nuclear racks were used; therefore, these radioisotopes will be analyzed to verify their absence.

A.1.1.3 CAS 06-51-01, Sump and Piping; and CAS 06-51-03, Clean Out Box and Piping

Physical Setting and Operational History - The CAS 06-51-01 is located in the Well 3 Yard in Area 6 and consists of a 4-in. vitreous clay pipe which trends north from Building 660 approximately 300 ft into a sump (see Figure A.1-4). Four floor drains and two sink drains within Building 660 connect into this pipe. The sump is approximately 25 by 30 ft and is located north of Building 660. An UST and associated piping located north of Building 660 is assigned to CAS 06-02-04 in

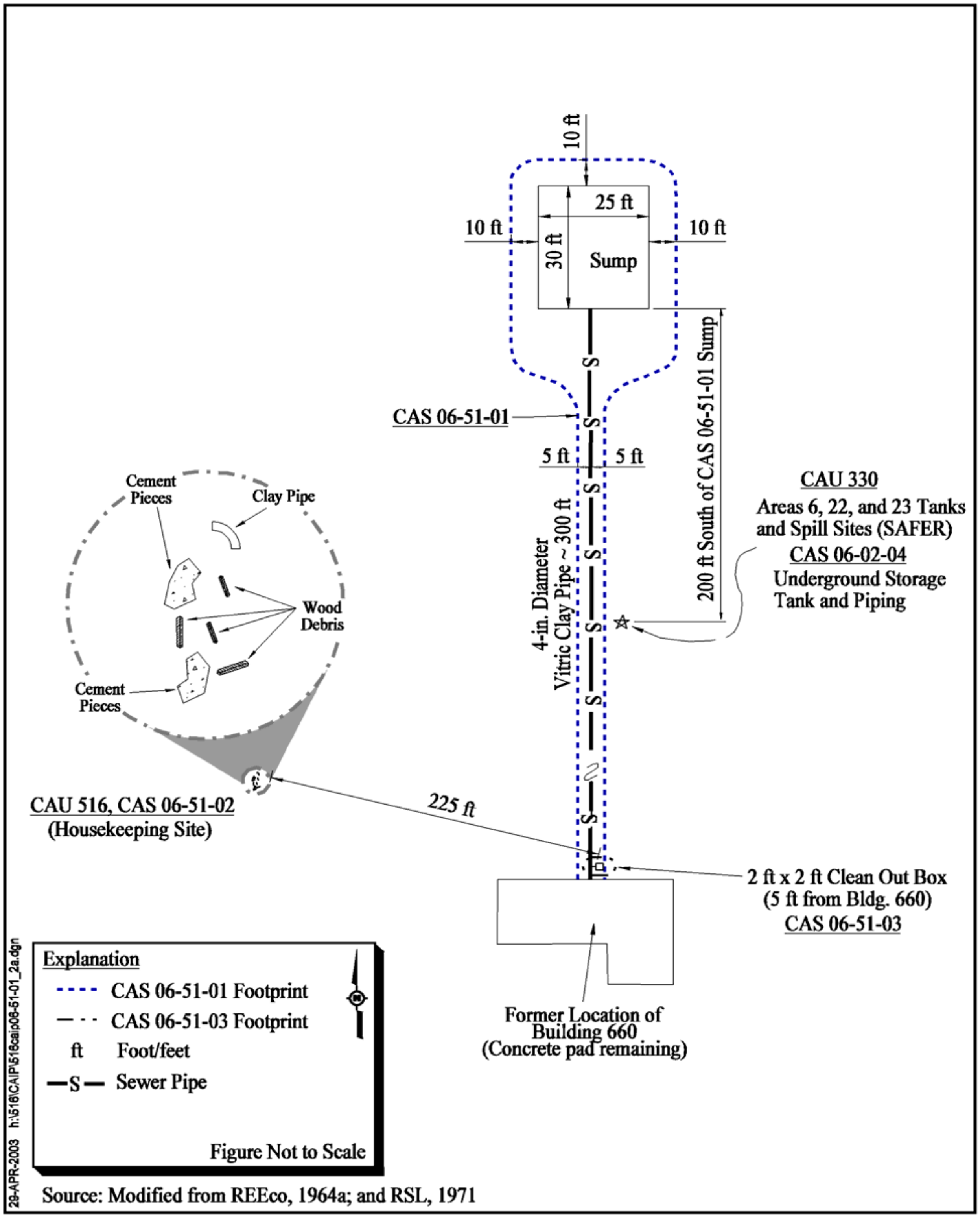


Figure A.1-4
CAS 06-51-01, Sump and Piping; CAS 06-51-02, Clay Pipe and Debris; and CAS 06-51-03, Clean Out Box and Piping

CAU 330 and is not associated with CAU 516. One interviewee recalled the UST resembling a settling tank rather than a septic tank constructed out of concrete and clay piping (Laub, 2001).

The associated clean out box and piping resides within CAS 06-51-03 (see Figure A.1-4). This CAS consists of a clean out box made of wood and concrete that measures 2 x 2 x 3 ft with a 6-in. cast-iron pipe with an end cap projecting into it from the west. The cast-iron pipe is believed to serve as an access pipe to the main 4-in. vitric clay pipe that extends north from Building 660 into the CAS 06-51-01 sump.

Building 660 was constructed in 1964 and was used until 1972 as a feed barn, dairy barn, slaughterhouse, and for the preparation of animal tissues for radiological monitoring and animal studies. After that the building was used to store tools, parts, and special pipe fittings until 1989. The building was reported to have also been used as a calibration laboratory (Madsen, 2001). In 1993, the sinks inside Building 660 were designated for hand washing only (Azhikakath, 1994).

Sources of Potential Contamination - According to historical documentation, Building 660 was discharging wastewater directly into the sump (REECo, 1994). An interviewee reported being told that radioactive animal feed was buried north of Building 660 and that all waste was discharged to the sump (Madsen, 2001). No evidence of buried material has been found. A document requesting closure of the CAU 330 UST stated that the use of Building WY-42 (also known as Building 660) was a cow barn, where cows were fed plutonium and americium contaminated hay and then slaughtered for study (Madsen, 2001; Sygitowicz, 1995). Drain lines connecting to the UST could not be verified. The document also indicates that wastewater generated within this building was directed through one sink and drain; however, the types of solvents or cleaners that might have been introduced into the sink and drain was undetermined (Sygitowicz, 1995). The engineering drawing RE-788 (REECo, 1964b) shows four floor drains and two sink drains in Building 660. The UST is not shown on any engineering drawings identified during this investigation. An engineering drawing shows transformers in the vicinity of Building 660 (REECo,1964a); although no report of PCB contamination or leaks were found during the preliminary assessment. During a 1994 investigation of Building 660, a Stop Work Order was issued for an unpermitted wastewater discharge as a result of wastewater discharging into a sump/leach pit rather than the UST for which it was intended. Water service was terminated and the sinks and drains were sealed inside and outside the building (REECo,1994).

Previous Investigation Results **-** No previous investigation results are identified for these CASs, but analytical results exist for a liquid sample collected in 1994 from the nearby UST in CAU 330 and submitted for analysis. The CAU 330 UST is located within 10 ft of CASs 05-51-01 and 05-51-02 and is designated 06-02-04. The sample collected in 1994 was analyzed for the following analytical parameters: VOCs, SVOCs, TCLP metals, TPH (gasoline/diesel/oil-ranges), pH, Clor-d-tect 4000, gamma spectrometry, isotopic Pu, and tritium. The analytical results reported the detection of chlorine, barium, caustics, corrosives, acids (Cowley, 1994); Pu-238, Pu-239, and tritium at concentrations below PALs (Latham, 1995). The pH of the sample was 7.94 (Cowley, 1994). Further investigation of the CAU 330 UST conducted in December 2002 verified that the drain lines connected to the UST are not connected to either CAS 06-51-01 or CAS 06-51-03 (Urbon, 2003). Additional liquid and sludge samples were collected from the UST in March 2003 and analyzed for TCLP VOCs, TCLP SVOCs, TCLP RCRA metals, TPH, PCBs, tritium, and alpha, beta and gamma-emitting radionuclides. Total petroleum hydrocarbons were detected at 191 mg/kg (Urbon, 2003).

Contaminants of Potential Concern - The following critical COPCs identified for this CAS are based on process knowledge and previous analytical results:

- Pu-238 and -239/240 (Latham, 1995) were detected below the MDLs in the UST liquid sample collected from CAU 330, CAS 06-04-02, and were used in the animal feed used in animal investigation studies (Madsen, 2001; Sygitowiciz, 1995)

- Am-241, and Pu-238 and -239/240 from animal feed used in animal investigation studies (Madsen, 2001; Sygitowicz, 1995)

- Cs-137 and Sr-90 based on historical documentation regarding the Animal Investigation Program (EPA, 1984). Analyses will be performed to verify their absence.

The noncritical COPCs identified below are based on process knowledge, common NTS concerns, and historical documentation:

- VOCs, SVOCs, petroleum hydrocarbons, and RCRA metals are representative of general characteristics of sewage (People for Puget Sound, 2001).
- Beryllium and PCBs are common concerns at the NTS and have not been ruled out based upon process knowledge.

A.1.1.4 CAS 22-19-04, Vehicle Decontamination Area

Physical Setting and Operational History - This CAS, 06-51-03, is a former vehicle decontamination area located approximately 800 ft southwest of the Weather Station in Area 22 (see Figure A.1-5). The vehicle decontamination site consists of a decontamination pad, a drainage trench, and a sump. The decontamination pad is rectangular, measures 32-ft long and 15-ft wide, and is topped with gravel ranging from approximately 5 to 10 in. in diameter. The drainage trench measures 30-ft long, 3-ft wide, and 2-ft deep and runs between the decontamination pad and sump. The sump consists of a depression in the soil measuring 11-ft long, 9-ft wide, and 4-ft deep.

Review of Defense Nuclear Agency historical documents report that a series of atmospheric tests named Buster-Jangle were conducted in the 1950s. Camp Desert Rock was activated in 1951 for the Buster-Jangle tests. Operations at Camp Desert Rock took place from 1951 until 1964. Military personnel at Camp Desert Rock were trained in personnel and equipment monitoring, in decontamination procedures, and established and operated a decontamination station near the exercise location. Immediately after the test was conducted, the decontamination personnel monitored all participants who had exceeded the prescribed distance from ground zero. If gamma intensities exceeded 0.02 Roentgen per hour (R/h), the personnel and vehicles were directed to a nearby decontamination facility. Vehicles were decontaminated with detergent and water. Vehicles or equipment requiring further decontamination were often decontaminated at the Area 22 vehicle decontamination pad. (DNA, 1982)

Sources of Potential Contamination - Radioactive fallout from atmospheric detonations contaminated personnel and vehicles with alpha-, beta-, and gamma-emitting radionuclides. Long-lived radionuclides possibly remaining at this CAS are Cs-137, Sr-90, Pu-238, Pu-239/240,

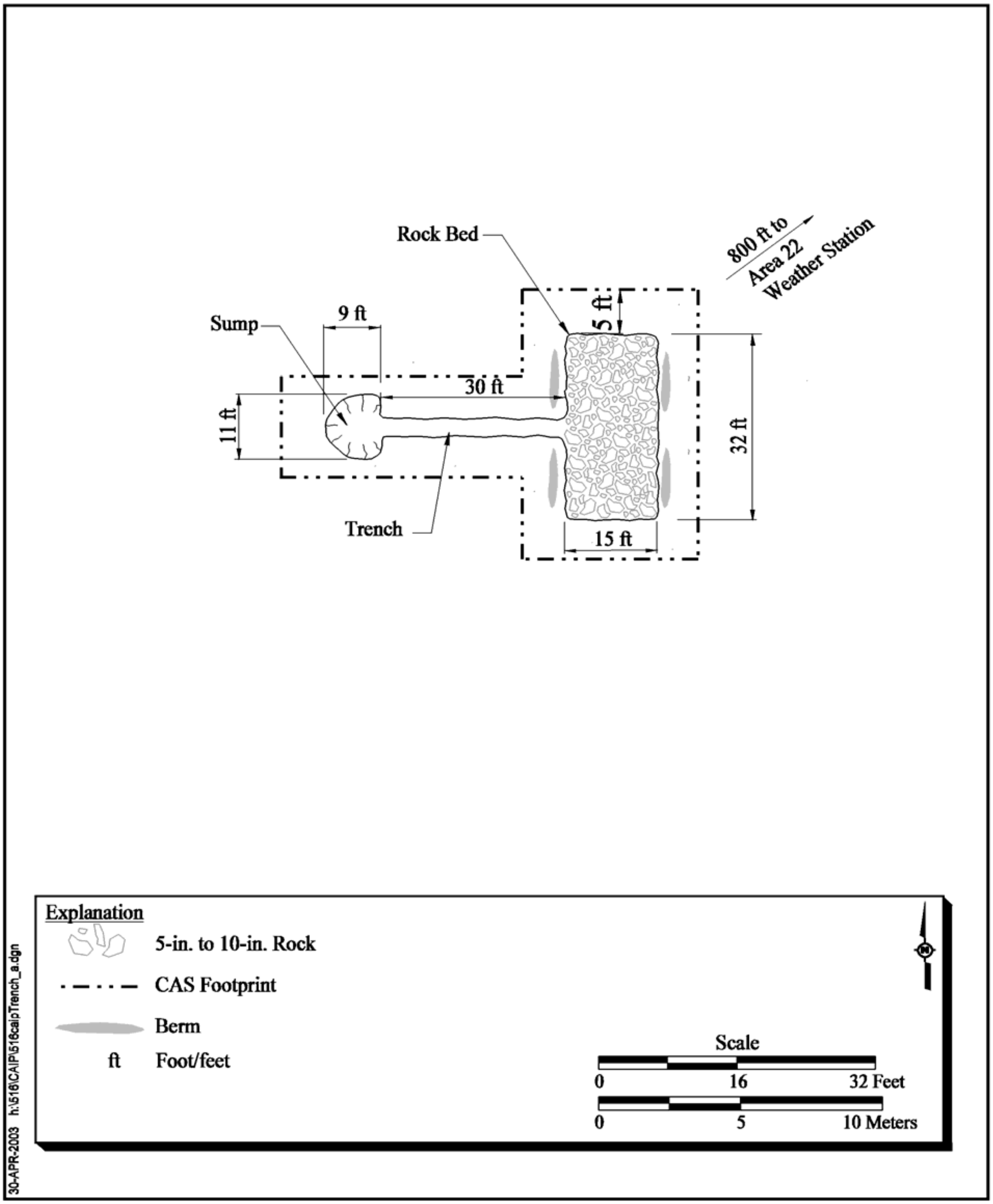


Figure A.1-5
CAS 22-19-04, Vehicle Decontamination Area

U-234, U-235, and U-238. Vehicles were subsequently decontaminated using high-pressure water and detergents, releasing rinsate potentially contaminated with VOCs, SVOCs, RCRA metals, and petroleum hydrocarbons, along with radionuclides, into the washdown pad, trench, and sump, which may have resulted in the transport of the contaminants below surface.

Previous Investigation Results - An EM-31-DL terrain conductivity survey was completed in 2001 over a 60- by 100-ft rectangular area. The survey confirmed that no metallic debris was buried within the surveyed area (SAIC, 2001).

Radiological surveys were conducted in 1998 (IT, 1998) and 2002 (IT, 2002). All radiological survey readings were below or within background levels.

Gamma spectroscopy was conducted on a soil sample taken underneath the vehicle washdown pad in 2001. Cesium-137 was noted at 0.5 pCi/g and is within the environmental fallout range for atmospheric tests. It is unknown if Cs-137 was introduced into the soil from runoff during decontamination activities or from nuclear fallout activity. All other radionuclides detected are naturally occurring potassium-40, as well as U and thorium decay chains. (Emer, 2001)

Contaminants of Potential Concern - No critical COPCs were identified for this CAS. The following noncritical COPCs identified for this CAS are based on process knowledge and historical documentation:

- VOCs and SVOCs used for the decontamination process
- RCRA metals and TPH from the decontamination of equipment and vehicles fueled by and maintained with petroleum hydrocarbon products
- Cs-137, Sr-90, Pu-238, -239/240; and U-234, -235, -238 from atmospheric testing fallout or from the decontamination of vehicles and equipment
- Because beryllium and PCBs are common concerns at the NTS, they have not been ruled out based upon process knowledge

A.1.2 Seven-Step DQO Process

This following section presents the seven-step DQO process for an investigation as applied to CAU 516.

A.1.2.1 Step 1 - State the Problem

This step identifies the DQO planning team members, describes the problem that has initiated the CAU 516 investigation, and develops CSMs.

A.1.2.2 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NSO, Shaw Environmental, Inc. (Shaw), and Bechtel Nevada (BN). The primary decision makers include NDEP and NNSA/NSO representatives. Table A.1-2 lists representatives from each organization in attendance for the January 9, 2003, DQO meeting.

A.1.2.3 Describe the Problem

Corrective Action Unit 516 is being investigated because effluent contaminated with hazardous and/or radioactive constituents may have been discharged into the septic systems and/or discharge points at CASs 03-59-01, 03-59-02, 06-51-01, and 06-51-03, potentially contaminating the native soil underlying the leachfields. In addition, contaminated effluent may have escaped into the surrounding soil as a result of failures in the septic system design (e.g., uncapped terminating pipes) and/or in the structural integrity (e.g., breaches) in one or more components of the septic system (e.g., septic tank, distribution box, piping).

Wastewater contaminated with hazardous and/or radioactive constituents produced from decontamination activities at CAS 22-19-04 was released to the underlying and surrounding native soil as it washed onto an unlined gravel pad constructed to direct the wastewater to a sump via a gravel-lined trench.

As a result of the above activities, hazardous and/or radioactive constituents may be present at these CASs at concentrations that could potentially pose a threat to human health and/or the environment.

Table A.1-2
DQO Meeting Participants

Participant	Affiliation	Function
Stacey Alderson	Shaw	Radiation Physics Lead
Kevin Cabble	NNSA/NSO	Environmental Restoration Division Task Manager
Jack Ellis	Shaw	Health and Safety Manager
Grant Evenson	SAIC	Industrial Sites Field Coordinator
Joe Hutchinson	SAIC	Radiological Data Validator
Syl Hersh	Shaw	Quality Processes Technical Staff
Robert Irwin	GRAM	Industrial Sites Technical Staff
Bridget Iverson	GeoTrans	Preliminary Assessments Liaison
Brad Jackson	BN	BN Task Manager
Linda Linden	SAIC	Industrial Sites CAU Lead
Joe Peters	SAIC	Chemical Data Validator
George Petersen	SAIC	Industrial Sites Technical Staff
Bill Nicosia	Shaw	Radiation Physics Technical Staff
Barbara Quinn	SAIC	Environmental Compliance and Waste Management Lead
James Traynor	BN	BN Task Manager
Al Wickline	SAIC	Industrial Sites Technical Staff
Jeanne Wightman	Shaw	Quality Processes Representative
Dustin Wilson	SAIC	Industrial Sites Task Manager
Ted Zaferatos	NDEP	Oversight/Representative

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

A.1.2.4 Develop Conceptual Site Models

Five CSMs have been developed for CAU 516 using assumptions formulated from the physical setting, historical background, and potential contaminant sources and release information. The applicability of the CSMs to each CAS is summarized in Table A.1-3 and discussed in the following subsections. The CSMs are termed:

- Septic System
- Leachfield
- Clean Out Box
- Dry Well
- Sump

Conceptual site models describe the most probable scenarios for current conditions at specific sites and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. They set the stage for assessing how contaminants could reach receptors both in the present and future by addressing contaminant nature and location, transport mechanisms, and pathways, potential receptors, and potential exposures to those receptors. Accurate CSMs are important as they serve as the basis for all subsequent inputs and decisions throughout the DQO process.

Table A.1-3
Conceptual Site Models and Applicable CASs

Conceptual Site Models	**03-59-01**	**03-59-02**	**06-51-01**	**06-51-03**	**22-19-04**
Septic System	Septic Tank, Distribution Box, and Piping	Septic Tank, Distribution Box, and Piping	Sump Piping	Clean Out Box Piping	----
Leachfield	Leachfield	Leachfield	----	----	----
Clean Out Box	----	----	----	Clean Out Box	
Dry Well	----	Photographic Dry Well, LANL Yard Dry Well	----	----	----
Sump	----	----	Sump	----	Decontamination Pad, Drainage Trench, and Sump

---- Does not apply

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

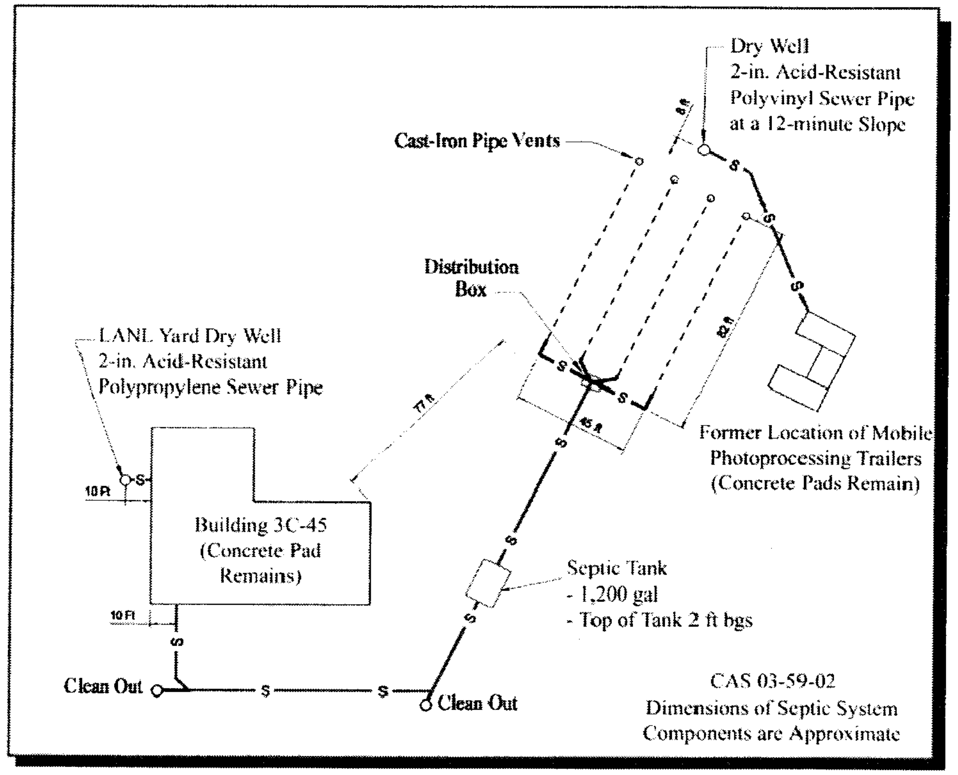
Contaminants migrating to regional aquifers are not considered a likely scenario at CAU 516 based on the average depth to groundwater, the low annual average precipitation rates, the high potential for evapotranspiration, and the low mobility of expected COPCs (e.g., SVOCs, PCBs, petroleum hydrocarbons, and RCRA metals).

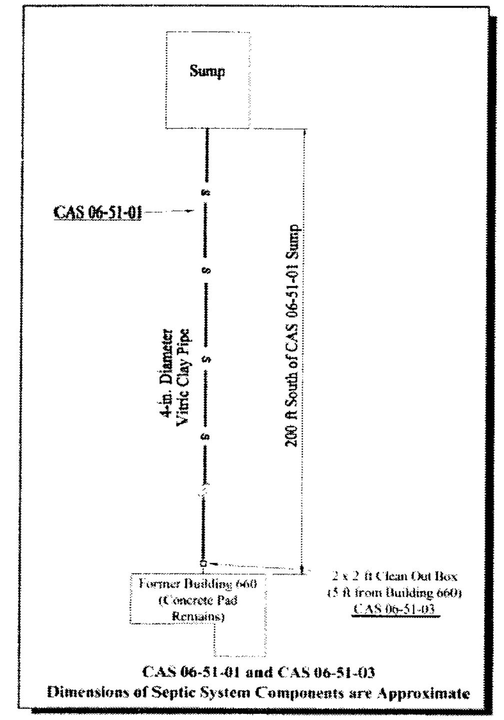
The five conceptual site models developed for CAU 516 and the CASs to which they are applicable are summarized in Table A.1-3 and discussed in the following subsections.

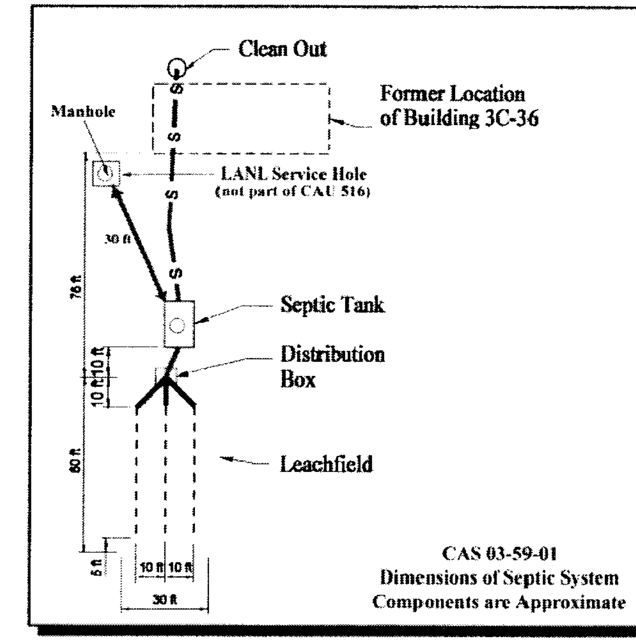
A.1.2.4.1 Septic System Conceptual Site Model

The Septic System CSM applies to the septic tanks, distribution boxes, and associated piping in CASs 03-59-01 and 03-59-02; the discharge pipe leading to the sump in CAS 06-51-01; and the tie-in to the CAS 06-51-03 clean out box. Upon release from the source, the effluent traveled through discharge lines and was routed into the various septic system components. Figure A.1-6 shows a generalized representation of the Septic System CSM. The following discussion of the CSM parameters provides additional details to supplement this model.

Exposure Scenario - The land-use designation for CASs 03-59-01 and 03-59-02 is within the Nuclear and High Explosives Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. The land-use designation for CASs 06-51-01 and 06-51-03 is within the Nuclear Test Zone reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests (DOE/NV, 1998). Based on these land-use designations, the potential for exposure to contaminants is limited to construction and industrial workers who may be







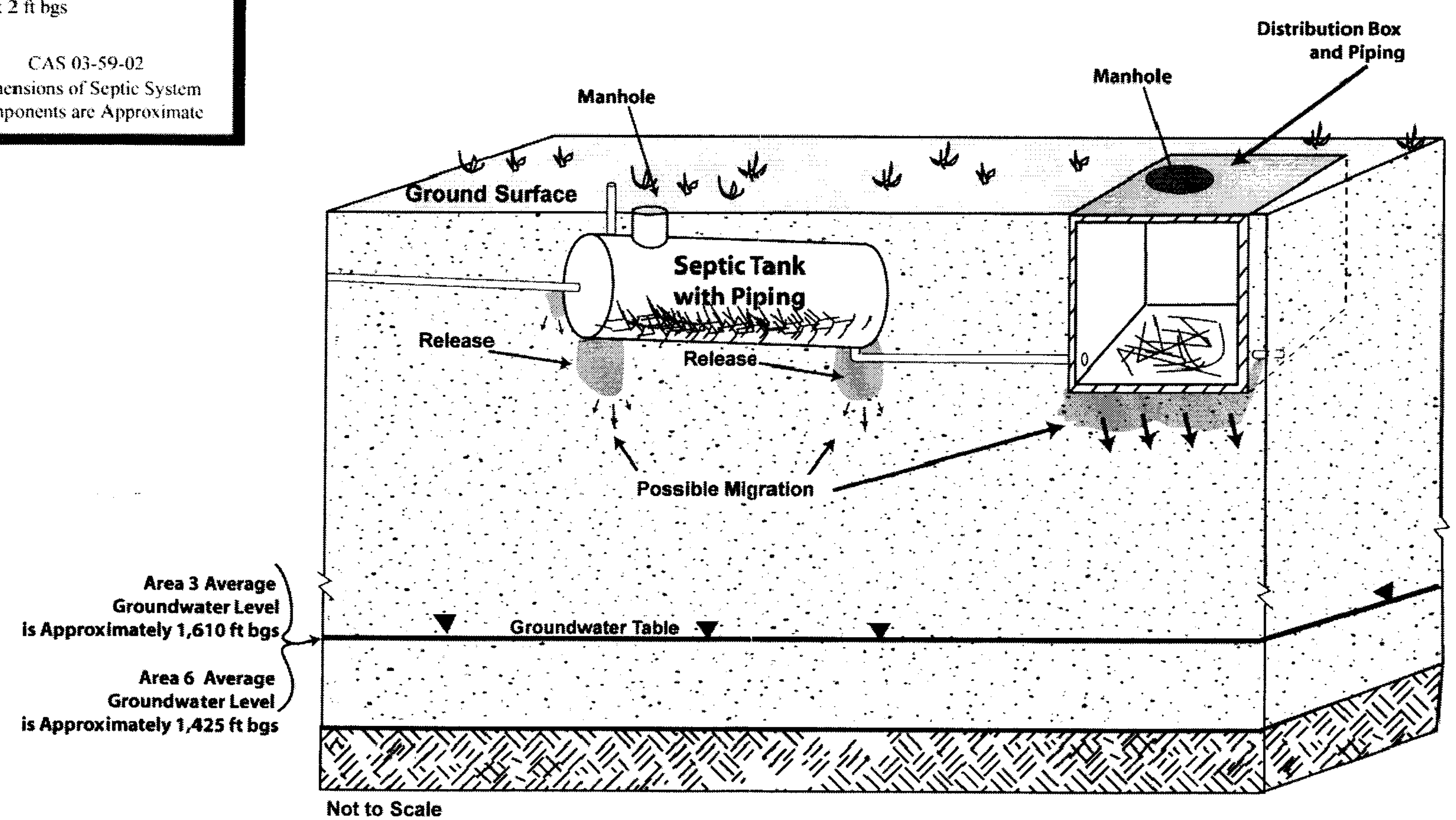


Figure A.1-6
Septic System Conceptual Site Model
Applicable to CAS 03-59-01, CAS 03-59-02, CAS 06-51-01, and CAS 06-51-03

exposed to COPCs through inadvertent oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris due to disturbance of these sites.

Affected Media - The affected media are subsurface soils beneath the base of the septic tank, distribution box, and associated piping.

Location of Contamination/Release Points - Beneath the outlet and inlet pipe ends and the base of the septic tanks, beneath the outlet end pipe and the base of the distribution boxes, and beneath any breaches in the associated piping. Migration of contamination would be expected to be primarily downward with horizontal migration to a lesser extent.

CAS 03-59-01 - Release from Building 3C-36 was through one drain leading to a distribution box and exiting into the leachfield.

CAS 03-59-02 - Release from Building 3C-45 was through a discharge pipe exiting the south side of the building. Another release from Building 3C-45 was through a discharge pipe exiting to the west side and leading to a dry well. Also, a release from the mobile photoprocessing trailers to a separate dry well located north of the leachfield.

CAS 06-51-01 - Release from Building 660 was through a 4-in. vitric clay pipe running north and exiting into the sump.

CAS 06-51-03 - Release into the clean out box was through a 6-in. diameter cast-iron pipe entering from the west side of the clean out box. The pipe served as an access point to the discharge pipe that serviced Building 660 and exited into the sump in CAS 06-51-01.

Transport Mechanisms - Injection of effluent and the infiltration and percolation of precipitation through soil serve as driving forces for downward migration.

Preferential Pathways - Preferential pathways for contaminant migration are not expected for this CSM.

Lateral and Vertical Extent of Contamination - The degree of contaminant migration, if any, at these sites is unknown, but it is assumed to be minimal based on the ambient and environmental conditions at the NTS such as low precipitation (i.e., 3 to 10 in.), high evapotranspiration (USGS, 1975), and the mobility of COPCs. Any contamination at these sites is expected to be contiguous with the source and decrease with distance and depth from the site. It is not believed that groundwater has been, or would be, impacted because of the significant depths of groundwater levels and local environmental conditions. The average groundwater level in Area 3 is reported at 1,610 ft bgs (Wuellner, 1994), and 1,425 ft in Area 6 (DRI, 1993).

A.1.2.5 Leachfield Conceptual Site Model

The Leachfield CSM applies to CASs 03-59-01 and 03-59-02. Effluent was dispersed throughout the leachfield by way of perforated distribution pipes. Figure A.1-7 shows a generalized representation of the Leachfield CSM. The following discussion of the CSM parameters provides additional details to supplement this model.

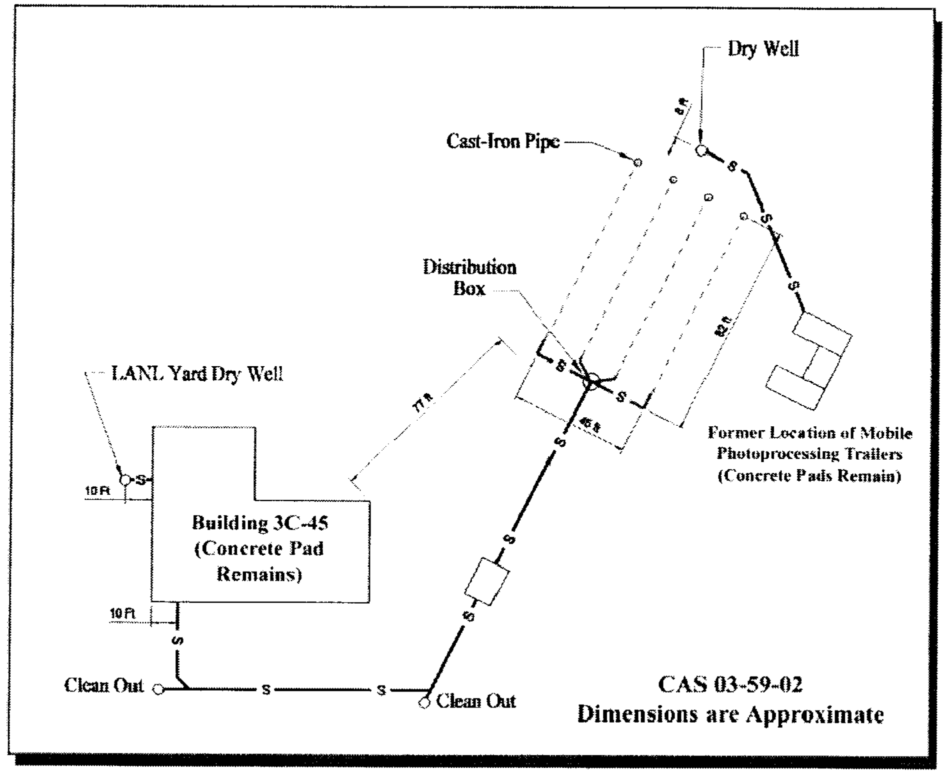
Exposure Scenario - The land-use designation for CASs 03-59-01 and 03-59-02 is within the Nuclear and High Explosives Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests (DOE/NV, 1998). Based on this land-use designation, the potential for exposure to contaminants is limited to construction and industrial workers who may be exposed to COPCs through inadvertent oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris due to disturbance of these materials.

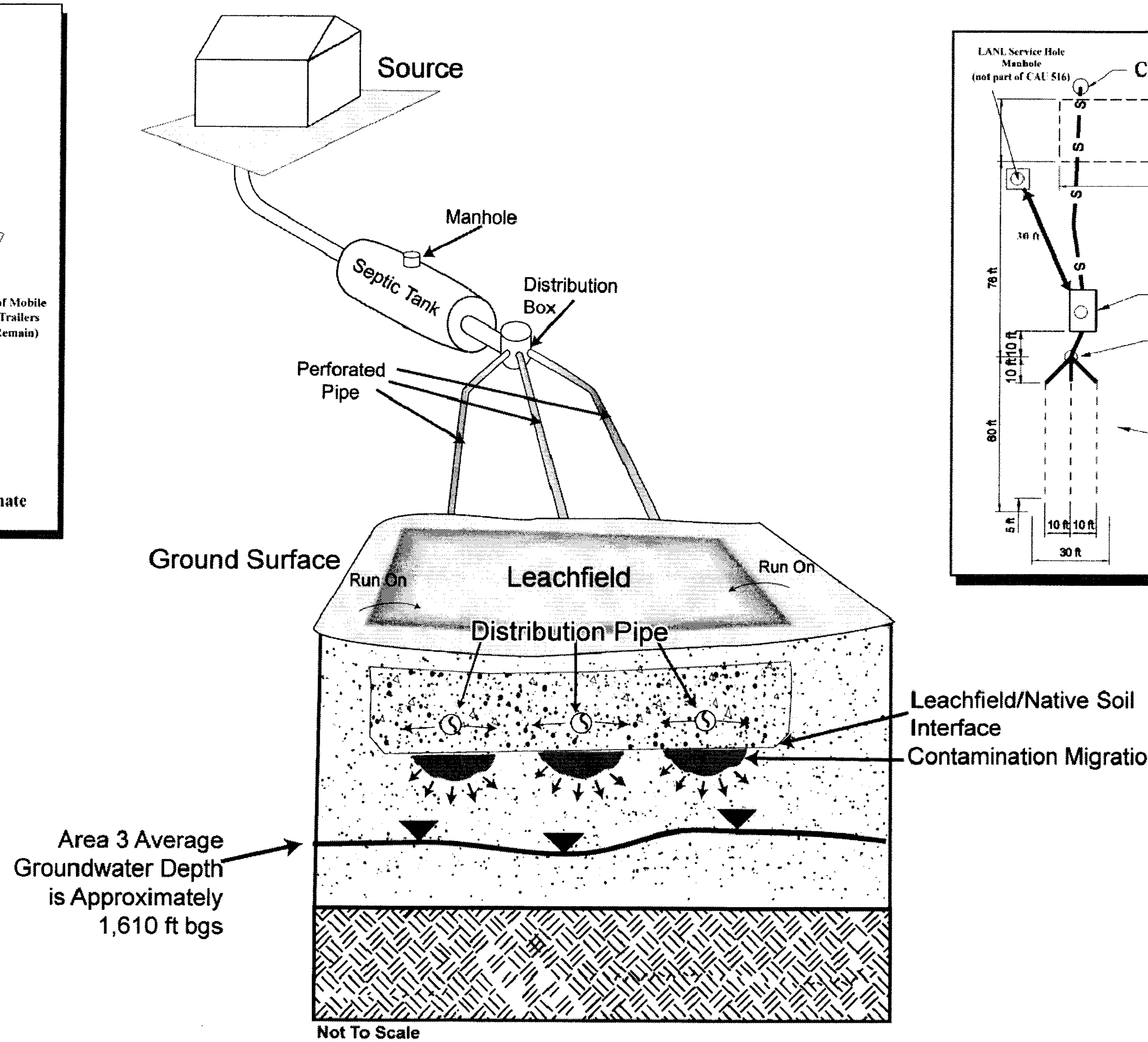
Affected Media - The affected medium is soil beneath the leachrock/native soil interface.

Location of Contamination/Release Points - The leachfields have multiple distribution lines. If present, soluble contaminants are expected in distal areas of the leachfield; insoluble and large-particle contaminants are expected in the proximal ends.

Transport Mechanisms - Injection of effluent and infiltration and percolation of precipitation through soil serve as driving forces for downward migration.

Preferential Pathways - Preferential pathways for contaminant migration are not expected for this CSM.





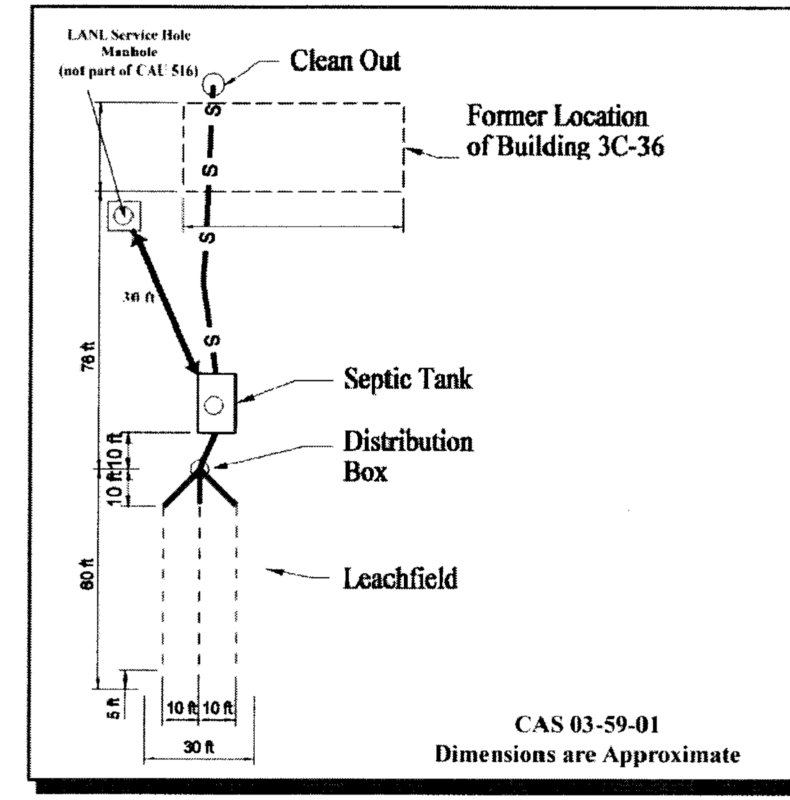


Figure A.1-7
Leachfield Conceptual Site Model
Applicable to CAS 03-59-01 and CAS 03-59-02

Lateral and Vertical Extent of Contamination - The degree of contaminant migration, if any, at these sites is unknown, but it is assumed to be minimal based on the ambient and environmental conditions at the NTS such as low precipitation (i.e., 3 to 10 in.), high evapotranspiration (USGS, 1975), and the mobility of COPCs. Any contamination at these sites is expected to be contiguous with the source and decrease with distance and depth from the site.

It is not believed that groundwater has been, or would be, impacted because of the significant depths of groundwater levels and local environmental conditions. The average groundwater level in Area 3 is reported at 1,610 ft bgs (Wuellner, 1994).

A.1.2.6 Clean Out Box Conceptual Site Model

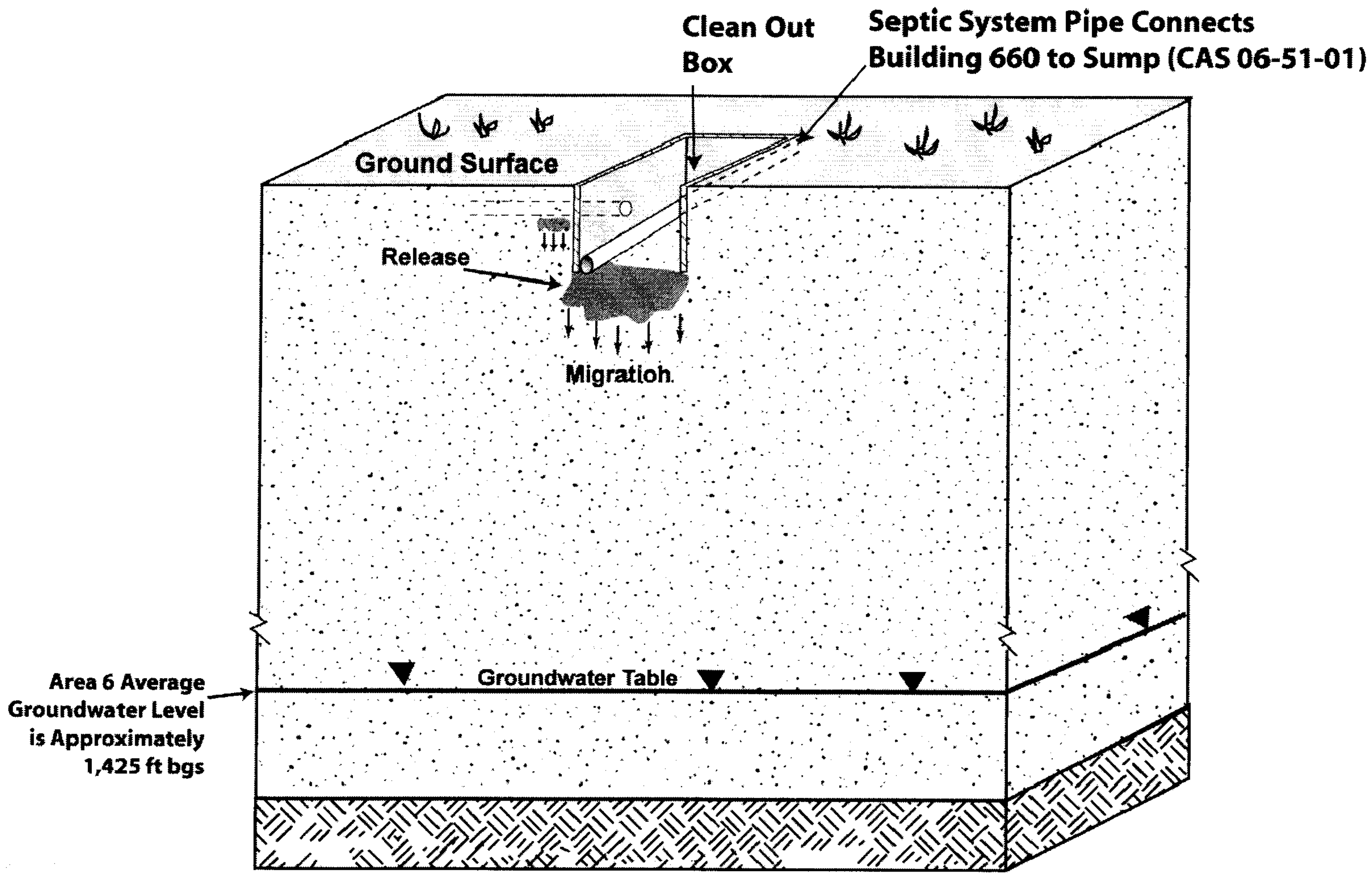
The Clean Out Box CSM applies to CAS 06-51-03. The clean out box provides a single-point access to the main discharge pipe connecting Building 660 to the sump. Figure A.1-8 shows a generalized representation of the Clean Out Box CSM. The following discussion of the CSM parameters provides additional details to supplement this model.

Exposure Scenario - Land-use designation for CAS 06-51-03 is within the Nuclear Test Zone reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests (DOE/NV, 1998). Based on this land-use designation, the potential for exposure to contaminants is limited to construction and industrial workers who may be exposed to COPCs through inadvertent oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris due to disturbance of these materials.

Affected Media - The affected medium is subsurface soil beneath the base of the clean out box.

Location of Contamination/Release Points - Contaminants would be expected to be more concentrated beneath the clean out box as a result of one direct release point and subsequent percolation from gravity. Any contamination would be attributable to the release of contaminants through direct release from the outlet pipe into the clean out box.

Transport Mechanisms - Injection of effluent through direct release from the access pipe into the clean out box and the infiltration and percolation of precipitation through soil serve as driving forces for downward migration.



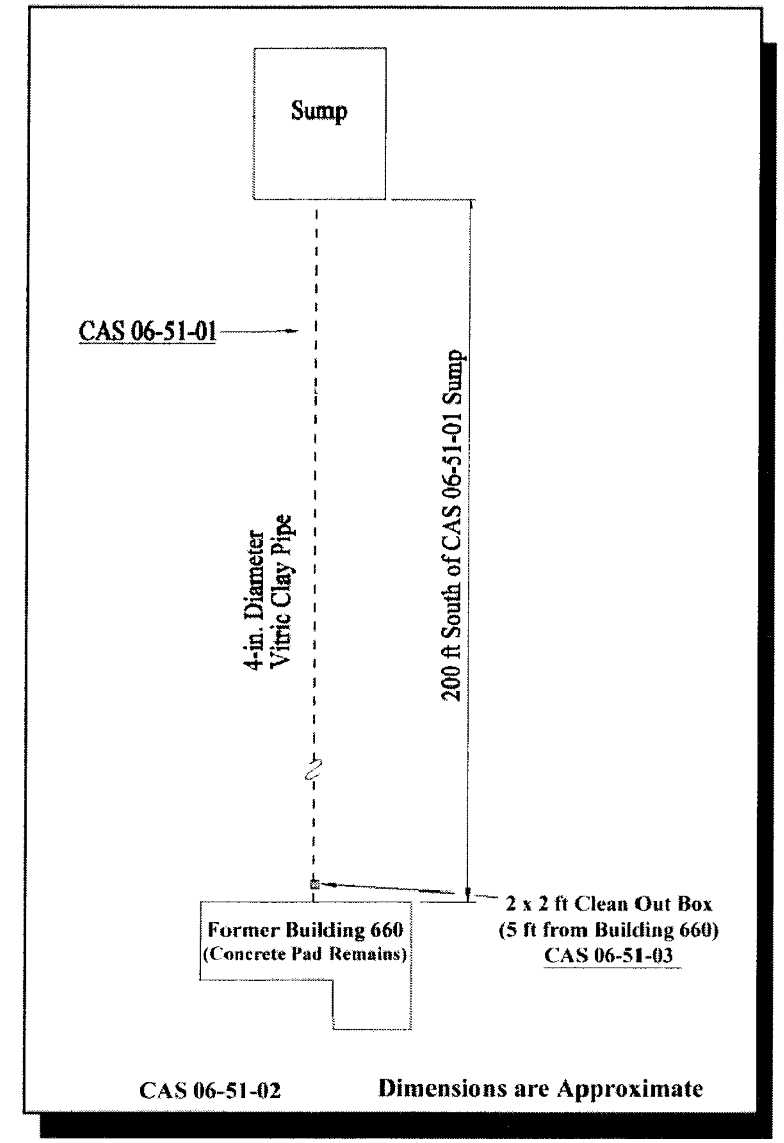


Figure A.1-8
Clean Out Box Conceptual Site Model
Applicable to CAS 06-51-03

Preferential Pathways - Preferential pathways for contaminant migration are not expected for this CSM.

Lateral and Vertical Extent of Contamination - The degree of contaminant migration, if any, at these sites is unknown, but it is assumed to be minimal based on the ambient and environmental conditions at the NTS such as low precipitation (i.e., 3 to 10 in.) and high evapotranspiration (USGS, 1975), and the mobility of COPCs. Any contamination at these sites is expected to be contiguous with the source and decrease with distance and depth from the site. It is not believed that groundwater has been or would be impacted because of the significant depths of groundwater levels and local environmental conditions. The average groundwater level in Area 6 is reported at 1,425 ft bgs (Wuellner, 1994).

A.1.2.7 Dry Well Conceptual Site Model

The Dry Well CSM applies to the dry wells at CAS 03-59-02. Effluent was released through a distribution pipe directly into the dry wells. Figure A.1-9 shows a generalized representation of the Dry Well CSM. The following discussion of the CSM parameters provide additional details to supplement this model.

Exposure Scenario - The CAS 03-59-02 land-use designation is within the Nuclear and High Explosives Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests (DOE/NV, 1998). Based on this land-use designation, the potential for exposure to contaminants is limited to construction and industrial workers who may be exposed to COPCs through inadvertent oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris due to disturbance of these materials.

Affected Media - The affected medium is subsurface soil beneath the base of the dry wells.

Location of Contamination/Release Points - The dry wells are a single-point source release. Any contaminants at this CAS are expected to beneath the dry wells.

Transport Mechanisms - The injection of wastewater to the dry wells was the primary transport mechanism. Infiltration and percolation through soil is a secondary mechanism that moves contaminants deeper into the soil.

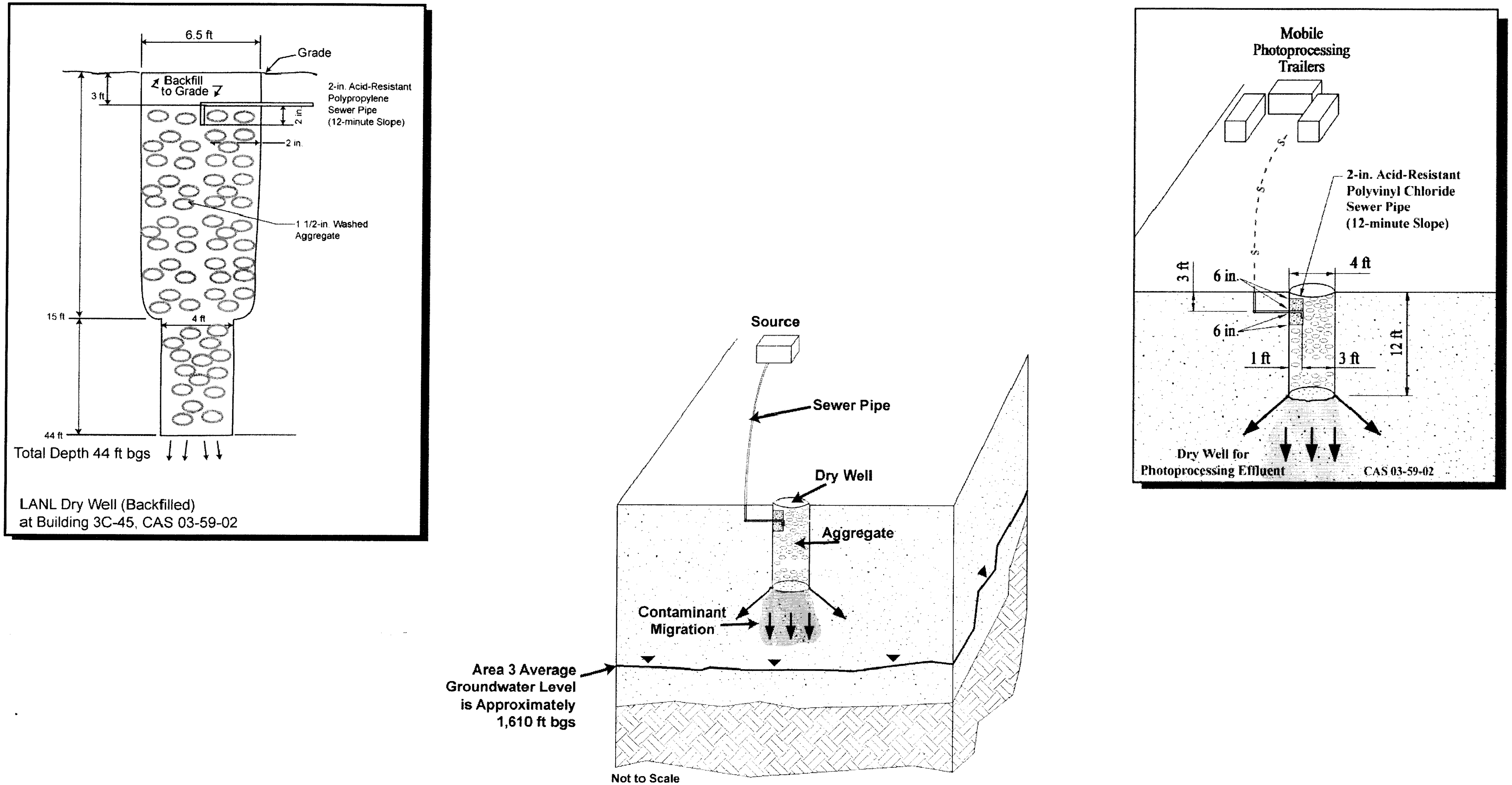


Figure A.1-9
Dry Well Conceptual Site Model
Applicable to CAS 03-59-01 and CAS 03-59-02

Preferential Pathways - Preferential pathways for contaminant migration are not expected for this CSM.

Lateral and Vertical Extent of Contamination - The degree of contaminant migration at the dry wells are unknown, but it is assumed to be minimal based on the ambient and environmental conditions at the NTS such as low precipitation (i.e., 3 to 10 in.), high evapotranspiration (USGS, 1975), and the mobility of COPCs. Any contamination in the dry wells is expected to be contiguous with the source and decrease with depth and lateral distance from a dry well.

The average groundwater level in Area 3 is 1,610 (Wuellner, 1994); therefore, it is not believed that the groundwater has been or would be impacted by any contamination in the dry wells.

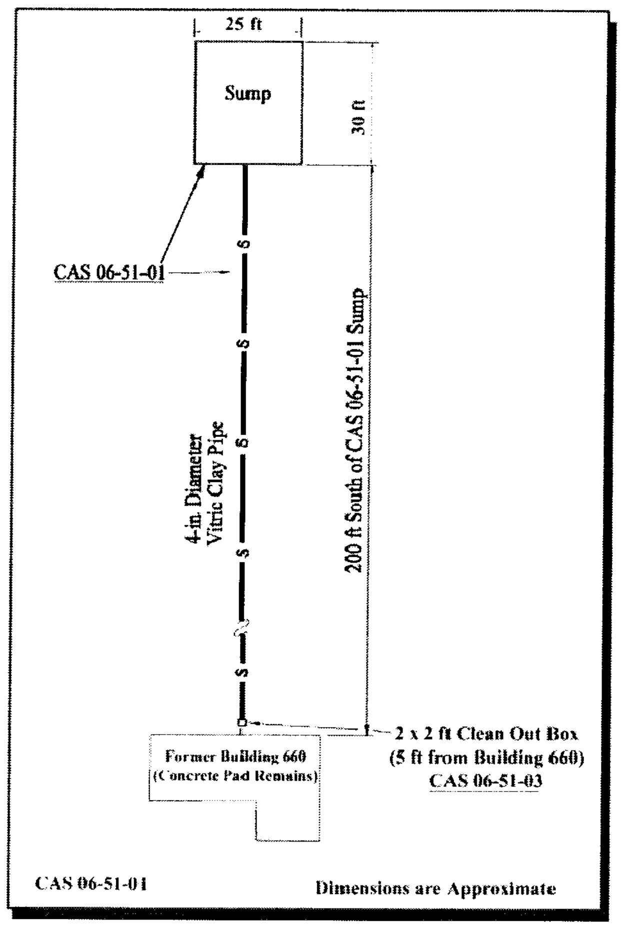
A.1.2.7.1 Sump Conceptual Site Model

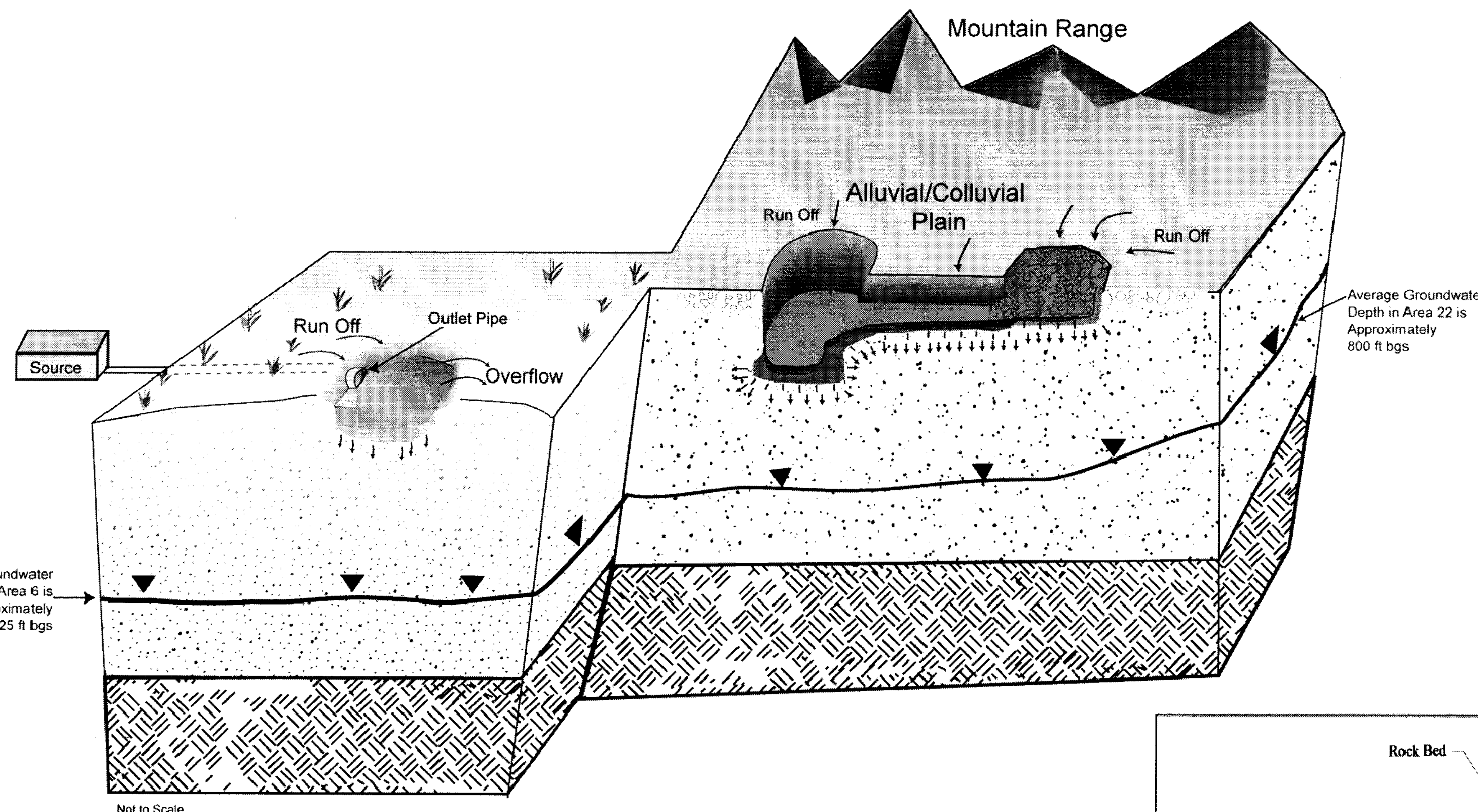
The Sump CSM applies to CASs 06-51-01 and 22-19-04. Figure A.1-10 shows a generalized representation of the Sump CSM. The following discussion of the CSM parameters provides additional details to supplement this model.

Exposure Scenario - The land-use designation for CAS 06-51-01 is within the Nuclear Test Zone reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. The land-use designation for CAS 22-19-04 is within the Solar Enterprise Zone (DOE/NV, 1998). This area is designated for the development of a solar power generation facility, and light industrial equipment and commercial manufacturing capability. Based on these land-use designations, the potential for exposure to contaminants are limited to construction and industrial workers in CAS 06-51-01, and to construction, industrial, and commercial workers in CAS 22-19-04 who may be exposed to COPCs through inadvertent oral ingestion, inhalation, or dermal contact (absorption) of soils and/or debris due to disturbance of these materials.

Affected Media - The affected media are soil beneath the sumps and possibly the surrounding surface soil. The sump in CAS 22-19-04 also includes the soil beneath the decontamination pad and trench.

Location of Contamination/Release Points - Contaminants, if present, would be concentrated at the sump material/native soil interface, within low points in the sump, and would be expected to be found at decreasing concentrations along the flow direction of the trench and surface discharge area.





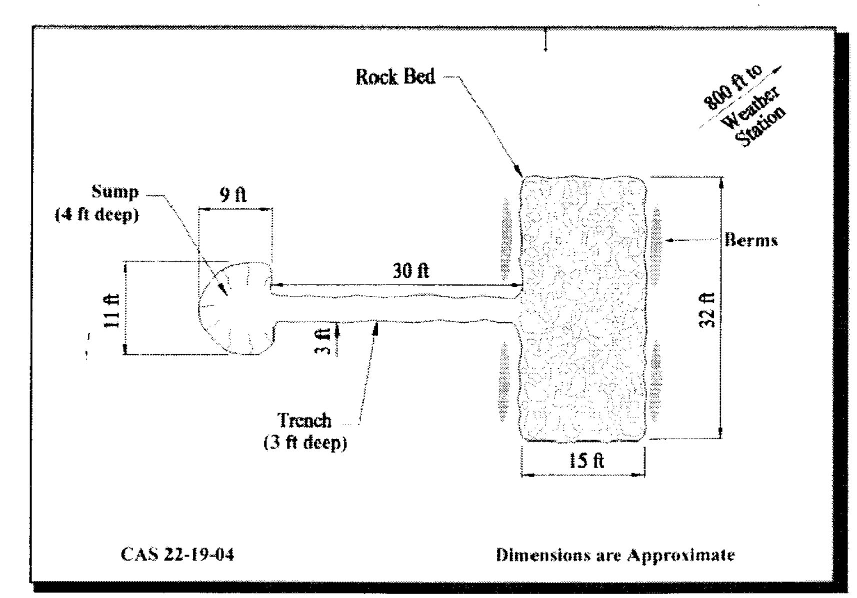


Figure A.1-10
Sump Conceptual Site Model
Applicable to CAS 06-51-01 and CAS 22-19-04

Surface runoff and erosion (e.g., flash flooding) would move contaminated soil laterally, with the concentration decreasing with distance.

Transport Mechanisms - The discharge of wastewater directly onto the surface of the decontamination area components (e.g., decontamination pad, trench, sump) at CAS 22-19-04 and directly into the sump at CAS 06-51-03, and the infiltration and percolating of precipitation into the soil are driving forces for downward migration; however, in the case of CAS 22-19-04, runoff from flash flooding also serves as a transport mechanism moving contamination to low-lying areas adjacent to the sump.

Preferential Pathways - The preferential pathway for contamination migration from the sump at CAS 22-19-04 would be erosion by surface water flow resulting from the perpendicular orientation of the sump on the alluvial/colluvial plain sloping to the south. No preferential pathways for contaminant migration at CAS 06-51-01 were identified.

Lateral and Vertical Extent of Contamination - The degree of contaminant migration at the sumps is unknown, but it is assumed to be minimal based on the ambient and environmental conditions at the NTS such as low precipitation (i.e., 3 to 10 in.), high evapotranspiration (USGS, 1975), and the mobility of COPCs. The average groundwater level in Area 22 is 787 ft (DRI, 1993); therefore, it is not believed that the groundwater has been or would be impacted by any contamination in the sumps.

A.1.3 Step 2 - Identify the Decision

This step develops a decision statement and defines alternative actions. The following subsections identify decisions and alternative actions appropriate for the investigation.

A.1.3.1 Develop a Decision Statement

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

The Decision I statement is, "Determine if a COC is present."

The Decision II statement is, "Determine the lateral and vertical extent of a COC."

A.1.3.2 Alternative Actions to the Decision

If a COC is not present, further assessment of the CAS is not required. If a COC is present, resolve Decision II.

If the extent of a COC is defined in both the lateral and vertical directions, further assessment of the CAS is not required. If the extent of a COC is not defined, reevaluate site conditions and collect additional samples.

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

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

A.1.4.1 Information Needs and Information Sources

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

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

In order to determine the extent of a COC for Decision II, sample data must be collected and analyzed at locations to bound the lateral and vertical extent of COCs. The data required to satisfy the information needed for each COC is a sample result that is below the PAL. Step-out locations will be selected. Samples will only be analyzed for those parameters that exceeded PALs (i.e., COCs) in prior samples. Biasing factors to support these information needs may include the factors previously listed and Phase I analytical results.

Table A.1-4 lists 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 in the following text. All data to be collected are classified into one of three measurement quality categories: quantitative, semiquantitative, and qualitative. The categories for measurement quality are defined below.

Quantitative Data

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

Semiquantitative Data

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

Qualitative Data

Qualitative data identifies or describes the characteristics or components of the population of interest. The QA/QC requirements for qualitative data are the least rigorous on data collection methods and measurement systems. Professional judgement is often used to generate qualitative data. The

Table A.1-4
Information Needs to Resolve the Phase I and Phase II Decisions

Information Need	Information Source	Collection Method	Data Type/Metric
Decision I: Determine if a COC is present. Criteria I: Samples must be collected in areas most likely to contain a COC.			
Source and location of release points	Process knowledge compiled during the preliminary assessment process and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	Qualitative - CSM has not been shown to be inaccurate
	Site visit and field observations	Conduct site visits and document field observations	Qualitative - CSM has not been shown to be inaccurate
	Aerial photographs	Review and interpret aerial photographs	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Radiological surveys	Review and interpret radiological surveys	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Field screening	Review and interpret field-screening results	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
Decision I: Determine if a COC is present. Criteria 2: Analyses must be sufficient to detect any COCs in samples.			
Identification of all potential contaminants	Process knowledge compiled during the preliminary assessment process and previous investigations of similar sites	Information reported in CSM and public reports - no additional data needed	Qualitative - CSM has not been shown to be inaccurate
Analytical results	Data packages of biased samples	Appropriate sampling techniques and approved analytical methods will be used	Quantitative - Detection limits will be less than or equal to PALs
Decision II: Determine the lateral and vertical extent of a COC.			
Identification of applicable COCs	Data packages of prior samples	Review analytical results to select COCs	Quantitative - Only COCs identified will be analyzed in future sampling events
Extent of Contamination	Field observations	Document field observations	Qualitative - CSM has not been shown to be inaccurate
	Field screening	Conduct field screening with appropriate instrumentation	Semiquantitative - FSRs will be compared to FSLs
	Phase I analytical results	Appropriate sampling techniques and approved analytical methods will be used to bound COCs	Quantitative - Validated analytical results will be compared to PALs to determine COC extent

intended use of the data is for information purposes, to refine conceptual models, and to guide investigations rather than resolve primary decisions. This measurement of quality is typically associated with historical information and data where QA/QC may be highly variable or not known. Metrics provide a tool to determine if the collected data support decision making as intended. Metrics tend to be numerical for quantitative and semiquantitative data, and descriptive for qualitative data.

A.1.4.2 Determine the Basis for the Preliminary Action Levels

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

- EPA *Region IX Risk-Based Preliminary Remediation Goals* for Industrial Soils (EPA, 2002).
- Background concentrations for metals are considered when natural background exceeds the PRG, as is often the case with arsenic. 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 Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999).
- TPH action level of 100 mg/kg per the NAC 445A.2272 (NAC, 2002).
- The PALs for radionuclides are isotope-specific and defined as the maximum concentration for the isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991; and DOE/NV, 1996).

A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods

Field Screening

Field-screening activities may be conducted for the following analytes and/or parameters:

- *Silver* - X-ray fluorescence, or equivalent method, may be used at the CAS 03-59-02 dry well where photoprocessing chemicals were disposed.
- *Alpha and Beta/Gamma Radiation* - Handheld radiological survey equipment may be used at CAS 03-59-02 based on nuclear racks used for nuclear tests diagnostics that were stored at Building C3-45, CASs 06-51-01 and 06-51-03, because radiological contaminants were

detected in the CAU 330 UST and in the decontamination rinsate decontamination activities conducted at CAS 22-19-04. Field screening using handheld radiological survey equipment may also be used at CAS 03-59-01 due to its location in a forward area and uncertainty regarding activities that occurred there.

- *Gamma Radiation* - Gamma spectrometry, or an equivalent instrument or method, may be used at CAS 03-59-01 and CAS 03-59-02 based on previous radiological surveys and analytical results that detected radiological activity at concentrations less than PALs. Gamma radiation may also be field screened at CAS 22-19-04 based on the exposure of vehicles and personnel to gamma radiation during near-field observations of nuclear tests.

- *VOCs* - A photoionization detector, or an equivalent instrument or method, may be used to conduct headspace analysis at all CASs because VOCs are representative of general characteristics of sewage and may have been released by decontamination activities once conducted at CAS 22-19-04.

- *TPH* - A gas chromatograph, or equivalent equipment or method, may be used at all the CASs because TPH is representative of general characteristics of sewage and may have been in the decontamination rinsate from decontamination activities conducted at CAS 22-19-04. Total petroleum hydrocarbons were detected at 191 mg/kg in the CAS 06-04-02 UST located within the boundaries of CAS 06-51-01 and CAS 06-51-03.

Based on the results of previous CAU investigations and common NTS practices, the aforementioned field-screening techniques may be applied to all the CASs with the exception of silver field screening. These field-screening techniques will provide semiquantitative data that can be used to guide soil sampling activities.

Soil Sampling

Auguring, direct-push, excavation, drilling, grab sampling by hand, or other appropriate sampling methods will be used to collect soil samples for laboratory analysis. Sample collection and handling activities will be conducted in accordance with the contractor's approved procedures.

The CAIP provides the analytical methods and laboratory performance requirements (e.g., detection limits, precision, and accuracy) to be followed in Section 3.0 and Section 6.0, respectively. Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory requirements. Specific analyses required for the disposal of IDW are identified in Section 4.2.5 of this CAIP.

The analyses to be conducted for samples collected for this CAU are listed in Table A.1-5. The analyses reports VOCs, SVOCs, petroleum hydrocarbons, PCBs, metal compounds, and radionuclides included in Table A.1-6.

Table A.1-5
Analytical Methods for Laboratory Analysis

Analytical Parameter	Analytical Method	
	Liquid	Soil/Sediment/Sludge
Total Volatile Organic Compounds	SW-846 8260B[a]	SW-846 8260B[a]
Total Semivolatile Organic Compounds (including Hydroquinone at CAS 03-59-02 photoprocessing dry well)	SW-846 8270C[a]	SW-846 8270C[a]
Total RCRA Metals, plus beryllium and aluminum	SW-846 6010B[a] (mercury - 7470A[a])	SW-846 6010B[a] (mercury - 7471A[a])
Polychlorinated Biphenyls	SW-846 8082[a]	SW-846 8082[a]
Total Petroleum Hydrocarbons (C_6 - C_{38})	SW-846 8015B[a] (modified)	SW-846 8015B[a] (modified)
Gamma Spectrometry (to include Cesium-137 and Americium-241)	EPA Procedure 901.1[b]	HASL-300[c]
Strontium-90	ASTM D5811-00[d]	HASL-300[c]
Isotopic Plutonium	ASTM D3865-02[e]	ASTM C1001-00[f]
Isotopic Uranium	ASTM D3972-02[g]	ASTM C1000-02[h]

ASTM = American Society of Testing and Materials
RCRA = *Resource Conservation and Recovery Act*
SW = Solid Waste

[a]*EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, Parts 1-4, SW-846* (EPA, 1996)
[b]*Prescribed Procedure for Measurements of Radioactivity in Drinking Water* (EPA, 1980)
[c]*The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300 (DOE, 1997)
[d]*Standard Test Method for Strontium-90 in Water* (ASTM, 2000b)
[e]*Standard Test Method for Plutonium in Water* (ASTM, 2002b)
[f]*Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy* (ASTM, 2000a)
[g]*Standard Test Method for Isotopic Uranium in Water by Radiochemistry* (ASTM, 2002a)
[h]*Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry* (ASTM, 2002c)

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

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

Table A.1-6
Analytes for CAU 516

Volatile Organic Compounds	Semi-Volatile Organic Compounds	Total Petroleum Hydrocarbons	Polychlorinated Biphenyls	Metals	Radionuclides
1,1,1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene cis-1,2-Dichloroethene cis-1,3-Dichloropropene trans-1,2-Dichloroethene 1,2-Dichloroethane 1,2-Dichloropropane 2-Butanone 2-Hexanone 4-Methyl-2-pentanone Acetone Benzene Bromochloromethane Bromodichloromethane Bromoform Bromomethane Carbon disulfide Carbon tetrachloride Chlorobenzene Chloroethane Chloroform Chloromethane Dibromochloromethane Ethylbenzene Methyl tertiary butyl ether Methylene chloride Styrene Tetrachloroethene Toluene trans 1,3-Dichloropropene Trichloroethene Vinyl acetate Vinyl chloride Xylene	1,2,4-Trichlorobenzene[a] 1,2-Dichlorobenzene[a] 1,3-Dichlorobenzene[a] 1,4-Dichlorobenzene[a] 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol 2,4-Dichlorophenol 2,4-Dimethylphenol 2,4-Dinitrophenol 2,4-Dinitrotoluene 2,6-Dinitrotoluene 2-Chloronaphthalene 2-Chlorophenol 2-Methylphenol 2-Nitroaniline 3,3'-Dichlorobenzidine 4-Bromophenyl phenyl ether 4-Chloroaniline 4-Methylphenol 4-Nitrophenol Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Benzo(k)fluoranthene Bis(2-chloroethoxy) methane Bis(2-chloroethyl)ether Bis(2-chloroisopropyl)ether Bis(2-ethylhexyl) phthalate Butyl benzyl phthalate Chrysene Dibenzo(a,h)anthracene Dibenzofuran Diethyl Phthalate Dimethyl Phthalate Di-n-butyl Phthalate Di-n-octyl Phthalate Fluoranthene Fluorene Hexachlorobenzene Hexachlorobutadiene[a] Hexachlorocyclopentadiene Hexachloroethane Hydroquinone[b] Indeno(1,2,3-cd)pyrene Isophorone Naphthalene[a] Nitrobenzene N-Nitroso-di-n-propylamine N-Nitrosodimethylamine N-Nitrosodiphenylamine Pentachlorophenol Phenanthrene Phenol Pyrene Pyridine	Total Petroleum Hydrocarbons [C^{6}-C^{38}]	Aroclor-1016 Aroclor-1221 Aroclor-1232 Aroclor-1242 Aroclor-1248 Aroclor-1254 Aroclor-1260	Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver Plus: Aluminum Beryllium	Americum-241 Cesium-137 Plutonium-238 Plutonium-239/240 Strontium-90 Uranium-234 Uranium-235 Uranium-238

[a]May be reported with VOCs
[b]A study is currently being conducted by the laboratory to determine the minimum detection limit.

A.1.5.1 Define the Target Population

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

A.1.5.2 Identify the Spatial and Temporal Boundaries

The spatial boundaries that apply to the CASs in Phase I are the sample locations selected for Phase I. In general, geographic boundaries are defined by the impacted soil. Intrusive activities are not intended to extend into the boundaries of neighboring areas of environmental concern (e.g., other CASs). With the exception of CASs 06-51-01 and 06-51-03, the spatial boundaries that apply to Phase II activities will be 100 ft laterally and 50 ft bgs vertically. The spatial boundary of the sump piping in CAS 06-51-01 is reduced laterally and vertically by the UST that comprises CAU 330, CAS 06-51-01, located directly west of the sump piping and midway between Building 660 and the sump. The spatial boundary of the clean out box and pipe that comprises CAS 06-51-03 is also reduced laterally and vertically by the same UST located approximately 50 ft directly north.

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

A.1.5.3 Identify Practical Constraints

Practical constraints include underground and overhead utilities, rough terrain, access restrictions such as scheduling conflicts at the NTS, posted contamination area requirements, physical barriers (e.g., fences, steep slopes), and areas requiring authorized access. Underground utilities surveys will be conducted at each CAS prior to the start of investigation activities to determine if utilities exist, and, if so, determine the limit of spatial boundaries for intrusive activities. No other practical constraints have been identified.

A.1.5.4 Define the Scale of Decision Making

The scale of decision making in Phase I is defined as each CAS. The scale of decision making in Phase II is defined as a contiguous area contaminated with any COC.

A.1.6 Step 5 - Develop a Decision Rule

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

A.1.6.1 Specify the Population Parameter

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

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

A.1.6.2 Choose an Action Level

Action levels are defined as those PALs listed in Section A.1.4.2.

A.1.6.3 Decision Rule

If the population parameter of any COPC in a target population exceeds the PAL for the COPC during Phase I, then that COPC is identified as a COC and Phase II sampling will be conducted. If the Site Supervisor determines that sufficient indicators (e.g., staining) are present, then Phase II sampling will also be conducted. If all COPC concentrations are less than the corresponding PALs, then the decision will be no further action.

Sample analyses conducted during this investigation will be sufficient to characterize the contents, if any, of a septic tank for clean closure according to the NAC.

If the observed population parameter of any COC in a sample exceeds the PALs during Phase II, then additional samples will be collected to define the extent. If all observed COC population parameters are less than PALs, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction(s).

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

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

The sampling approach for Phases I and II relies on biased sampling locations; therefore, statistical analysis is not appropriate. Only validated analytical results (quantitative data) will be used to determine if COCs are present (Phase I) or the extent of a COC (Phase II), unless otherwise stated. The baseline condition (i.e., null hypothesis) and alternative condition for Phase I are:

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

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

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

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

A.1.7.1 False Rejection Decision Error

The false rejection (alpha) decision error would mean:

- Deciding in Phase I that a COC is not present when it is, or
- Deciding in Phase II that the extent of a COC has been defined when it has not.

In both cases, the consequence is the increased risk to human health and the environment.

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

To satisfy the first criterion, Phase I data and samples will be collected in areas most likely to be contaminated by any COCs. In Phase II, data collection will sample areas that represent the lateral and vertical extent of contamination. The following characteristics are considered during both phases to accomplish the first criterion:

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

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

To satisfy the second criterion, all Phase I samples will be analyzed for the chemical and radiological parameters listed in Table A.1-1. Phase II samples will be analyzed for those chemical and radiological parameters that identified unbounded COCs.

To satisfy the third criterion, the entire dataset, as well as individual sample results, will be assessed against the DQIs of precision, accuracy, comparability, completeness, and representativeness defined in the Industrial Sites QAPP (NNSA/NV, 2002). The goal for the DQI of completeness is that 90 percent of the critical COPC results are valid for every sample. Critical COPCs are defined as those contaminants that are known or expected to be present within a CAS. In addition, sensitivity has been included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in

Section 6.0 of the CAIP. Strict adherence to established procedures and QA/QC protocol also protects against false negatives.

A.1.7.2 False Acceptance Decision Error

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

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

A.1.7.3 Quality Assurance/Quality Control

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

Quality control samples will be collected as required by the Industrial Sites QAPP (NNSA/NV, 2002) and in accordance with established procedures. The required QC samples include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per source lot per sampling event)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples)
- Field blanks (minimum of 1 per 20 environmental samples)
- MS/MSD (minimum of 1 each per matrix per 20 environmental samples), as required by the analytical method

Additional QC samples may be submitted based on site conditions.

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

Intrusive soil sampling for field screening and laboratory analysis will be conducted at CAU 516. Biased locations are determined based on biasing factors listed in Section A.1.4.1. The Site Supervisor has the discretion to modify the biased locations, but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.3. The following sections provide the general approach for obtaining the information necessary to resolve Phase I and Phase II decisions.

A.1.8.1 Intrusive Investigation

Intrusive investigations will be conducted at CAU 516 to resolve the decision statements discussed in Section A.1.3. Drilling, direct-push, excavation, or other appropriate soil collection techniques will be used at select sample locations to collect soil samples for laboratory analysis. Biased locations for these activities are determined based on the biasing factors listed in Section A.1.4.1.

Phase II step-out locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected, other biasing factors listed in Section A.1.4.1, and ambient and site conditions. If biasing factors indicate COCs extend beyond Phase II sample locations, further step-out locations may be necessary. If the step-out locations from different original locations approach each other, then the Site Supervisor may consider this as one area and collect samples only in an outward direction. In general, samples submitted for off-site laboratory analysis would be those that define the lateral and vertical extent of COCs.

The Site Supervisor has the discretion of modifying or replacing the biased sample locations based on biasing factors or Phase I analytical results. The proposed sample locations are discussed in the following sections.

Some of the CASs have vegetation and miscellaneous debris that will need to be moved and/or staged during site preparation activities to facilitate the investigation. Details for preparing sites for investigation will be provided by the A-E contractor to the M&O contractor prior to the start of the investigation.

A.1.8.1.1 Septic System

Piping is a septic system component in all the CASs with the exception of CASs 06-51-02 and 22-19-04. Phase I activities at these CASs will consist of excavating to locate the discharge pipes, visually inspecting the pipes for residual material, and collecting biased samples related to the operation of the septic system. Samples will be submitted for laboratory analysis from the following target population:

- COC concentrations in residual material in the septic system piping, if present
- COC concentrations in the soil beneath any detectable breaches in the septic system piping

The CASs 03-59-01 and 03-59-02 each have a septic tank. Phase I activities at these CASs will consist of excavating to locate the septic tank, inspecting inside the septic tank, and collecting biased samples for laboratory analysis from the following target populations:

- COC concentrations in the content of the septic tanks, if present
- COC concentrations in the soil underneath the inlet and outlet end pipes of the septic tanks
- COC concentrations in the soil horizon underlying the base of the septic tank ends

The CASs 03-59-01 and 03-59-02 each have one distribution box where the effluent is directed to a leachfield. Phase I activities at these CASs will consist of excavating to locate the distribution boxes, inspecting inside the distribution boxes, and collecting biased samples for laboratory analysis from the following target populations:

- COC concentrations in the content of the distribution boxes, if present
- COC concentrations in the soil horizon underlying the base of the distribution boxes

A.1.8.1.2 Leachfield

The CASs 03-59-01 and 03-59-02 each have a leachfield. Phase I activities at these CASs will consist of excavating to locate the boundaries of each leachfield, exposing the midpoint, and the proximal and distal ends of the associated perforated distribution pipes, and collecting biased samples for laboratory analysis from the following target populations:

- COC concentrations in the soil beneath the leachrock/native soil interface at the midpoint, and proximal and distal ends of the distribution pipes. If the interface cannot be identified, then samples will be collected directly beneath the distribution pipes.

A.1.8.1.3 Clean Out Box

The clean out box in CAS 06-51-03 is located directly east of the discharge pipe in CAS 06-51-01. Phase I activities at this CAS will consist of using excavation and/or hand tools to determine the relationship of the clean out box and access pipe to the discharge pipe in CAS 06-51-01, and to collect biased samples for laboratory analysis from the following target populations:

- COC concentrations in the residual material in the clean out box, if present
- COC concentrations in soil underneath the access pipe into the clean out box
- COC concentrations in the soil horizon underlying the base of the clean out box

A.1.8.1.4 Dry Well

Corrective Action Site 03-59-02 has a dry well located 8 ft northeast of the leachfield for disposal of photographic waste and a dry well connected to Building 3C-45 by a sewer line. Phase I activities will consist of confirming the presence of the dry wells and collecting samples for laboratory analysis from the following target populations:

- COC concentrations of residual material in the dry wells, if present
- COC concentrations in the soil at the leachrock/native soil interface of the dry wells

If the interface is not distinguishable, a sample will be collected at the base as shown in as-built engineering drawings, if available.

A.1.8.1.5 Sump

The CAS 22-19-04 consists of a vehicle decontamination pad, trench, and sump. Phase I activities at this CAS will consist of locating the base of the sump via excavation and collecting biased samples for laboratory analysis from the following target populations:

- COC concentrations at the rock bed/native soil interface at the center and northwest and southwest ends of the decontamination pad

- Soil at midpoint of trench between pad and sump

- COC concentrations in the soil at the lowest point in the sump

The CAS 06-51-03 includes a sump. Phase I activities will consist of collecting a biased soil sample from the lowest point in the sump and other locations, if appropriate, based on biasing factors.

A.1.8.2 Analytical Program

All samples will be submitted for off-site analysis that are collected from within the septic system piping, septic tanks, distribution boxes, and clean out boxes with a solid, impermeable base (e.g., concrete). If contamination is detected by field screening, the sample with the highest contamination concentration will be submitted. Any samples exceeding FSLs will have at least one additional sample (i.e., confirmatory sample) submitted to confirm contamination is less than PALs.

A.1.8.3 Additional Sample Collection

Additional samples may be collected and analyzed to obtain data for the purpose of managing and disposing IDW, protecting the health and ensuring the safety of field and laboratory personnel, and developing corrective action alternatives (e.g., risk assessments, remediation potential) for contaminated sites. Details of these sample collection activities are provided in Section 4.2.6.

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Appendix A.2

Project Organization

A.2 Project Organization

The NNSA/NSO Project Manager is Janet Appenzeller-Wing, and her telephone number is (702) 295-0461. The NNSA/NSO Task Manager assigned to CAU 516 is Kevin Cabble and his telephone number is (702) 295-5000.

The identification of the project Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate NNSA/NSO plan. However, personnel are subject to change and it is suggested that the NNSA/NSO Project Manager be contacted for further information. The NNSA/NSO Task Manager will be identified in the FFACO Biweekly Activity Report prior to the start of field activities.

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 516: Septic Systems and Discharge Points, Nevada Test Site, Nevada	2. Document Date: February 2003
3. Revision Number: 0	4. Originator/Organization: Shaw Environmental, Inc.
5. Responsible NNSA/NSO ERP Project Mgr.: Janet Appenzeller-Wing	6. Date Comments Due: March 28, 2003
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No.: NDEP	9. Reviewer's Signature:

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1)		NDEP reviewed the Draft Corrective Action Investigation Plan for Corrective Action Unit 516: Septic Systems and Discharge Points and had no comments on this document.		

[a] Comment Types: M = Mandatory, S = Suggested.

Return Document Review Sheets to NNSA/NSO Environmental Restoration Division, Attn: QAC, M/S 505.

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