RECORD OF TECHNICAL CHANGE

Technical Change No. CAIP-1 | Page 1 of 2

Project/Job No. IS05-046 | Date 05/26/2005

Project/Job Name CAIP for CAU 151: Septic Systems and Discharge Area, Nevada Test Site, Nevada, June 2004

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

Grant Evenson (Name) | Task Manager – Industrial Sites (Title)

Description of Changes:

Section 3.3.3, Page 40, third row: Change text from, "scaled from 25 to 15 millirem…" to "based on 25 millirem…"

Section 3.3.3, Page 40, first paragraph, fifth row: Change sentence to read, "Radiochemistry PALs are based on the NCRP 25 mrem per year dose-based levels (NCRP, 1999) and the recommended levels for certain radionuclides in DOE Order 5400.5 Change 2 (DOE, 1993) as listed in Table 3-4.

Section A.1.4.2, Page A-49, sixth bullet, third row: Change text from, "scaled from 25 to 15 mrem…" to "based on 25 mrem…"

Table A.1-8, Page A-50: Change values of the second column of the table (PAL) to reflect the 25 mrem/year dose constraint:

Am-241: from "7.62 pCi/g" to "12.7 pCi/g"

Cs-137: from "7.3 pCi/g" to "12.2 pCi/g"

Pu-238: from "7.78 pCi/g" to "13 pCi/g"

Pu-239/240: from "7.62 pCi/g" to "12.7 pCi/g"

Sr-90: from "503.0 pCi/g" to "838 pCi/g"

U-234: from "85.9 pCi/g" to "143 pCi/g"

U-235: from "10.5 pCi/g" to "17.5 pCi/g"

U-238: from "63.2 pCi/g" to "105 pCi/g"

Table 3-5, Page 38: For "Soil" values only, change values of 5th column of the table (PAL) to reflect the 25 mrem/year dose constraint:

Americium-241: from "7.62 pCi/g" to "12.7 pCi/g"

Cesium-137: from "7.3 pCi/g" to "12.2 pCi/g"

Cobalt-60: from "1.61 pCi/g" to "2.7 pCi/g"

Plutonium-238: from "7.78 pCi/g" to "13 pCi/g"

Plutonium-239/240: from "7.62 pCi/g" to "12.7 pCi/g"

Strontium-90: from "503.0 pCi/g" to "838 pCi/g"

Uranium-234: from "85.9 pCi/g" to "143 pCi/g"

Uranium-235: from "10.5 pCi/g" to "17.5 pCi/g"

Uranium-238: from "63.2 pCi/g" to "105 pCi/g"

Table 3-5 Explanation, Page 38: In superscript "b" explanation, change text from "…scaled from 25 to 15 mrem/yr dose…" to "…based on 25 mrem/yr dose…".

Justification:

The Preliminary Action Levels (PALs) values for radiological isotopes in the environment are calculated based on 25 mrem per year exposure level, not 15 mrem per year, as agreed between NNSA/NSO, NDEP and SNJV for the Industrial Sites project.

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

Applicable Project-Specific Document(s):
Corrective Action Investigation Plan for Corrective Action Unit 151, Septic Systems and Discharge Area, Nevada Test Site, Nevada, June 2004

Approved By: [signature] Date 5/23/05
NNSA/NSO Project Manager

[signature: Robert M. Bangerter] Date 5/23/05
NNSA/NSO Environmental Restoration Division Director

__________ Date ________
NDEP

Uranium-234: from "85.9 pCi/g" to "143 pCi/g"

Uranium-235: from "10.5 pCi/g" to "17.5 pCi/g"

Uranium-238: from "63.2 pCi/g" to "105 pCi/g"

Table 3-5 Explanation, Page 38: In superscript "b" explanation, change text from "…scaled from 25 to 15 mrem/yr dose…" to "…based on 25 mrem/yr dose…".

Justification:

The Preliminary Action Levels (PALs) values for radiological isotopes in the environment are calculated based on 25 mrem per year exposure level, not 15 mrem per year, as agreed between NNSA/NSO, NDEP and SNJV for the Industrial Sites project.

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

Applicable Project-Specific Document(s):
Corrective Action Investigation Plan for Corrective Action Unit 151, Septic Systems and Discharge Area, Nevada Test Site, Nevada, June 2004

Approved By: [signature] Date 5/23/05
NNSA/NSO Project Manager

Robert M. Bangerter Date 5/23/05
NNSA/NSO Environmental Restoration Division Director

[signature] Date 5/24/05
NDEP

Nevada
Environmental
Restoration
Project

DOE/NV--981

National Nuclear Security Administration

Corrective Action Investigation Plan for Corrective Action Unit 151: Septic Systems and Discharge Area, Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

June 2004

Approved for public release; further dissemination unlimited.

Environmental Restoration
Division

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

UNCONTROLLED When Printed

Available for public sale, in paper, from:

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

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

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

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

DOE/NV--981

CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 151: SEPTIC SYSTEMS AND DISCHARGE AREA NEVADA TEST SITE, NEVADA

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

Controlled Copy No.: ___

Revision No.: 0

June 2004

CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 151: SEPTIC SYSTEMS AND DISCHARGE AREA NEVADA TEST SITE, NEVADA

Approved by: Signature Approved Date: 6/24/04

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: Signature Approved Date: 6/24/04

Monica Sanchez, Acting Division Director
Environmental Restoration Division

Table of Contents

Table of Contents *(Continued)*

Table of Contents (Continued)

Table of Contents *(Continued)*

Table of Contents *(Continued)*

List of Figures

List of Figures (Continued)

Number	Title	Page

List of Tables

List of Acronyms and Abbreviations

ACM	Asbestos-containing material
ACP	Asbestos Clay Pipe
A-E	Architect-Engineer
AEC	U.S. Atomic Energy Commission
Ag	Silver
amsl	Above mean sea level
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BN	Bechtel Nevada
BOD	Biological Oxygen Demand
CADD	Corrective Action Decision Document
CAI	Corrective action investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
COC	Contaminant of concern
COD	Chemical Oxygen Demand
COLIWASA	Composite Liquid Waste Sampler
COPC	Contaminant of potential concern
cps	Counts per Second
CRQL	Contract-required quantitation limit
CSM	Conceptual site model

List of Acronyms and Abbreviations *(Continued)*

DO	Dissolved Oxygen
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQI	Data quality indicator
dpm	Disintegrations per Minute
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
ft^2	Square feet
ft^2/sec	Square feet per second
ft/mi	Feet per mile
gal	Gallon
HASP	Health and Safety Plan
HWAA	Hazardous waste accumulation area
IDW	Investigation-derived waste
in.	Inch(es)
in./yr	Inches per year
IRIS	Integrated Risk Information System
ISMS	Integrated Safety Management System

List of Acronyms and Abbreviations *(Continued)*

ITLV	IT Corporation, Las Vegas
LCS	Laboratory control sample
m	Meter
M&O	Management and Operating
MDC	Minimum detectable concentration
mg/L	Milligrams per liter
mg/kg	Milligram per kilogram
mi	Mile
mi^2	Square mile
mrem/year	Millirem per year
MRL	Minimum reporting level
MS	Matrix spike
MSD	Matrix spike duplicate
NAC	*Nevada Administrative Code*
nCi/L	Nanocuries per liter
NCRP	National Council on Radiation Protection and Measurement
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NEPA	*National Environmental Policy Act*
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NRS	*Nevada Revised Statutes*
NTS	Nevada Test Site
NTSWAC	*Nevada Test Site Waste Acceptance Criteria*
PAL	Preliminary action level

List of Acronyms and Abbreviations *(Continued)*

PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
PID	Photoionization detector
POC	Performance Objective Certification
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RadCon	Radiological Control
RCRA	*Resource Conservation and Recovery Act*
REECo	Reynolds Electrical & Engineering Co., Inc.
RMA	Radioactive Materials Area
ROTC	Record of Technical Change
RPD	Relative percent difference
SDG	Sample Delivery Group
SDWA	*Safe Drinking Water Act*
SDWS	*Safe Drinking Water Standard*
SNJV	Stoller-Navarro Joint Venture
SQP	Standard Quality Practice
SSHASP	Site-Specific Health and Safety Plan
SVOC	Semivolatile organic compound

List of Acronyms and Abbreviations *(Continued)*

TPH	Total petroleum hydrocarbon
TSCA	*Toxic Substance Control Act*
USGS	U.S. Geological Survey
UST	Underground storage tank
VCP	Vitrified clay pipe
VOC	Volatile organic compound
VSP	Visual Sample Plan
Fg/L	Micrograms per liter
FR/h	Micro Roentgen per hour

Executive Summary

This Corrective Action Investigation Plan (CAIP) contains project-specific information for conducting site investigation activities at Corrective Action Unit (CAU) 151: Septic Systems and Discharge Area, Nevada Test Site, Nevada. Information presented in this CAIP includes facility descriptions, environmental sample collection objectives, and criteria for the selection and evaluation of environmental corrective action alternatives.

Corrective Action Unit 151 is located in Areas 2, 12, 18, and 20 of the Nevada Test Site, which is 65 miles northwest of Las Vegas, Nevada. Corrective Action Unit 151 is comprised of the nine Corrective Action Sites (CAS) listed below:

- 02-05-01, UE-2ce Pond
- 12-03-01, Sewage Lagoons (6)
- 12-04-01, Septic Tanks
- 12-04-02, Septic Tanks
- 12-04-03, Septic Tank
- 12-47-01, Wastewater Pond
- 18-03-01, Sewage Lagoon
- 18-99-09, Sewer Line (Exposed)
- 20-19-02, Photochemical Drain

The CASs within CAU 151 are discharge and collection systems. Corrective Action Site 02-05-01 is located in Area 2 and is a well-water collection pond used as a part of the Nash test. Corrective Action Sites 12-03-01, 12-04-01, 12-04-02, 12-04-03, and 12-47-01 are located in Area 12 and are comprised of sewage lagoons, septic tanks, associated piping, and two sumps. The features are a part of the Area 12 Camp housing and administrative septic systems. Corrective Action Sites 18-03-01 and 18-99-09 are located in the Area 17 Camp in Area 18. These sites are sewage lagoons and associated piping. The origin and terminus of CAS 18-99-09 are unknown; however, the type and configuration of the pipe indicates that it may be a part of the septic systems in Area 18. Corrective Action Site 20-19-02 is located in the Area 20 Camp. This site is comprised of a surface discharge of photoprocessing chemicals.

All of the CASs with the exception of CAS 20-19-02, Photochemical Drain, have the same investigation strategy. The features of the eight CASs include lagoons, ponds, sumps, abandoned piping, septic tanks, distribution boxes, manholes, cleanouts, arroyos, and washout areas. The

components of the individual CASs have varying combinations of the aforementioned features. The conceptual site model for all CASs, except CAS 20-19-02, account for individual and combined features of these components which comprise the systems within the CAU 151 CASs.

A surface discharge conceptual site model has been developed to encompass the feature of CAS 20-19-02. To satisfy the decisions developed for CAS 20-19-02, a systematic grid based sampling method was developed to locate the discharge associated with this CAS. The results from this effort will determine if the CAS will be investigated using the same strategy of the other CASs.

The sites will be investigated based on the data quality objectives (DQOs) developed on March 31, 2004, by representatives of the Nevada Division of Environmental Protection; U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office; Stoller-Navarro Joint Venture; and Bechtel Nevada. The DQO process was used to identify and define the type, amount, and quality of data needed to support the decisions identified in the DQO process. These sites are being investigated because existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives.

The general technical approach for CAU 151 includes the following activities:

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

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Under the *Federal Facility Agreement and Consent Order*, this CAIP will be submitted to the Nevada Division of Environmental Protection for approval. Field work will be conducted following approval of the plan. The results of the field investigation will support a defensible evaluation of corrective action alternatives that will be presented in the Corrective Action Decision Document.

1.0 Introduction

This Corrective Action Investigation Plan (CAIP) contains project-specific information including facility descriptions, environmental sample collection objectives, and criteria for conducting site investigation activities at Corrective Action Unit (CAU) 151: Septic Systems and Discharge Area, Nevada Test Site (NTS), Nevada.

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

The NTS is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1). Corrective Action Unit 151 is comprised of the nine Corrective Action Sites (CAS) listed below:

- 02-05-01, UE-2ce Pond
- 12-03-01, Sewage Lagoons (6)
- 12-04-01, Septic Tanks
- 12-04-02, Septic Tanks
- 12-04-03, Septic Tank
- 12-47-01, Wastewater Pond
- 18-03-01, Sewage Lagoon
- 18-99-09, Sewer Line (Exposed)
- 20-19-02, Photochemical Drain

The corrective action investigation (CAI) will include field inspections and inventories, radiological surveys, video mole surveys, and sampling of media where appropriate.

1.1 Purpose

The CASs in CAU 151 are being investigated because hazardous and/or radioactive constituents may be present in concentrations that could potentially pose a threat to human health and/or the environment. The nine CASs at CAU 151 consist of septic tank systems, discharge collection systems, and a surface release. Existing information on the nature and extent of potential contamination at these sites are insufficient to evaluate and recommend corrective action alternatives for the nine CASs. Therefore, additional information will be obtained by conducting a CAI prior to evaluating corrective action alternatives and selecting the appropriate corrective action for each CAS.

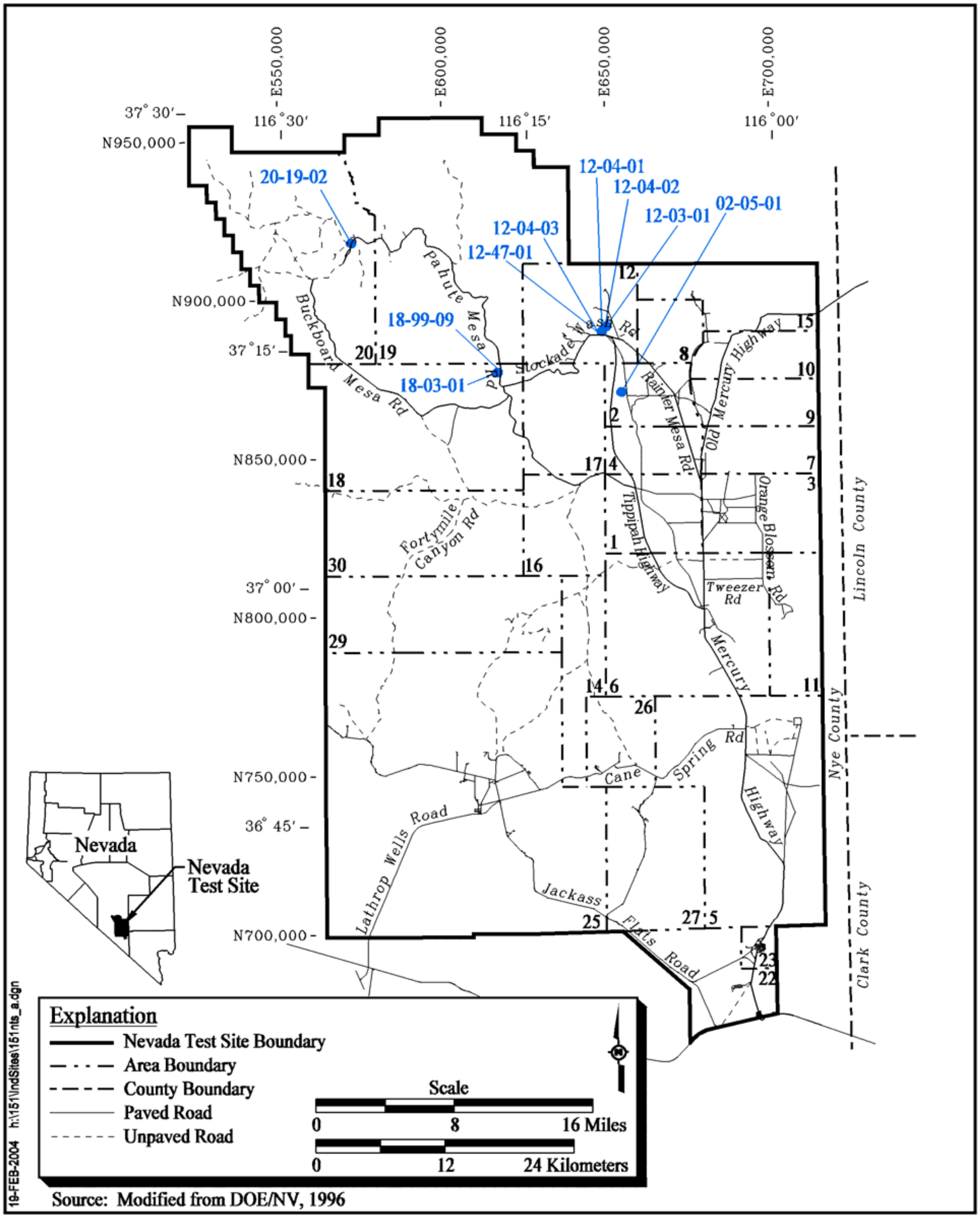


Figure 1-1
CAU 151, CAS Location Map

The sources of possible contamination identified for CAU 151 are associated with septic systems, septic tanks, distribution boxes and manholes, associated system piping, lagoons, ponds, sumps, arroyos and washouts, and a surface discharge. At the UE-2ce pond in Area 2, well water was discharged into the pond from the UE-2ce well. The well was constructed to measure the radiological contamination in the carbonate layer as a result of the Nash test. In Area 12, sanitary effluents discharged into the septic systems from the housing, administrative, and recreational trailers in the Area 12 Camp. It is possible that other industrial contaminants may have been discharged into the septic systems in Area 12. For the Area 17 Camp in Area 18, sanitary and industrial effluents discharged into the sewage lagoons and associated piping. In Area 20, liquid photochemical wastes generated from photographic processing activities in Trailer 992 may have been discharged onto the surface.

1.1.1 DQO Summary

The CAI will be conducted in accordance with the data quality objectives (DQOs) developed by the Nevada Division of Environmental Protection (NDEP) and the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO). The DQOs (presented as Appendix A.1) are used to identify the type, amount, and quality of data needed to define the nature and extent of contamination and identify and evaluate the most appropriate corrective action alternatives for CAU 151. This CAIP will describe the investigation plan developed to collect the data needs identified in the DQO process. While a detailed discussion of the DQO methodology and the DQOs specific to each CAS is presented in Appendix A.1 to this document, a summary of the results of the DQO process is provided below.

The primary problem statement for the investigation is: “Existing information on the nature of potential contaminants and, if present, the extent of contamination is insufficient to evaluate and recommend corrective action alternatives for CAU 151.” To address this question, resolution of the decision statements are required.

The decision statements were developed to encompass the similar decisions for CAU 151. However, for CAS 20-19-02, Photochemical Drain, three decision statements have been established to address the uncertainty of the location of the surface discharge. The two Decision I statements for CAS 20-19-02 are:

- Decision I(a) for CAS 20-19-02 is: "Where is the release location of the surface discharge?" The location of the surface discharge will be identified as any location with detection above preliminary action levels (PALs) for total silver (Ag).
- Decision I(b) for CAS 20-19-02 is: "Is a contaminant of potential concern (COPC) present at a concentration that could pose an unacceptable risk to human health and the environment?" Any contaminant detected at a concentration exceeding the corresponding PAL, as defined in Section 3.3, will be considered a contaminant of concern (COC). Samples collected to resolve decisions for CAS 20-19-02 will be referred to as Decision I(a) and Decision I(b) samples respectively.

The Decision I statement for all other CASs in CAU 151 is known as the Decision I/Ib to encompass the Decision I(a) statement for CAS 20-19-02 and the Decision I statement for all other CASs. Decision I/I(b): "Is a COPC present at a concentration that could pose an unacceptable risk to human health and the environment?" Any contaminant detected at a concentration exceeding the corresponding PAL, as defined in Section 3.3, will be considered a COC. Samples used to resolve Decision I/I(b) are referred to as Decision I/I(b) samples.

A Decision II statement has been developed to satisfy the results of COPCs identified from Decision I/I(b).

Decision II: "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?" Sufficient information is defined as the data needs identified in this DQO to include the lateral and vertical extent of all COCs associated with a CAS. Samples used to resolve this decision are identified as Decision II samples.

The informational inputs and data needs to resolve the problem statement and the decision statements were generated as part of the DQO process for this CAU and are documented in Appendix A.1. The information necessary to resolve the DQO decisions will be generated for each CAU 151 CAS by analyzing samples collected during a field investigation. The presence and nature of contamination at each CAS will be determined by sampling locations that are determined to be the most probable to contain COCs if they are present anywhere within the CAS. If, while defining the nature of contamination, it is determined that COCs are present at a CAS, that CAS will be further addressed by determining the extent of contamination before evaluating corrective action alternatives.

1.2 Scope

To generate the information needed to resolve the decision statements identified in the DQO processes, the scope of the CAI for CAU 151 will include the following activities:

- Move surface debris and/or materials as needed to facilitate sampling.
- Conduct video mole surveys at CASs with piping to identify residual materials and/or breaches in piping.
- Perform radiological surveys on solid materials to determine status.
- Collect and submit environmental samples from various forms of media (e.g., soil, sludge, residual liquids) for laboratory analysis to determine if COCs are present and ensure characterization of waste, when necessary.
- If COCs are present, collect additional step-out samples to define the extent of the contamination.
- Collect quality control (QC) samples for laboratory analyses to evaluate the performance of measurement systems and controls based on the requirements of 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. Collect samples of IDW and conduct inspections and surveys, as needed, to support waste management decisions.

Based on historical records, piping has been rerouted and diverted at sites to accommodate new discharge feature (e.g., lagoon) or updates to the existing systems. Piping not associated directly adjacent to the discharge feature or tank (CASs 12-03-01, 12-04-01, 12-04-02, 12-04-03, 12-47-01, 18-03-01, and 18-99-09) and past the point of diversion will not be considered a part of this investigation. If active piping is not diverted or cut off within the system being investigated, and active piping is encountered, the investigation will be suspended and re-evaluated in order to redefine the spatial boundaries established for the CAS.

1.3 CAIP Contents

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

Appendix A.1, Section A.1 provides a DQO summary, while Section A.2 contains information on the project organization.

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

2.0 Facility Description

Corrective Action Unit 151 includes nine CASs, which were grouped together based on technical similarities (releases from septic systems and discharge areas), and the agency responsibility (Environmental Restoration) for closure. The CASs that include septic and/or discharge collection components are located in Areas 2, 12, and 18 and include CASs 02-05-01, 12-03-01, 12-04-01, 12-04-02, 12-04-03, 12-47-01, 18-03-01, and 18-99-09. Corrective Action Site 20-19-02 is a surface discharge location in Area 20. The following sections provide information on the physical setting, operational history, waste inventory, release information, and investigative background of each site.

2.1 Physical Setting

The CAU 151 CASs are located within Areas 2, 12, 18, and 20 of the NTS. General background information pertaining to topography, geology, hydrogeology, and climatology are provided for these specific areas or the NTS region in the *Geologic Map of the Nevada Test Site, Southern Nevada* (USGS, 1990); *CERCLA Preliminary Assessment for DOE's Nevada Operations Office Nuclear Weapons Testing Areas* (DRI, 1988); the *Final Environmental Impact Statement*, *Nevada Test Site, Nye County, Nevada* (ERDA, 1977); and the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996).

2.1.1 Area 2

Corrective Action Site 02-05-01 in Area 2 is situated in Yucca Flat (also known as Yucca Valley) in the northwestern portion of Area 2 at the NTS. The Yucca Flat area encompasses about 530 square miles (mi^2) in the northeastern corner of the NTS (USGS, 1968a). It is an oval-shaped intermontane basin that ranges in elevation from about 4,000 feet (ft) above mean sea level (amsl) in Yucca Lake, at its southern end, to about 5,000 ft amsl at its northern end (USGS, 1968b). Yucca Valley slopes to the south at approximately 23 feet per mile (ft/mi) (USGS, 1959).

The current surficial geology of Yucca Flat has been defined by the regional structure and general geology of the area. Yucca Flat is slowly being filled by alluvial (sedimentary) debris eroding from the surrounding foothills. Basins of this type were formed during the past 15 million years by major extensional deformation (pulling apart) of the earth's crust. They are typically bounded by steeply dipping fault zones. Regions of the earth's crust under major tensional stress are subject to several kinds of faulting. In the Yucca Flat area, the plastic extension of deeper earth material has created fault planes inclined at steep angles to the surface. Blocks of rock have dropped down along these faults to produce characteristic basin and range surface features. When ranges become significantly higher than basins, they serve as sources of the alluvial deposits that gradually fill the basins. Both uplifting and extension of the entire region containing the NTS continue today (LLNL, 1982).

Groundwater recharge occurs predominantly through the slow percolation of surface water through the unsaturated zone that overlies the water table or from underflow from areas north and northwest of the NTS. Most of this recharge is restricted to higher elevations where precipitation is greatest. Average annual recharge from precipitation has been estimated to be 32,500 acre-ft for the Ash Meadows system (DOE/NV, Date Unknown). No information regarding perched water was found.

The closest water supply well is UE-2ce and is located 57 ft northwest of CAS 02-05-01. It has a groundwater level approximately 1,448 ft below ground surface (bgs) at a land-surface elevation of 4,764 ft amsl (USGS and DOE, 2003). The existing water distribution system for the Area 2 camp is supplied by Well 8 (USGS HTH-8) which is located in Area 18, approximately 8.7 mi to the southwest (USGS and DOE, 2003).

Precipitation is less than 6 inches (in.) annually with less than 40 days receiving measurable amounts. Typical temperature ranges are from 25 to 50 degrees Fahrenheit (° F) in winter and from 60 to 95° F in summer. However, actual temperatures will vary from 0 to 104° F (Holmes & Narver, 1981).

2.1.2 Area 12

Corrective Action Sites 12-03-01, 12-04-01, 12-04-02, 12-04-03, and 12-47-01 are located in Area 12 Camp near the base of the eastern slope of Rainier Mesa close to the base of Dolomite Hill. It is near the surficial expression of the Tongue Wash Fault, a northeast-trending sinistral-reverse fault that dips approximately 45 degrees to the west (DRI, 1996).

Rainier Mesa is in the north-central part of the NTS and the highest of a group of mesas, ridges, and low mountains that border the northwestern part of Yucca Flat, a large intermontane basin. The mesa trends north-south, is about 3 mi long, 1.5 mi wide, and includes 4.4 mi^2 within the area of its caprock. The mesa rises 200 ft to more than 700 ft above the nearby highlands, and about 2,500 to 3,500 ft above nearby intermontane basins. The elevation of the volcanic caprock of the mesa ranges from 7,400 to 7,679 ft amsl. By contrast, the maximum elevation of Yucca Flat, about 5,000 ft amsl, is attained about 3 mi east of Rainier Mesa (USGS, 1965).

The CASs located in Area 12 are within the Ash Meadows groundwater subbasin. Near Rainier Mesa, the boundary between the Ash Meadows and Alkali Flat/Furnace Creek subbasins has been located on the basis of hydrography. It is unlikely that this groundwater subbasin boundary coincides with the hydrographic divide. A more realistic scenario is the groundwater subbasin boundary is defined by the relatively impermeable Eleana Formation. If true, groundwater may be draining into the Alkali Flat/Furnace Creek subbasin (via Timber Mountain) with flow ultimately discharging in Alkali Flat and Furnace Creek in Death Valley. If the current boundary is correct, then the ultimate discharge area for groundwater flow originating near the CASs would be the springs at Ash Meadows and perhaps Death Valley (via Yucca and Frenchman Flats) (DRI, 1996).

Results of hydrological investigations indicate that the static composite fluid level in Well ER-12-1 was 1,540 ft bgs. Drill-stem tests and flow logs determined that the lower two intervals in the well are underpressured relative to the upper zones by approximately 1,300 ft. Aquifer tests, drill-stem tests, and flow logs determined that the transmissivity of the well ranged from 8.1 x 10-5 to 4.3 x 10-3 square feet per second (ft^2/sec), with the most transmissive zone being 1,700 to1,820 ft bgs followed by the 3,000- to 3,160-ft interval. The pressure differential between theses zones allowed for substantial crossflow to occur while the well was open (DRI, 1996).

The nearest well in Area 12 Camp is Well ER-12-1. The well was installed in 1991 for use as a test site; the water is unused. The borehole depth is 3,588 ft and the well depth is 3,434 ft. The nearest in-use well to the CASs is Water Well 2 (USGS HTH #2), which is 4.1 mi southeast of CAS 12-03-01 in Area 2 (USGS and DOE, 2003). The well is currently active and is included in the Environmental Restoration Program (ERP) Network. Water Well 2 was constructed on March 8, 1962, to a depth of 3,422 ft. Water levels have ranged from 2,053 to 2,066 ft bgs. In 2002, the water depth was approximately 2,053 ft bgs. This well is used primarily for industrial purposes (USGS and DOE, 2003).

Surface water at CAS 12-03-01 drains into Tongue Wash, which eventually flows into other ephemeral channels draining east into Yucca Flat, a closed hydrographic basin (DRI, 1996).

Rainier Mesa is characterized by low precipitation, low relative humidity, and large daily variations in temperature. The mean precipitation is approximately 13.8 inches per year (in./yr) and is seasonal. Most precipitation occurs in the late winter months as snow, which is normally found on the higher elevations from late November through April. Summer precipitation is derived primarily from infrequent thundershowers (DRI, 1987).

2.1.3 Area 18

Corrective Action Sites 18-03-01 and 18-99-09 are located in a flat area of Area 18; however, an arroyo runs through the center portion of the CASs from the north to the south. Area 18 is within the northeastern part of the Timber Mountain caldera moat, which comprises the Rainier Mesa Member and the Ammonia Tanks Member. The Rainier Mesa Member of the Timber Mountain tuff was erupted from vents above a magma chamber within Timber Mountain caldera. The eruption deposited the ash-flow tuff of the Rainier Mesa inside the caldera at a thickness of greater than 2,000 ft. The debris flows and breccia from the Rainier Mesa Member are a mixture of dense, hard rhyolite lava and welded tuff blocks in a matrix of porous, soft, ashy tuff, now altered largely to clay. The maximum known thickness is 850 ft.

The soil in the surrounding area is brown, silty, and sandy. Depth to bedrock is unknown at this time. However, due to the amount of testing conducted in the area, it is likely that fractured rock is very prevalent throughout Area 18.

The site is located within the Alkali Flat-Furnace Creek Ranch Subbasin. Groundwater flow in this area is generally to the south and southwest through volcanic rock aquifers (BN, 1999; USGS and DOE, 2003). As groundwater within the region percolates toward the water table, it often contacts low permeability rocks. This results in saturated perched and semiperched zones that can be several hundred feet closer to the ground surface than the regional water table. Perched water zones are common throughout the mesas (DRI, 1988; BN, 1997).

Recharge of the Alkali Flat-Furnace Creek Subbasin occurs along its northern boundary from precipitation in the Kawich Range and Reveille Range, and along the northeastern boundary at Belted Range, Rainier Mesa, and Shoshone Mountain. Within the subbasin, recharge occurs throughout eastern Pahute Mesa and in the southern portion of the Kawich Range. Some recharge may also occur from precipitation on Timber Mountain and in the Funeral Mountains. During moderate to intense precipitation events, it is possible that infiltration of surface run-off in the upper portions of the Forty Mile Wash drainage also contributes to area recharge (USGS, 1996).

Water Well 8 (USGS HTH-8) is located approximately 1.5 mi northwest of CASs 18-03-01 and 18-99-09, and the water level at the well is reported to be at 1,081 ft bgs. Water Well 8 is the nearest well to the CASs in CAU 151. Water in this well is primarily used for testing (USGS and DOE, 2003).

Annual rainfall recorded at rain gauge station Little Feller 2 averaged 8.02 in. for the years 1977 to 2002 (ARL/SORD, 2003).

2.1.4 Area 20

Corrective Action Site 20-19-02 is located in a flat area within the mesa which slopes to the southwest and lies within the eastern part of Pahute Mesa, which is a volcanic plateau underlain by tuffs and lavas from the Timber Mountain Oasis Valley caldera complex and the Silent Canyon and Black Mountain calderas north of Timber Mountain. A Miocene, rhyolitic, eruptive center produced this overlapping complex of fault-controlled calderas (USGS, 1996). The major subsurface of Pahute Mesa is the Silent Canyon caldera, which is a deep structural depression. This caldera is comprised of different types of Tertiary volcanic rocks, such as ash-flow and ash-fall tuffs. These tuffs are more than 13,000 ft thick in some places (DRI, 1988).

Corrective Action Site 20-19-02 is located within the inner collapse zone of the Area 20 Caldera, located within the Silent Canyon complex (BN, 1997). Due to the numerous amount of testing events conducted in the area, it is likely that fractured rock is very prevalent throughout Area 20.

A general description of the soil is unavailable due to the amount of snow cover on the ground during the most recent field visit. Also, the depth to the local alluvium layer was not determined. Further, the depth to bedrock and the existence of localized caliche are unknown at this time.

Inside the Area 20 Caldera, the depth of the water table ranges from 1,950 to 2,350 ft. Outside of the caldera, the depth decreases to approximately 850 ft in the extreme northwest corner of the NTS. The permeability of the rock is generally low, and groundwater movement is primarily through fractures in the rock. The total flow of groundwater beneath Pahute Mesa is estimated to be about 8,000 acre-ft/year, of which 5,500 acre-ft enters the groundwater system from Gold Flat and Kawich Valley to the north. Groundwater flow is generally south and southwest to the Oasis Valley, about 20 mi away. As groundwater within the region percolates toward the water table, it often contacts low permeability rocks. This results in saturated perched and semiperched zones that can be several hundred feet closer to the ground surface than the regional water table. Perched water zones are common throughout the mesas (DRI, 1988; BN, 1997).

U-20 Water Well (U-20WW) is located approximately 1.6 mi southwest of CAS 20-19-02. The U-20WW well is active and used for industrial purposes. The most recent depth to groundwater data for U-20WW, which was recorded in 2003, is about 2,050 ft bgs (USGS and DOE, 2003).

Annual rainfall recorded at rain gauge station Pahute Mesa 1 (PM 1) is approximately 7.8 in./yr (ARL/SORD, 2003). The rate at which recharge occurs at CAS 20-19-02 is unknown.

2.2 Operational History

The following subsections provide a description of the use and history of each CAS in CAU 151 that may have resulted in a potential release to the environment. The CAS-specific summaries are designed to illustrate all significant, known activities. A site visit was conducted on March 23, 2004, and included representatives from NDEP, NNSA/NSO, and NNSA/NSO contractors. Information gathered during this and other site visits has been added to the individual CAS operational histories where appropriate. Additional details on each CAS description is also available in Section A.1.1 of Appendix A.1.

2.2.1 Corrective Action Site 02-05-01, UE-2ce Pond

The UE-2ce Well was drilled in 1977 to collect post-test radiological data of the geologic conditions from the Nash test conducted in 1967 (DOE/NV, 1986). According to the *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada* (DOE, 1988a), the satellite well was drilled to a depth of 502 meters (m), 138 m deeper than the Nash explosion level. The well was created to produce water from the carbonate rock. The water was sampled and results indicated that the Nash test forced the contaminants into the newly formed fractures. Sampling was performed on the well to study radionuclide migration from the unsaturated zone to the saturated zone. During construction of the well, the adjacent pond was constructed to receive tritium-contaminated water from the adjacent well. The UE-2ce well and the adjacent pond are connected by a 60-ft trench. As the well was sampled and tests were conducted in the well, the excess water was pumped into the UE-2ce pond. Pumping was discontinued in 1986 when the pump was no longer functional and was not repaired or replaced. Today, hand bailers are used to collect water from the well for the samples.

Corrective Action Site 02-05-01 consists of an excavated pond, surrounding bermed area, and a surface trench running between the pond and the UE-2ce Well. The topography of the UE-2ce pond area is a bermed pond with the overflow at the northeast corner of the pond, which drains into an arroyo that runs to the southeast. The pond measures approximately 68 by 50 ft and is dry. A 6-ft high berm surrounds the pond, except on the east side of the pond where the berm is 10 ft high. There is a gravel mound within the pond that is approximately 3-ft tall, 4-ft wide, and 60-ft long. In addition to the mound, there is miscellaneous debris including cables, scrap metal, and wood scattered on the bottom and around the pond. The 4-in. deep and 12-in. wide surface trench leading from the pond to the well is approximately 60-ft long and contains small pieces of wood debris and vegetation. Boundaries of this CAS are well defined by the surficial features.

2.2.2 CAS 12-03-01, Sewage Lagoons (6)

Corrective Action Site 12-03-01 consists of seven lagoons that were constructed in the late 1960s and early 1980s. For this CAS, the features have been identified as Lagoons A through G. These lagoons are associated with the septic systems from the Area 12 Camp (CASs 12-04-01, 12-04-02, and 12-04-03). Interviews with personnel indicate that these lagoons did not receive effluent from the B and E tunnels in Area 12.

The layout of the lagoons start at the south end of the site and hooks to the east. The topography of the site consists of two generally flat areas that slope to the northeast. There is a difference in elevation between Lagoon F to Lagoon E of approximately 40 ft. An arroyo runs through the site from the west and discharges into Lagoon G.

These lagoons in Area 12 were used between the closing of the septic tanks (CASs 12-04-01, 12-04-02, and 12-04-03) and the opening of the new sewage lagoons to the northwest (REECo, 1967a, b, and c). The lagoons received effluent from the septic systems and buildings in the Area 12 Camp. The known piping and any closed/abandoned piping directly associated with the layout are included in the scope of the CAS. There is piping leading into the lagoons from the Area 12 Camp septic systems that previously fed into the lagoons, but was diverted to the new lagoons located east of 12-01 Road. This piping remains active and is not associated or included in the scope of this CAS. However, piping from the old lagoons to the point of diversion to the new system (indicated by a manhole) is included in the scope of this CAS. Documentation indicates that the primary lagoons (Lagoons A and B) are connected to the two adjacent lagoons (Lagoons C and D) via an underground system, and that the two closed distribution boxes, manholes, and cleanouts are included in the scope of this CAS. None of the piping is visible from the ground surface with the exception of the piping between Lagoons E and G (REECo, 1967a, b, and c).

2.2.3 CASs 12-04-01, Septic Tanks; 12-04-02, Septic Tanks; and 12-04-03, Septic Tank

Corrective Action Sites 12-04-01, 12-04-02, and 12-04-03 are located in the Area 12 Camp at the NTS. The CAS consists of four separate septic systems named Systems # 1, 3, 4, and 5. These systems are associated with and discharge into CAS 12-03-01, Sewage Lagoons (6). Historical documentation indicates that these CASs were used to collect sanitary effluent from the Area 12 Camp administrative, recreational, and housing buildings (REECo, 1992a, and 1995).

All of these CASs are located in a washout area within the Area 12 Camp. The washout is located along the south side of Rainier Mesa Road and runs to the east.

Corrective Action Site 12-04-01 addresses Systems #1 and #4. System #1 was installed around 1961 and consists of two septic tanks, two manholes, four access covers, and the associated 6-in. vitrified clay pipe (VCP). There are approximately 5,000 gallon (gal) of septage and liquid in each tank. System #4 was constructed prior to 1961 and originally contained only two septic tanks and associated VCP. This system was updated between 1961 and 1965 to include two additional tanks. This system (named A121 on engineering drawings) is comprised of four tanks that contained 3,500 gal of liquid at the time of the survey. All of the tanks in Systems #1 and #4 are documented as 8 by 25 ft with a 7,500-gal capacity (Bingham, 1992; REECo, 1967a, 1992a and b, and 1995).

Corrective Action Site 12-04-02 addresses System #5. This system was constructed between 1961 and 1962 and consists of six septic tanks, two manholes, and eight visible access covers. The same 6-in. VCP and tank size applies to this system as for Systems #1 and #4. This system (named A125 on engineering drawings) is comprised of six tanks that contained approximately 3,500 to 5,000 gal in each tank.

Corrective Action Site 12-04-03 addresses System #3. Originally the CAS included System #2; however, System #2 may have never been completed. Geophysical surveys are planned to verify the absence or presence of this system. System #3 consists of two manholes, one visible access cover, and 6-in. VCP associated with the tanks. This system is shown on engineering drawings to have a total of four tanks, but after excavation only three tanks were identified during the sampling event in 1995 (REECo, 1995). In the three identified tanks, there was approximately 5,000 gal of liquid and sludge remaining in each tank. There was a solid cover of vegetation over the liquid and sludge in two of the tanks. The vegetation cover was approximately 4 to 6 in. thick and there were approximately 3 ft of liquid underneath the cover.

2.2.4 CAS 12-47-01, Wastewater Pond

Corrective Action Site 12-47-01 consists of two sumps (evaporation ponds) and associated inactive piping located at the Area 12 Fleet Operations at the NTS. It is documented that three buildings and a women's restroom trailer fed into these sumps: Building 12-8, Area 12 Construction Shops, was constructed before 1964 and demolished in 2002; Building 12-16, Motor Pool Equipment Maintenance Shop, was constructed around 1965 and was demolished in 2002; while Building 12-910, Crafts Building, was constructed in 1987 and its wastewater was diverted to the new septic tank leachfield system that was constructed in the late 1980s or early 1990s, and the women's restroom trailer was added in 1971. Both sumps were constructed for the purpose of receiving sewage waste from Buildings 12-8 and 12-16. However, when the new sump was built in 1970, sewage from both buildings was diverted to the new sump, as were Building 12-910 and the women's restroom trailer. The old unlined sump is approximately 35 by 35 ft and was constructed between 1964 and 1966. This sump is located southwest of the new sump. The new sump, that is also included in this CAS, is approximately 30 by 60 ft and was constructed around 1970. In the late 1980s it was proposed to replace these sumps with a septic tank and a leachfield. On as-built drawings from 1992 the new leachfield and septic system replaced this system. This new system services Building 12-910 and is currently active. At the time of the addition of the septic tanks and leachfield, the new sump and the old sump were backfilled. Additionally, it has been well documented that the sumps have overflown on several occasions onto the surrounding area (DOE, 1988a and b). The CAS is located in a washout area where surface drainage runs to the east.

In addition to the sanitary effluent drains from Buildings 12-8, 12-16, and 12-910, there are drains located within Building 12-16 that were used during steam cleaning and vehicle maintenance activities. Documentation suggests that this new sump may have received the waste waters from these activities and that these effluents may have been hazardous (DOE, 1988a and b).

2.2.5 CAS 18-03-01, Sewage Lagoon

Corrective Action Site 18-03-01, Sewage Lagoons, is located in the Area 17 Camp of Area 18 at the NTS. The topography of the Area 17 Camp indicates that surface drainage would have flown to the south-southeast. This site includes two septic lagoons and its associated piping that was constructed during the early 1960s and was active until the late 1980s. These lagoons were used to collect sanitary effluent from the Area 17 Camp administrative offices and the sanitary and possibly industrial effluent from the construction area to the east of the lagoons (AEC, Date Unknown). The lagoons will be referred to as the northern and southern lagoons. The northern lagoon measures 163 by 93 ft and is approximately 18 ft deep. The southern lagoon is 141 by 113 by 10 ft. Both of the lagoons are dry, contain vegetation, and are immediately adjacent to one another. There are no drawings that indicate CAS 18-99-09, Sewer Line (exposed), and CAS 18-03-01 are connected. Geophysical survey results did not indicate a tie-in of the pipe to the sewage lagoon (AEC, Date Unknown; SAIC, 2003; Shaw, 2003b).

Because the drawing and surveys indicate that CASs 18-03-01 and 18-99-09 are not related, they shall remain separate CASs and approached separately unless the field investigation determines that they are connected.

2.2.6 CAS 18-99-09, Sewer Line (Exposed)

Corrective Action Site 18-99-09, Sewer Line (Exposed), is located in the Area 17 Camp of Area 18 at the NTS. The topography of the Area 17 Camp indicates that surface drainage would have flown to the south-southeast. This 6-in. VCP is in the vicinity of CAS 18-03-01, Sewage Lagoons; however, documentation and geophysical surveys indicate that the pipe is not attached to the system associated with the sewage lagoons. Approximately 3 ft of the pipe is exposed at the ground surface under a wire fence. The southern end of the pipe is elbowed downward. The origin and terminus of the pipe are not known and there is minimal documentation as to what structures are associated with this pipe. The operational history of this pipe is not known; however, the type and size of the VCP is consistent with sewer lines constructed at the Area 17 Camp. Due to the physical similarities and proximity between this pipe and those of CAS 18-03-01, it is suspected that it was also constructed in the early 1960s and was abandoned and inactive by the 1980s.

2.2.7 CAS 20-19-02, Photochemical Drain

Corrective Action Site 20-19-02, Photochemical Drain, consists of a surface discharge from the Trailer 992 photoprocessing drain in the Area 20 Camp. The regional surface drainage of the Area 20 Camp trends southwest. The discharge of photochemicals from Trailer 992 onto the soil beneath the trailer occurred during film processing operations from 1967 through 1991. The trailer was not active the entire year, but was operational a few weeks of each year to support the tests conducted in the area (Maddox, 1991).

Area 20 Camp was used as a support camp. After 1991, portions of the camp were demolished. Presently, there are two metal buildings (the former ironworkers shop and welding shop) and concrete pads that remain at the camp. It is not known, nor documented, whether or not the site was graded as a part of the demolition activities. The exact location of Trailer 992 has not been determined. Discussions with employees who have worked at the Area 20 Camp indicate that the trailer may have been located approximately 50 ft west of the metal buildings (Templeton, 2004).

Although CAS 20-19-02 has been identified in audits and is documented, its former location has not been physically identified during field visits. Documentation suggests that the photochemicals were discharged directly onto the ground surface; however, in 1990 the operations at the trailer changed and the photochemicals were supposedly contained in 55-gal drums that were stored alongside the trailer (Maddox, 1991).

2.3 Waste Inventory

Available documentation, interviews with former site employees, process knowledge, previous investigations at similar sites, and general historical NTS practices were used to identify wastes that may be present. More detailed information was evaluated during the DQO process and is discussed in Section A.1.1 of Appendix A.1. The following subsections summarize the types of waste and associated contaminants expected, or suspected, to be present at each CAS.

2.3.1 Corrective Action Site 02-05-01, UE-2ce Pond

Radiological and/or hazardous wastes are suspected to be present in surface and/or subsurface soils within the boundaries of this CAS as a result of the construction and discharge activities associated with the UE-2ce well. Surface and/or subsurface soils may have been contaminated during the operations and in the case of an overflow, a potential exists that the adjacent arroyo to the northeast of the pond may have also been impacted from the well water. The current radiological and hazardous constituent levels within the well are documented and have been provided in Appendix A.1.

2.3.2 CAS 12-03-01, Sewage Lagoons (6)

Hydrocarbons and/or other hazardous wastes are suspected to be present at the lagoons of this CAS as a result of activities conducted in the Area 12 Camp. The sanitary systems that discharged into the system may have received industrial effluents in addition to the intended sanitary effluents from the Area 12 Camp. Surface and/or subsurface soils may have been contaminated during the operations. Previous investigations of the tanks within Area 12 Camp and the lagoons provide information about the types of contaminants that may be present (Trump, 1992). Based on interviews with personnel, the B and E tunnels did not discharge into the lagoons; therefore, tritium is not a expected at this CAS. Due to the uncertainty of activities at the NTS, additional constituents have been added to encompass any industrial discharge that may have occurred in the Area 12 Camp into sanitary systems.

2.3.3 CASs 12-04-01, Septic Tanks; 12-04-02, Septic Tanks; and 12-04-03, Septic Tank

Hydrocarbons and/or other hazardous wastes are suspected to be present at this CAS as a result of activities conducted in the Area 12 Camp that may have discharged contaminants into these septic tanks via the camp's sanitary sewer system. Surface and/or subsurface soils surrounding the tanks may have been contaminated as a result of overflow of the tanks or if the tanks have leaked. Previous investigations of the tanks within Area 12 Camp provides information about the types of contaminants that may be present. Due to the uncertainty of activities at the NTS additional constituents have been added to encompass any industrial discharge that may have occurred in the Area 12 Camp into sanitary systems.

2.3.4 CAS 12-47-01, Wastewater Pond

Hydrocarbons and/or other hazardous wastes are suspected to be present at this CAS as a result of activities conducted in the Area 12 Camp that may have discharged contaminants into the old and new sumps associated with this CAS. Surrounding surface and/or subsurface soils may have been contaminated as a result of overflow of the sumps. Previous investigations of the tanks within Area 12 Camp provides information about the types of contaminants that may be present. Based on operational history of the buildings associated with these sumps and due to the uncertainty of activities at the NTS, additional constituents have been added to encompass any industrial discharge that may have occurred in the Area 12 Camp.

2.3.5 CAS 18-03-01, Sewage Lagoon

Hydrocarbons and/or hazardous wastes are suspected to be present at this CAS as a result of activities conducted in the Area 17 Camp that may have resulted from contaminants being discharged into the lagoons and may have impacted the surface and/or subsurface soils. Surrounding surface and/or subsurface soils may have been contaminated as a result of overflow of the lagoons and/or breaches along its associated piping. Based on operational history of the buildings associated with these sumps and due to the uncertainty of activities at the NTS, additional constituents have been added to encompass any industrial discharge that may have occurred in the Area 17 Camp (Trump, 1992).

2.3.6 CAS 18-99-09, Sewer Line (Exposed)

The operational history of this CAS is unknown; therefore, the types of potential waste are unknown. Based on previous knowledge of similar sites or activities in the Area 17 Camp, it will be assumed that hazardous, hydrocarbon, and/or radiological waste may be present. Based on these assumptions, it can be assumed that if there has been a breach in the pipe, then the subsurface soils surrounding the pipe may have been impacted by any contaminants that may be present as a result of operations in the Area 17 Camp.

2.3.7 CAS 20-19-02, Photochemical Drain

Hazardous wastes may be present in the surface and/or subsurface soils at this CAS as a result of surface discharge. It is documented that photochemicals used for developing photographs of the tests in Area 20 were discharged to the ground surface as a result of operations at Trailer 992 in the Area 20 Camp to support operations during projects conducted in the area.

2.4 Release Information

The release information, migration routes, exposure pathways, and affected media are discussed in this section. Process knowledge, historical information, and visual observations provide the following evidence:

- Releases of effluent and/or run-off to the ground surface have occurred at CASs that are adjacent to/or within a washout area (CAS 12-04-01, 12-04-02, 12-04-03, and 12-47-01).
- A surface release is documented into the pond at CAS 02-05-01.
- A surface release is documented as discharged directly to the ground surface at CAS 20-19-02.
- Corrective Action Sites 12-03-01, 12-47-01, 18-03-01, and possibly 18-99-09, were designed to receive sanitary and/or industrial effluent. There are releases that have occurred at these sites from the septic systems and industrial drains associated with these location.

- The integrity of the tanks in CASs 12-04-01, 12-04-02, and 12-04-03 are not documented. It is not known if there is a subsurface release associated with these features.
- The integrity of the piping, manholes, and distribution boxes are not documented. It is not known if there are any subsurface releases associated with these features.

Migration of potential contamination is assumed to be minimal based on the affinity of the COPCs for soil particles, and the low precipitation and high evapotranspiration rates typical of the NTS environment. Contaminants may have been transported by infiltration and percolation of precipitation through soil, which would serve as the primary driving force for downward migration. Additional information on migration, exposure routes, and affected media is presented in Section 3.1.3 and in Section A.1.2.3 of Appendix A.1.

2.4.1 Exposure Pathways

Site workers, construction personnel, and military personnel may be exposed to potentially contaminated soil or residual material in septic tanks or piping. Exposure pathways include ingestion, inhalation of dust, and/or dermal contact (absorption) from disturbance of contaminated soils, debris, and/or structures. This exposure pathway in considered unlikely to result in significant exposure to potential receptors from contaminated soil from the site because of the expected limited use and the restricted access to the NTS. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated materials.

2.5 Investigative Background

There are no large scale characterization efforts associated with any of the CASs in CAU 151, except CAS 12-04-01. The following subsections summarize the previous investigations or sampling conducted at the CASs within CAU 151. The investigations and analytical data provide information about contaminants that may be present at the CASs.

2.5.1 Corrective Action Site 02-05-01, UE-2ce Pond

Soil sampling was conducted at the UE-2ce pond on August 27, 1997. The intent of the sampling was to collect soil from the areas most likely contaminated within the UE-2ce pond. Samples were submitted for laboratory analysis for total volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), total *Resource Conservation and Recovery Act* (RCRA)-8 metals, and radionuclides. Reported concentrations of arsenic and lead did not exceed industrial preliminary remediation goals (PRGs) (Bordelois, 1998). Other chemical contaminants detected and below the PALs were acetone, ethylenebenzene, methylene chloride, tetrachloroethene, toluene, trichloroethlene, xylenes, bis (2-ethylhexyl) phthalate, 4,4,-DDT, arsenic, chromium, barium, and lead. Other radiological contaminants detected include gross alpha, lead-212, lead-214, and potassium-40 (Bordelois, 1998). It should be noted that the radionuclides lead-212, lead-214, and potassium-40 are naturally occurring.

A radiological survey was conducted in 1998 at the west side of the pond. Results showed readings of 423 disintegrations per minute (dpm) alpha and 1,008 dpm beta/gamma, which are considered slightly above background. The report suggests the wastewater of concern is located at the surface (IT, 1998). The site has never undergone any remedial actions, but there are no radiological signs posted (IT, 1998).

As a part of the Hot Well Program in August 2001, the UE-2ce well was sampled using a wireline bailer. The sampling depth was 472.5 m. In 1993, the tritium activity was 1.3 x 10^5 pCi/L and in 2001, the results were 1.4 x 10^5 pCi/L (LLNL, 2003). There were low uranium concentrations (0.39 micrograms/liter [μg/L]) and plutonium results were below the detection limit of 0.6 picograms/L (LLNL, 2003).

2.5.2 CAS 12-03-01, Sewage Lagoons (6)

Water samples were collected from the Area 12 sewage lagoons between 1982 and 1985. Data was collected for pH, total suspended solids, fecal coliform, biological oxygen demand (BOD), chemical oxygen demand (COD), and dissolved oxygen (DO). Based on the collected data, the lagoons would have not met the standard set by 40 *Code of Federal Regulations* (CFR) Part 141.23 under the *Safe Drinking Water Act* (SDWA) (DOE, 1988a).

Soil/sediment samples were collected from the lagoons in 1989 for analysis to determine if hazardous materials were present. Lead was detected below PALs in Lagoons B,C, and E (Haworth, 1989).

In 1990, soil samples were collected from Lagoons A, B, and G; however, only Lagoons A and B had reported results. For both lagoons, toluene (7.9 Fg/L), barium (1.0 milligrams per liter [mg/L]), benzyl alcohol (21 Fg/L), acetophenone (5.2 Fg/L), phenol (2.5 Fg/L), and bis (2-ethylhexyl) phthalate (3.2 Fg/L) were detected in the samples. This event did not distinguish between lagoons A and B, but presented both locations as one lagoon (Mattes, 1990).

In 1992, soil samples were collected from Lagoon E, and the results were determined to be below the U.S. Environmental Protection Agency (EPA) PRGs; however, there were detects for barium, chromium, PCBs, methylene chloride, acetone, tetrachloroethene, and toluene. It was indicated that PCBs may be related to pesticides because of the detections. Acetone and methylene chloride were also detected in the laboratory QC blank, so the results may be erroneous due to laboratory artifact (Trump, 1992).

2.5.3 CASs 12-04-01, Septic Tanks; 12-04-02, Septic Tanks; and 12-04-03, Septic Tank

There was a characterization effort conducted in 1995 to characterize and inventory the contents of septic tanks throughout the NTS (REECo, 1995). During this effort, the systems in CAS 12-04-01 were characterized and inventoried. Analytical data was available for the compilation of contaminants of concern at CAS 12-04-01. Based on the analytical data, Reynolds Electrical & Engineering Co., Inc. (REECo) recommended that the tank contents be closed under NDEP guidelines. Elevated levels of total petroleum hydrocarbons (TPH); 1,2-dichlorobenzene; and trichloroethylene were detected in sludge samples from the tanks in this CAS (REECo, 1995). Details of the investigation are indicated in Appendix A.1.

Geophysical surveys were conducted in March 2003 and March 2004 at CASs 12-04-01, 12-04-02, and 12-040-03 (SAIC, 2003; SNJV, 2004). Results for each system and details of the geophysical results are located in Appendix A.1.

Walk-over surveys were conducted on February 18 and February 19, 2003, to determine if radiological contamination was present in surficial soil concentrations was statistically greater than surficial soil from undisturbed background locations. The survey conducted for CASs 12-04-01 and 12-04-03 encompassed an area of approximately 38,500 square feet (ft^2). A total of 4,929 data points were recorded with a mean gamma radiation emission rate of 198 counts per second (cps) versus the mean undisturbed background gamma radiation emission rate of 181 cps. The maximum gamma radiation emission rate was 277 cps. With the exception of a few elevated gamma emissions in the surficial soil, the gamma radiation emission rate is uniformly distributed. The document states that currently the site poses no risk to individuals from residential radiological contamination. The document also includes a figure showing the results of the survey (Nicosia, 2003).

2.5.4 CAS 12-47-01, Wastewater Pond

In April 1989, samples were collected from one of the unspecified sumps and analyzed for RCRA hazardous wastes. The results included detections for 1,2-dichlorobenzene; 1,4-dichlorobenzene; and pyrene (Haworth, 1989).

Corrective Action Unit 339, Area 12 Fleet Operations Steam Cleaning Effluent, is adjacent to CAS 12-47-01. The discharge east of Building 12-16 revealed that TPH exceeded guidelines for oil at this location. Other analytes detected include acetone, 2-hexanone, methylene chloride, methyl ethyl ketone, methyl-isobutyl-ketone, and toluene (DOE/NV, 1997a). Although this location is not included in CAU 151, the proximity of the building to the CAS provides current information of contaminants that may be associated with CAU 151.

2.5.5 CAS 18-03-01, Sewage Lagoon

No previous investigations have been identified for CAS 18-03-01.

2.5.6 CAS 18-99-09, Sewer Line (Exposed)

Geophysical survey were conducted at CAS 18-99-09 between March 5 and 27, 2003. The report states that the CAS consists of a partially exposed VCP sewer pipe located on the west side of the abandoned Area 17 Camp gas station. The pipe is 8 in. in diameter and approximately 10 ft long. A barbwire fence runs east to west, perpendicular to the pipe. The origin and termination points for the exposed pipe are unknown; thus, the purpose of the survey was to determine the origin, terminus, and location of the clay pipe within the survey area and to determine if a leachfield or tank is associated with the piping. Four distinct anomalies were identified in the survey. Anomaly A runs east to west and is believed to be related to the barbwire fence that bisects the site. Anomaly B and C both run northwest to southeast and are believed to be underground utilities. Anomaly B was traced to the southeast to where it terminated at a 6-in. diameter steel pipe outfall opening to a drainage swale. The origin of this facility could not be determined. Anomaly C was traced to wooden markers and signs that were labeled as underground cable. Finally, Anomaly D was characterized as a group of isolated targets that are most likely metallic debris contained within a drainage swale that parallels the west side of road RSMP P38. No features characteristic of a septic tank were identified within the limits of the survey.

2.5.7 CAS 20-19-02, Photochemical Drain

An aerial radiological survey was performed on Areas 18 and 20 in November 1985 and the results of the survey are consistent with the activities associated with testing in the area. The exposure rate for the vicinity of CAS 20-19-02 was 17 to 20 microroentgen per hour (FR/h). Background for the NTS is 10-20 FR/h (EG&G/EM, 1985). Radiological contamination is not expected to be a concern at the Area 20 Camp; however, due to the uncertainty of activities at NTS, radiological constituents will remain a COPC for this CAS.

In April 2004, preliminary assessment samples were collected using a systematic grid-based sampling plan at CAS 20-19-02. These samples were collected to determine the potential presence of silver as an indicator of the photochemical discharge to the surface soils. The surface samples were collected on a grid using a triangular pattern to encompass the potential area of the photochemical discharge. Additional biased surface samples were collected in areas based on historical knowledge and topographical features in the Area 20 Camp.

In April 2004, samples were collected from the systematic grid-based sample locations and from biased locations at the Area 20 Camp. Results of the sampling effort concluded that no silver results were above background detection levels. As a result of this effort, it has been determined that this CAS will be moved into CAU 5000, Archived Corrective Action Sites.

2.5.8 National Environmental Policy Act

In accordance with the NNSA/NSO's *National Environmental Policy Act* (NEPA) Compliance Program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 151. This checklist requires NNSA/NSO project personnel to evaluate their proposed project activities against a list of potential impacts that include, but are not limited to: air quality, chemical use, waste generation, noise level, and land use. Completion of the checklist results in a determination of the appropriate level of NEPA documentation by the NNSA/NSO NEPA Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 151 and formulation of the CSMs. Also presented is a summary listing of the COPCs and PALs for the investigation. Additional details and figures depicting the CSMs are located in Appendix A.1.

3.1 Conceptual Site Model

The CSM demonstrates the most probable scenario for current conditions at the CASs within CAU 151 and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. Two CSMs have been developed for CAU 151 using assumptions formulated from physical setting, potential contaminant sources/release mechanisms, process knowledge, historical background information, knowledge from studies of similar sites, and data from previous sampling efforts. The Type 1- Septic and/or Discharge Collection System CSM identifies the components for a discharge from a sanitary sewer or collection system and the pathways and features associated with these systems. Types of pathways include septic tanks, piping from septic systems, sewage lagoons, and potentially arroyos and washouts if overflow occurred. The Type 2- Surface Release CSM has been developed to address CAS 20-19-02. The known discharge occurred at the surface and the pathways and affected media are demonstrated within this CSM. Table 3-1 provides the CSMs as they apply to the CASs. Figure 3-1 and Figure 3-2 show the CSMs developed for current site conditions at the CAU 151. Appendix A.1, Section A.1.2.3 provides more detailed information on the CSM as presented for DQO formulation.

Table 3-1
Conceptual Site Model Components, Elements, and Applicable CASs

CSM	02-05-01	12-03-01	12-04-01 12-04-02 12-04-03	12-47-01	18-03-01	18-99-09	20-19-02
Septic Component CSM	X	X	X	X	X	X	
Surface Release CSM							X

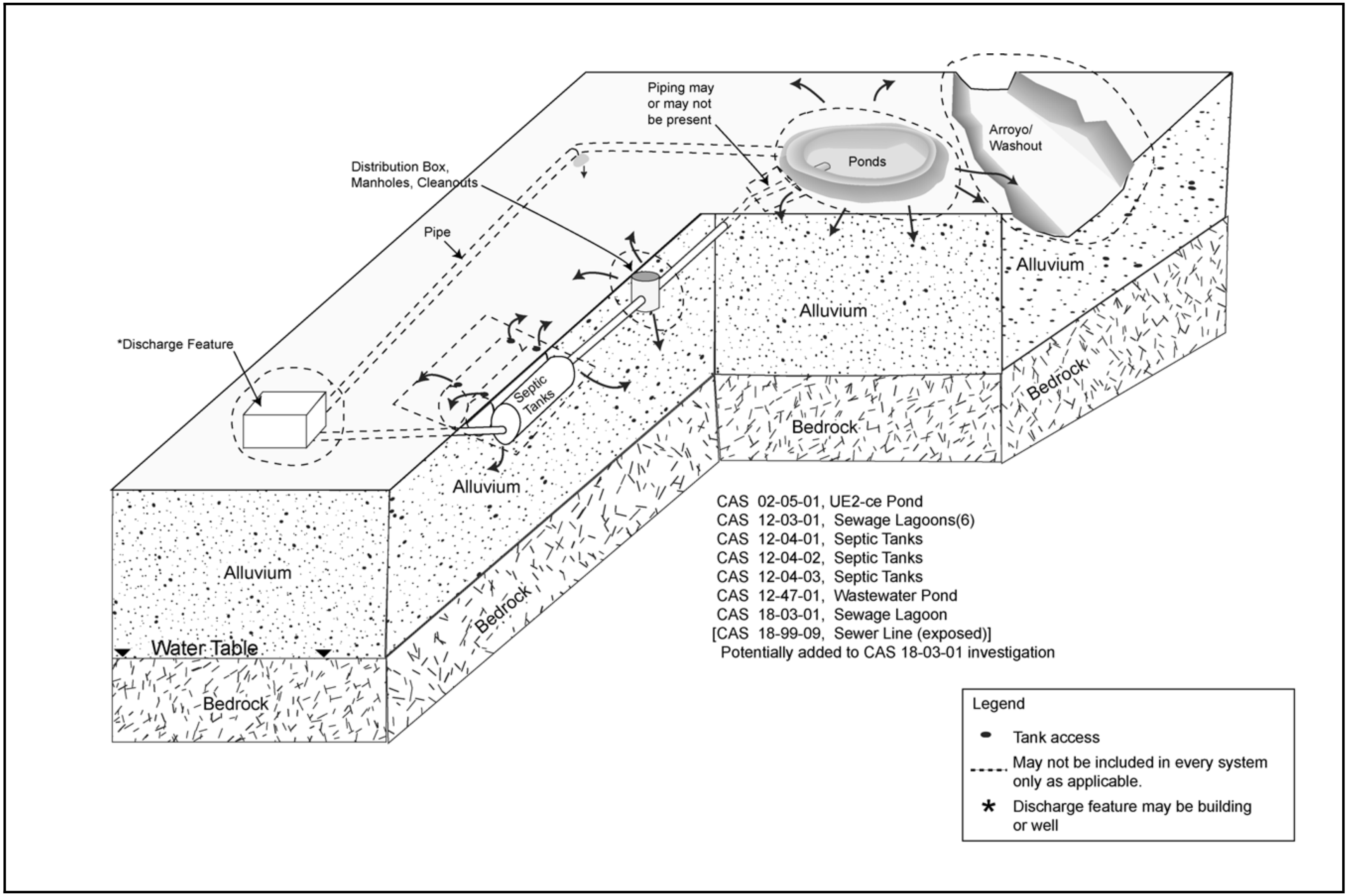


Figure 3-1
CSM Type 1 - Septic and/or Discharge Collection Systems

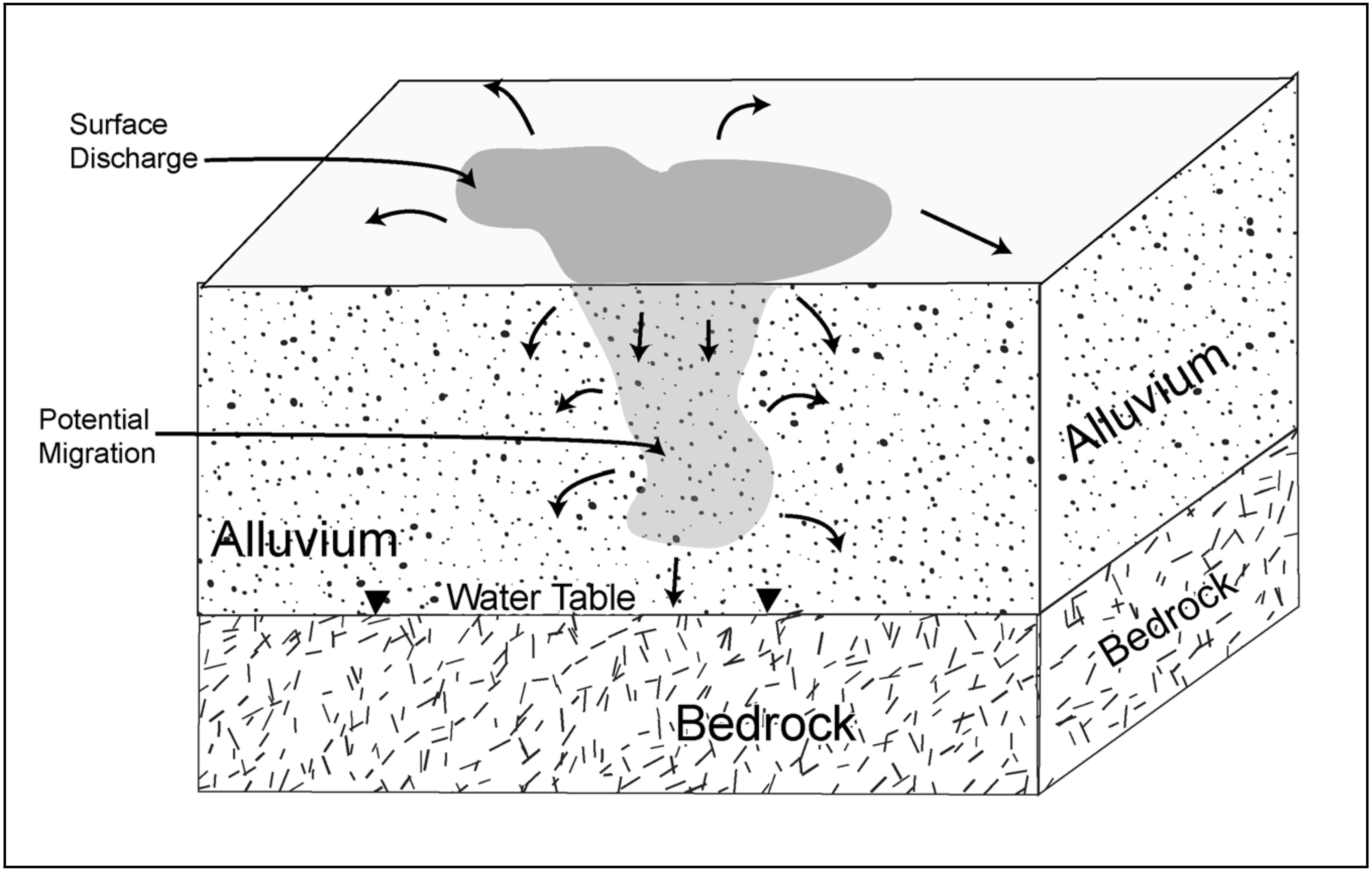


Figure 3-2
CSM Type 2 - Surface Release
Conceptual Site Model for CAU 151

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

The following sections discuss future land use and the identification of exposure pathways (i.e., combination of source, release, migration, exposure point, and receptor exposure route) for CAU 151.

3.1.1 Future Land Use

The future land-use scenarios for CAU 151 are detailed in Table 3-2. This table also summarizes the land-use designations and associated descriptions for the CAU 151 CASs (DOE/NV, 1998a).

Since all the land-use zones identified for the CASs in CAU 151 restrict future land use to industrial activities, residential land use will not be considered in evaluating corrective action alternatives.

Table 3-2
Future Land-Use Scenarios

Land-Use Designation	Land-Use Description	CASs
Nuclear and High Explosive Test Zone	The area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high-explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities.	02-05-01, 12-03-01, 12-04-01, 12-04-02, 12-04-03, and 12-47-01
Nuclear Test Zone	This area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.	20-19-02
Reserved Zone	This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Central training and U.S. Department of Defense land-navigation exercises and training.	18-03-01 and 18-99-09

3.1.2 Contaminant Sources

The contaminant sources identified for CAU 151 are associated with sanitary and industrial effluent discharged into a septic and/or discharge collection system and a surface discharge of potentially hazardous and/or radiological effluent. The release at CAS 20-19-02 was discharged directly to the ground surface. Additional source information for individual CASs is discussed in Section 2.2.

3.1.3 Release Mechanisms

Release mechanisms for the septic and/or discharge collection system CSM are sanitary effluent and possible industrial discharge into sanitary systems, release of hazardous effluent into a collection system (e.g., lagoon, sump, or pond), and discharge of radiologically contaminated well water into a pond. The designed releases are the primary concern for the CSM; however, unplanned releases may have occurred in the piping, distribution boxes, manholes, and/or tanks. The unplanned releases have been discussed in the septic and/or discharge collection system CSM.

The release mechanism for the surface release CSM is the surface discharge of photochemicals containing potentially hazardous constituents, reportedly originating from a drain inside Trailer 992 in the Area 20 Camp.

3.1.4 Migration Pathways

An important element of the CSM in developing a sampling strategy 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 of contaminants are presented in the CSM as the migration pathways and transport mechanism that could potentially move the contaminants throughout the various media. Fate and transport are influenced by physical and chemical characteristics of the contaminants and media. Contaminant characteristics include, but are not limited to: 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. These factors affect the migration pathways and potential exposure points for the contaminants in the various media under consideration.

The migration pathways for the CASs within a drainage channel or washout area (CASs 02-05-01, 12-03-01, 12-04-01, 12-04-02, 12-04-03, and 12-47-01) may have experienced significant lateral migration if overflow or washout of the areas occurred. The septic and/or discharge collection system CSM accounts for the possibility that contaminants present at locations adjacent to or in one of these washout/arroyo features may have laterally migrated. Based on the low annual average precipitation for these areas, the potential for vertical migration in these areas is unlikely.

For subsurface piping, tanks, distribution boxes, and manholes, the potential for vertical migration is considered in the septic and/or discharge collection system CSM. It is not expected that significant lateral migration of contaminants would occur at these features.

For the surface discharge CSM at CAS 20-19-02, the migration pathway is expected to be in the general area of the release based on the relatively flat surface topography in the Area 20 Camp.

The migration pathways for the remaining CAS features not previously identified are expected to be generally limited to vertical migration through the near-surface soil as most of these CASs have very minor surface gradients or not located in drainage channels.

Infiltration and percolation of precipitation serves as a driving force for downward migration of contaminants. However, due to the arid environment and limited precipitation at the NTS (annual average precipitation for the regions in CAU 151 vary from less than 6 in. for Area 2; 8 to12 in. for Area 12; 8 in. for Area 18; and 7 in. for Area 20 (DOE/NV, Date Unknown). The potential evapotranspiration at the Area 3 Radiological Waste Management Site has been estimated at 62.6 in. (Shott et al., 1997). These data indicate that evapotranspiration is the dominant factor influencing the movement of water in the upper unsaturated zone. Therefore, recharge to groundwater from precipitation does not provide a significant mechanism for migration of contaminants to groundwater.

3.1.5 Exposure Points

Exposure points for both CSMs are expected to be areas of surface contamination where visitors and site workers will come in contact with soil surface. Exposure points for the septic and/or discharge collection system CSM also include the possibility of subsurface contamination where site workers may come in contact with subsurface soil during construction activities. Contamination, if present, is expected to be contiguous to the release site. Concentrations of contaminants, if present, are expected to decrease with increasing horizontal and vertical distance from the locations of release.

3.1.6 Exposure Routes

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

3.1.7 Additional Information

Additional topographic information for CAU 151 will not be necessary because the data available is adequate to make determinations about the sites.

General surface and subsurface soil descriptions will be observed and recorded during the CAI. These data will be combined with information from adjacent CAUs (CAU 339 and 394) to more fully define the soil descriptions.

Climatic conditions for the CAU are well documented for this area of the NTS and have been addressed in the DQO process and reflected in the CSM. No further information is required.

Groundwater data for the CAU is known and has been addressed in the CSM. The CAS-specific depth to groundwater data are presented in Section 2.1. No further information is required.

Specific structure descriptions will be observed and recorded during the CAI. The structures include the subsurface piping and associated distribution features, septic system tanks, and various utilities. The CAI will not compromise the structural integrity of the septic system or active utilities.

3.2 Contaminants of Potential Concern

Suspected contaminants for CAU 151 were identified through a review of site history documentation, process knowledge information, personal interviews, past investigation efforts, site-specific analytical data, analytical data from nearby CASs, and inferred activities associated with the CASs.

Table 3-3 identifies the analytical program for CAU 151. Table 3-4 and Table 3-5 identifies the analytical requirements based on the COPCs identified for the CASs within CAU 151. The COPCs for Phase I/I(b) samples are the potential chemical and radiological constituents that are reasonably suspected to be present at the site based on documented use, analytical results, or process knowledge. Table A.1-1 identifies specific COPCs per CAS based on previous sampling results, historical documentation, and process knowledge.

Table 3-3
Analytical Program for CAU 151

COPC	CAS					
	02-05-01	12-03-01	12-04-01, 12-04-02, 12-04-03	12-47-01	18-03-01, 18-99-09	20-19-02
Organics						
VOCs[a]	X	X	X	X	X	X
SVOCs[a]	X	X	X	X	X	X
TPH	--	X	X	--	--	--
PCBs[a]	X	X	X	X	X	X
Metals						
RCRA metals[a]	X	X	X	X	X	X
Beryllium	X	X	X	X	X	X
Total Silver	--	--	--	--	--	X
Other Parameters						
Pesticides	--	--	--	X	X	--
Radionuclides						
Gamma Emitting Radionuclides**	X	X	X	X	X	X
Tritium	X	--	--	--	--	--
Isotopic Plutonium	X	X	X	X	X	X
Isotopic Uranium	X	X	X	X	X	X

[a]For those COPCs identified that include multiple parameters, the parameters with PALs will be evaluated using EPA *Region IX Risk-Based Preliminary Remediation Goals* for chemical contaminants in industrial soils (EPA, 2002c)

** Radiological constituents include Americium-241, Cesium-137, Plutonium 238, Plutonium-239/240, Strontium-90, Uranium-234, Uranium-235, and Uranium-238.

X = COPCs

Table 3-4
Nonradiological Analytical Requirements for CAU 151
(Page 1 of 3)

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

Table 3-4
Nonradiological Analytical Requirements for CAU 151
(Page 2 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
Total Petroleum Hydrocarbons (TPH) (C_6-C_{38})	Aqueous GRO	8015B modified[c]	0.1 mg/L[h]	NA	Lab-specific[e]	Lab-specific[e]
	Soil GRO		0.5 mg/kg[h]			
	Aqueous DRO		0.5 mg/L[h]			
	Soil DRO		25 mg/kg[h]			
INORGANICS						
Total Metals						
Arsenic	Aqueous	6010B[c]	10 µg/L[h, i]	NA	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80 - 120[i]
	Soil		1 mg/kg[h, i]		35[h]	
Barium	Aqueous	6010B[c]	200 µg/L[h, i]		20[i]	
	Soil		20 mg/kg[h, i]		35[h]	
Beryllium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil		0.5 mg/kg[h, i]		35[h]	
Cadmium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil		0.5 mg/kg[h, i]		35[h]	
Chromium	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil		1 mg/kg[h, i]		35[h]	
Lead	Aqueous	6010B[c]	3 µg/L[h, i]		20[i]	
	Soil		0.3 mg/kg[h, i]		35[h]	
Mercury	Aqueous	7470A[c]	0.2 µg/L[h, i]		20[i]	
	Soil	7471A[c]	0.1 mg/kg[h, i]		35[h]	
Selenium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil		0.5 mg/kg[h, i]		35[h]	
Silver	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil		1 mg/kg[h, i]		35[h]	
Zinc	Aqueous	6010B[c]	20 µg/L[h, i]		20[i]	
	Soil		2 mg/kg[h, i]		35[h]	

Table 3-4
Nonradiological Analytical Requirements for CAU 151
(Page 3 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B[c] 1311/7470A[c]	0.10 mg/L[h, i]	5 mg/L[f]	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80 - 120[i]
Barium			2 mg/L[h, i]	100 mg/L[f]		
Cadmium			0.05 mg/L[h, i]	1 mg/L[f]		
Chromium			0.10 mg/L[h, i]	5 mg/L[f]		
Lead			0.03 mg/L[h, i]	5 mg/L[f]		
Mercury			0.002 mg/L[h, i]	0.2 mg/L[f]		
Selenium			0.05 mg/L[h, i]	1 mg/L[f]		
Silver			0.10 mg/L[h, i]	5 mg/L[f]		
Pesticides						
Total Pesticides	Water Soil	8081A[c]	Analyte-specific (CRQL)[e]	NA	27[e]	38-131[e]

[a] Relative percent difference (RPD) is used to calculate precision.
Precision is estimated from the relative percent difference of the concentrations measured for the matrix spike and matrix spike duplicate or of laboratory, or field duplicates of unspiked samples. It is calculated by: $RPD = 100 \times \{(|C_1-C_2|)/[(C_1+C_2)/2]\}$, where C_1 = Concentration of the parameter in the first sample aliquot, C_2 = Concentration of the parameter in the second sample aliquot.

[b] %R is used to calculate accuracy.
Accuracy is assessed from the recovery of parameters spiked into a blank or sample matrix of interest, or from the recovery of surrogate compounds spiked into each sample. The recovery of each spiked parameter is calculated by: percent recovery $(\%R) = 100 \times (C_s-C_u/C_n)$, where C_s = Concentration of the parameter in the spiked sample,
C_u = Concentration of the parameter in the unspiked sample, C_n = Concentration increase that should result from spiking the sample

[c] U.S. Environmental Protection Agency (EPA) *Test Methods for Evaluating Solid Wast*e, 3rd Edition, Parts 1-4, SW-846 CD ROM, Washington, DC (EPA,1996)

[d] Estimated Quantitation Limit as given in SW-846 (EPA, 1996)

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

[f] Title 40 *Code of Federal Regulations* Part 261, "Identification and Listing of Hazardous Waste" (CFR, 2003a)

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

[h] *Industrial Sites Quality Assurance Project Plan* (NNSA/NV, 2002)

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

[j] *Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)

[k] Normalized Difference is not RPD, it is another measure of precision used to evaluate duplicate analyses. The normalized difference is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)

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

Table 3-5
Analytical Requirements for Radionuclides for CAU 151

Parameter/ Analyte	Matrix	Analytical Method	MDC[a]	PAL[b,c]	Laboratory Precision	Percent Recovery
Gamma Spectroscopy						
Americium-241	water	EPA 901.1[d]	50 pCi/L[e]	50 pCi/L	Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2<ND<2[g]	Laboratory Control Sample Recovery 80-120[h] Percent Recovery (%R)
	soil	HASL-300[f]	2.0 pCi/g[e]	7.62 pCi/g		
Cesium-137	water	EPA 901.1[d]	10 pCi/L[e]	10 pCi/L		
	soil	HASL-300[f]	0.5 pCi/g[e]	7.3 pCi/g		
Cobalt-60	water	EPA 901.1[d]	10 pCi/L[e]	10 pCi/L		
	soil	HASL-300[f]	0.5 pCi/g[e]	1.61 pCi/g		
Tritium						
Tritium	soil	lab specific	400,000 pCi/g	400,000 pCi/g		
Other Radionuclides						
Plutonium-238	water	ASTM D3865-02[i]	0.1 pCi/L	0.1 pCi/L	Relative Percent Difference (RPD) 20% water 35% Soil Normalized Difference -2<ND<2[g]	Laboratory Control Sample Recovery 80-120[h] Percent Recovery (%R) Chemical Yield 30-105[j] %R
	soil	ASTM C1001-00[k]	0.05 pCi/g	7.78 pCi/g		
Plutonium-239/240	water	ASTM D3865-02[i]	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1001-00[k]	0.05 pCi/g	7.62 pCi/g		
Strontium-90	water	ASTM D5811-00[n]	1.0 pCi/L	1.0 pCi/L		
	soil	HASL 300[f]	0.5 pCi/g	503.0 pCi/g		
Uranium-234	water	ASTM D3972-02[l]	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1000-02[m]	0.05 pCi/g	85.9 pCi/g		
Uranium-235	water	ASTM D3972-02[l]	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1000-02[m]	0.05 pCi/g	10.5 pCi/g		
Uranium-238	water	ASTM D3972-02[l]	0.1 pCi/L	0.1 pCi/L		
	soil	ASTM C1000-02[m]	0.05 pCi/g	63.2 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 are based on the National Council for Radiation Protection and Measurement (NCRP) Report No. 129 Recommended Screening Limits for Contaminated Soil and Review of Factors Relevant to Site-Specific Studies (NCRP, 1999) scaled from 25 to 15 mrem/yr dose and the guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).
[c]The PALs for liquids are set equal to the MDC.
[d]*Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)
[e]MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample and are relative to the MDC for Cs-137.
[f]*The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300 (DOE, 1997)
[g] 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)
[h]EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1995; and 2002b)
[i]*Standard Test Method for Plutonium in Water* (ASTM, 2002b)
[j] General Radiochemistry and Routine Analytical Services Protocol (GRASP) (EG&G Rocky Flats, 1991). The chemical yield only applies to plutonium, uranium and strontium.
[k]*Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy* (ASTM, 2000a)
[l]*Standard Test Method for Isotopic Uranium in Water by Radiochemistry* (ASTM, 2002a)
[m]*Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectroscopy* (ASTM, 2002c)
[n]*Standard Test Method for Strontium-90 in Water* (ASTM, 2000b).

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

Chemical COPCs are defined as the analytes detected using the analytical methods listed in Table 3-4 for which the EPA Region IX has established PRGs (EPA, 2002c) or for which toxicity data are listed in the EPA Integrated Risk Information System (IRIS) database (EPA, 2001b). The Phase I/I(b) nonradiological analytical methods for CAU 151 are presented in Table 3-4. For Phase I(a) sampling at CAS 20-19-02, the only analyte is total silver. Radiological COPCs are defined as the radionuclides reported from the analytical methods also listed in Table 3-5.

3.3 Preliminary Action Levels

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

3.3.1 Chemical PALs

The organic and inorganic chemical PALs are based on the EPA Region IX Risk-Based PRGs for chemical constituents in Industrial Soils and are provided in Table 3-4 (EPA, 2002c). The PRGs are risk-based contaminant concentrations in environmental media (soil, air, and water) that EPA considers protective of humans (including sensitive groups) over a lifetime. The industrial-use scenario is applicable to sites at the NTS based on future land-use scenarios as presented in Section 3.1.1 and agreements between NDEP and NNSA/NSO.

For detected chemical COPCs without established PRGs that are listed in the EPA IRIS database (EPA, 2001b), the protocol used by the EPA Region IX in establishing PRGs (or similar) will be used to establish the PALs. If used, this process will be documented in the investigation report.

Background concentrations for RCRA metals will be used instead of PRGs when natural background concentrations exceed 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).

3.3.2 TPH PALs

The PAL for TPH in soil is the TPH action limit of 100 parts per million (ppm) established by the *Nevada Administrative Code* (NAC) 445A.2272 (NAC, 2003).

3.3.3 Radiological PALs

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 scenarios (NCRP, 1999) scaled from 25 to 15 mrem per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The specific radiological PALs for CAU 151 are listed in Table 3-5. Radiochemistry PALs are based on a scaling of the NCRP 25 mrem/yr dose-based levels (NCRP, 1999) to a conservative 15 mrem/yr and the recommended levels for certain radionuclides in DOE Order 5400.5 Change 2 (DOE, 1993) as listed in Table 3-4. These PALs are based on the construction, commercial, industrial land-use scenarios provided in the guidance and are appropriate for the NTS based on future land use scenarios as presented in Table 3-2. These established PALs have been accepted by the regulatory agency for use.

The PALs for material, equipment, and structures with residual surface contamination are the allowable total residual surface contamination values for unrestricted release of material and equipment listed in DOE Order 5400.5 (DOE, 1993), which is also Table 4-2 of the *NV/YMP Radiological Control (RadCon) Manual* (DOE/NV, 2000).

3.4 DQO Process Discussion

The DQO process is a strategic planning approach based on the scientific method that is used to prepare for site characterization data collection. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommendation of viable corrective actions (e.g., no further action or close in place).

Details of the DQO process are presented in Appendix A.1. During the DQO discussion for this CAU, the informational inputs and data needs to resolve the 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 CSM and determine if the DQOs were met based on the DQIs of precision, accuracy, representativeness, completeness, and comparability. Other DQIs, such as sensitivity, also may be used.

The DQO strategy for CAU 151 was developed at a meeting on March 31, 2004, to identify data needs, clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented.

The primary problem statement is: "Existing information on the nature of potential contaminants and, if present, the extent of contamination is insufficient to evaluate and recommend corrective action alternatives for CAS (s)."

Therefore, the following two decision statements have been established for all of the CASs with the exception of CAS 20-19-02, Photochemical Drain, as criteria for determining the adequacy of the data collected during the CAI to resolve the problem statement.

Because the location of CAS 20-19-02, Photochemical Drain, has not been clearly defined, two Decision I statements have been developed for this CAS. Decision I(a) for CAS 20-19-02 is: "Where is the release location of the surface discharge?" The location of the surface discharge will be identified as any location with detection above PALs for total silver (Ag). Decision I(b) for CAS 20-19-02 is: "Is a COPC present at a concentration that could pose an unacceptable risk to human health and the environment?" Any contaminant detected at a concentration exceeding the corresponding PAL, as defined in Section A.1.4.2, will be considered a COC. Samples used to resolve Decision I are referred to as Decision I/I(b) samples.

There is only one decision statement for all other CASs in CAU 151. Decision I (will be identified as I/I(b) for this document): "Is a COPC present at a concentration that could pose an unacceptable risk to human health and the environment?" Any contaminant detected at a concentration exceeding the corresponding PAL, as defined in Section A.1.4.2, will be considered a COC. Samples used to resolve Decision I are referred to as Decision I samples.

Decision II: "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?" Sufficient information is defined as the data needs identified in this DQO to include the lateral and vertical extent all COCs associated with a CAS. Samples used to resolve the decision are identified as Decision II samples.

4.0 Field Investigation

This section of the CAIP contains the approach for investigating CAU 151.

4.1 Technical Approach

The information necessary to satisfy the DQO data needs will be generated for each CAU 151 CAS by analyzing samples collected during a field investigation. The presence and nature of contamination at each CAS will be evaluated by collecting samples at biased locations that are determined to be most probable to contain COCs within the CAS. These locations will be determined based on the appropriate CSM and the identification of biasing factors. If, while defining the nature of contamination, it is determined that COCs are present at a CAS, that CAS will be further addressed by determining the extent of contamination before evaluating corrective action alternatives.

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

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

Soil samples will be collected at selected locations using hand/power auger, hand tools, backhoe, direct-push, and/or various drilling methods (e.g., hollow-stem auger, rotary sonic, or other applicable methods), as appropriate. Table 3-5 and Table 3-4 provide the analytical methods and laboratory requirements (i.e., detection limits, precision, and accuracy requirements) to be followed during this CAI. All quality control requirements for field and laboratory environmental sampling and analysis will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002) and other applicable, approved procedures.

4.2 Field Activities

The CAU 151 investigation will consist of, but not limited to, the following activities:

- Relocation of surface debris or equipment as necessary to allow access to sampling locations.
- Perform visual surveys at all CASs to identify any staining, discoloration, disturbance of native soils, or any other indication of potential contamination.
- Perform video-mole surveys at all CASs with piping to identify possible residual materials, breaches or tie-ins within the piping, and, if possible, whether source drains are plugged and sealed.
- Perform field screening for applicable COPCs.
- Collect and analyze samples from locations as described in this section.
- Collect required QC samples for appropriate media.
- Collect additional samples (soil, liquid, and/or sludge), as necessary, to support the characterization of IDW and potential corrective action waste streams.
- Collect soil samples from background locations, if necessary.
- Collect and analyze bioassessment samples, if necessary.
- Perform radiological surveys of piping and distribution feature materials to determine status for unrestricted release.
- Stake or flag sample locations and record coordinates using Global Positioning System (GPS).

These activities may be conducted at any point during the investigation as deemed most efficient and appropriate by the Site Supervisor.

4.2.1 Site Preparation Activities

Site preparation will be required by the NTS Management and Operating (M&O) Contractor prior to the investigation. Site preparation may include, but not be limited to: establish access to sampling points (e.g., fence removal), the construction of hazardous waste accumulation areas (HWAAs) and site exclusion zones, providing sanitary facilities, removal and proper disposal of surface debris, and temporarily moving staged equipment.

4.2.2 Decision I(a) Activities

The objective of the Decision I(a) strategy will be to identify the release location of the CAS 20-19-02 surface discharge only. Sampling has been conducted at nearly 300 locations within the Area 20 Camp using a systematic grid-based sampling methodology in an effort to locate the exact location of this release. Analytical results for total Ag will be validated and the results will be used to indicate the location of the spill. If analytical results indicate elevated detectable levels consistent with similar sites, the locations will then be handled according to the Decision I(b) strategy as identified in Appendix A.1. If analytical results do not indicate a presence of Ag in the soil, then the stakeholders involved in the DQO process will reconvene to determine the appropriate measures and course of action for CAS 20-19-02.

During the DQO meeting on March 31, 2004, it was determined that if there was no evidence of contamination to resolve the Decision I(a) statement, a decision would be made for further action at this site. In April 2004, samples were collected to resolve Decision I(a) for CAS 20-19-02, Photochemical Drain. Samples were collected in accordance with the systematic grid-based sampling method developed for this CAS. Two hundred ninety-three samples were submitted from the systematic grid and from biased locations determined from the field conditions and interviews. None of the results presented the evidence of the location of CAS 20-19-02. It was determined by the Stakeholders (i.e., SNJV, NNSA, and NDEP) that this CAS will be moved into CAU 5000, Archived Corrective Action Sites, based on the research and results of the systematic grid-based sampling effort.

4.2.3 Decision I/I(b) Activities

The objective of the Decision I/I(b) strategy is to determine the presence and nature of COCs within the CAS boundary. The Decision I/I(b) sampling strategy targets locations and media most likely to be contaminated by releases of COCs. The initial Decision I activities planned for CAU 151 include visual inspections, video-mole surveys, field screening, and biased soil sampling and analysis. A point-by-point comparison of laboratory analytical results from Decision I/I(b) samples to PALs will be used to confirm the presence or absence of COCs.

Appendix A.1 lists the target populations for Decision I/I(b) and identifies information needs in selecting data collection locations to determine the nature of contamination. Biasing factors will be used to select the most appropriate sample locations for submittal to the analytical laboratory. Biasing factors to be used for selection of sampling locations will include the following:

- Documented process knowledge on source and location of release
- Visual evidence of discoloration, textural discontinuities, disturbance of native soils, or any other indication of potential contamination
- Presence of debris or equipment
- Visual identification of the features consistent with and conducting an investigation in accordance with the Leachfield Work Plan (DOE/NV, 1998b)
- Field-screening results
- Previous sample or screening results
- Geophysical and/or radiological survey results
- Experience and data from investigations of similar sites

Any biasing factors identified and used for selection of sampling locations will be documented in the appropriate field documents. Additional samples may be collected from residual materials in subsurface piping, manholes, distribution boxes, and septic tanks, as necessary, for waste characterization. If multiphased residual material is present, they will be collected by appropriate method to characterize two segregated phases (e.g., liquid, sludge, solid).

For the CASs that include subsurface piping, a video-mole survey will be conducted prior to Decision I/I(b) sampling to identify additional biasing factors such as residual material, breaches, or unknown tie-ins. The video-mole survey will be conducted from the discharge feature inlet to the point of diversion. If site conditions and/or conditions of the piping do not allow 100 percent video survey coverage, an excavator may be used to access those portions of the pipe. If the video survey identifies breaches and/or conditions that may have provided a means for effluent to reach the surrounding soils, then Decision I/I(b) samples will be collected at those locations for laboratory analysis. If residual material is present and of an adequate volume, a sample will be collected for analysis. If no breaches or residual materials are identified during the survey, Decision I sampling adjacent to and within the buried portions of the piping will not be necessary.

Decision I/I(b) surface soil samples (0 to 0.5 ft bgs) will be collected from selected locations based on the biasing factors listed above. If biasing factors are present in soils below locations where Decision I samples were removed, subsurface Decision I/I(b) soil samples will also be collected by hand augering, backhoe excavation, direct-push, or drilling techniques, as appropriate. Decision I/I(b) subsurface soil samples will be collected at depth intervals selected by the Site Supervisor based on biasing factors to a depth where the biasing factors are no longer present.

4.2.4 Decision II Activities

Decision II sampling will consist of further defining the extent of contamination where COCs from Decision I/I(b) sampling have been confirmed. Step-out (Decision II) sampling locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected in the Decision I/I(b) samples. Decision II samples will also be selected based on the elements of the CSM and other biasing factors listed in Section 4.2.4. In general, step-out sample locations will be arranged around the Decision I/I(b) location at distances based on site conditions, COC concentrations, process knowledge, and biasing factors. If COCs extend beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. The number, location, and spacing of step-outs may be modified by the Site Supervisor, as warranted by site conditions. If the field-screening results (FSRs) are not greater than field-screening levels (FSLs), one of these samples (typically the uppermost) will be submitted to the laboratory for analysis. A minimum of one clean sample (i.e., FSR less than FSL) will be collected from each lateral and vertical direction and submitted for laboratory analysis to define the extent of COC contamination. The lateral and vertical extent of COCs will be established based on validated laboratory analytical results (i.e., not field screening). Contaminants determined not to be present in Decision I/I(b) samples may be eliminated from Decision II analytical suites.

The spatial boundaries that apply to each CAS for Decision II are defined in Table A.1-14. If the nature and/or extent of contamination is inconsistent with the CSM or if contamination extends beyond the spatial boundaries identified in Table A.1-14, 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, sampling will continue to define extent.

In the event that the nature sampling determines that the site has been affected by more than one source (e.g., septic tank overflow, machine shop discharges) the extent may be defined for an area that combines sources, rather than defining extent for individual sources. In these situations, sample locations to define the extent of contamination will be selected adjacent to the boundaries of the outer features with limited locations between features.

4.2.5 Detailed Investigation Strategy

The following sections discuss the approach for obtaining the information necessary to resolve the Decisions I(a) and I/I(b) based on the CSMs. The strategy may be further revised based on upcoming field inspections, geophysical surveys, and radiological surveys. Target populations to be sampled are detailed in Section A.1.5.1. The proposed sampling locations for Decision I/I(b) are illustrated for each CAS in Figure 4-1 through Figure 4-9.

4.2.5.1 Piping

Piping is common in all the CASs with the exception of CAS 02-03-01, UE-2ce Pond, and CAS 20-19-02, Photochemical Drain. Sampling activities at CASs with piping will consist of video-mole survey of abandoned piping adjacent to a feature in the CAS to identify breaches or residual material. The investigation may entail excavating to locate the piping, and breaching the pipe to continue any video-mole activities that have exceeded the length of the device. Decision I and II samples will be collected for laboratory analysis as necessary in the event of a breach or identification of sludge material within a breached section of the pipe. If a pipe is breached as a part of the investigation and material is present, a sample will be collected from below the breach to properly characterize any potential release to the environment that may have occurred.

4.2.5.2 Manholes, Cleanouts, and Distribution Boxes

Corrective Action Site 12-03-01 has a covered distribution box that directed effluent to the lagoons, and CASs 12-47-01 and 18-03-01 has manhole/cleanouts along the piping that head into the sewage lagoons. Decision I activities at these CASs will consist of excavating (as appropriate) to locate the distribution box, manhole, and/or cleanout for collecting Decision I samples for laboratory analysis of residual contents in the feature (if present). Decision I soil samples will be collected beneath the inlet and outlet piping of the features if breaches are suspected and the soil horizon underlying the base of

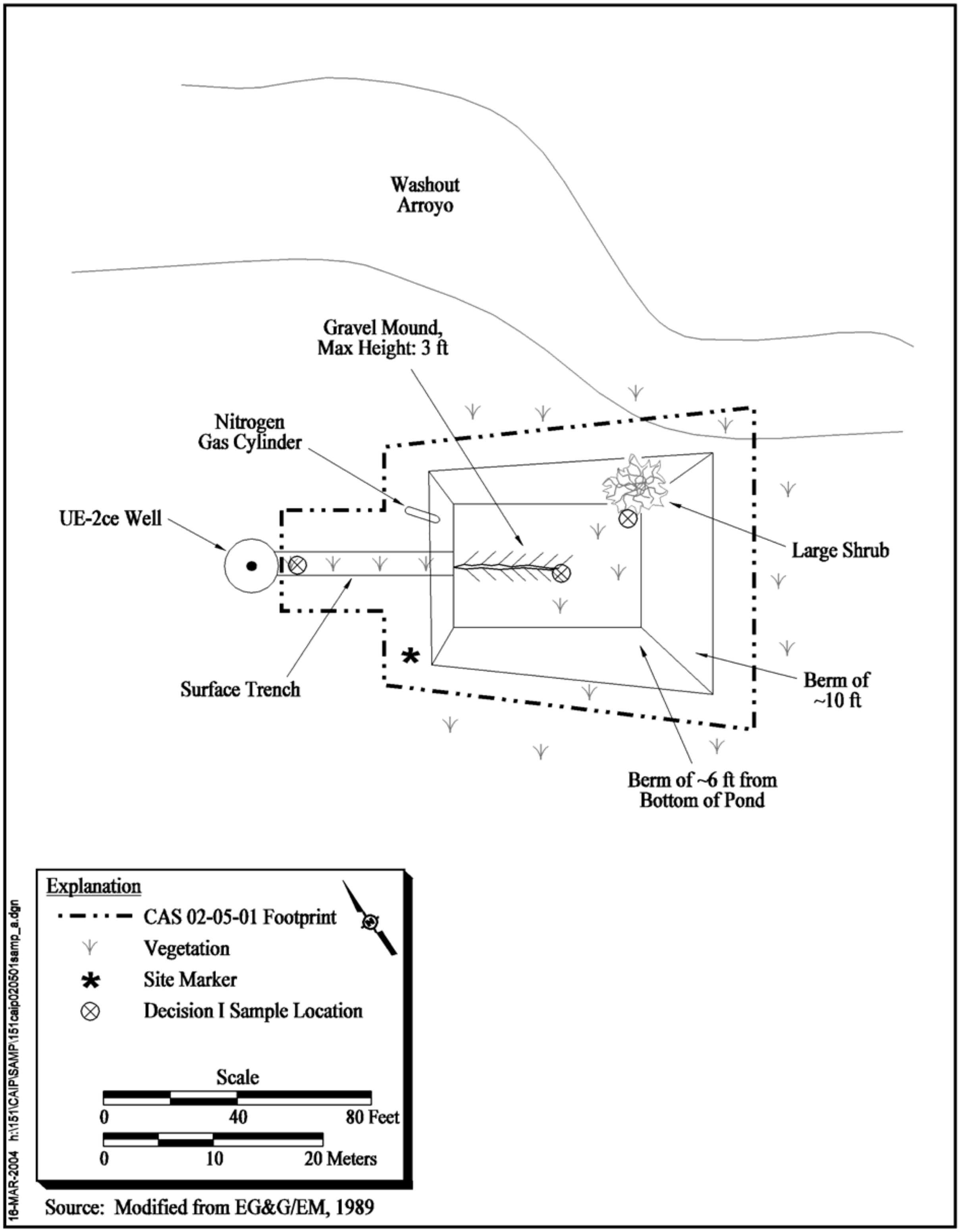


Figure 4-1
CAU 151, CAS 02-05-01 Sample Locations

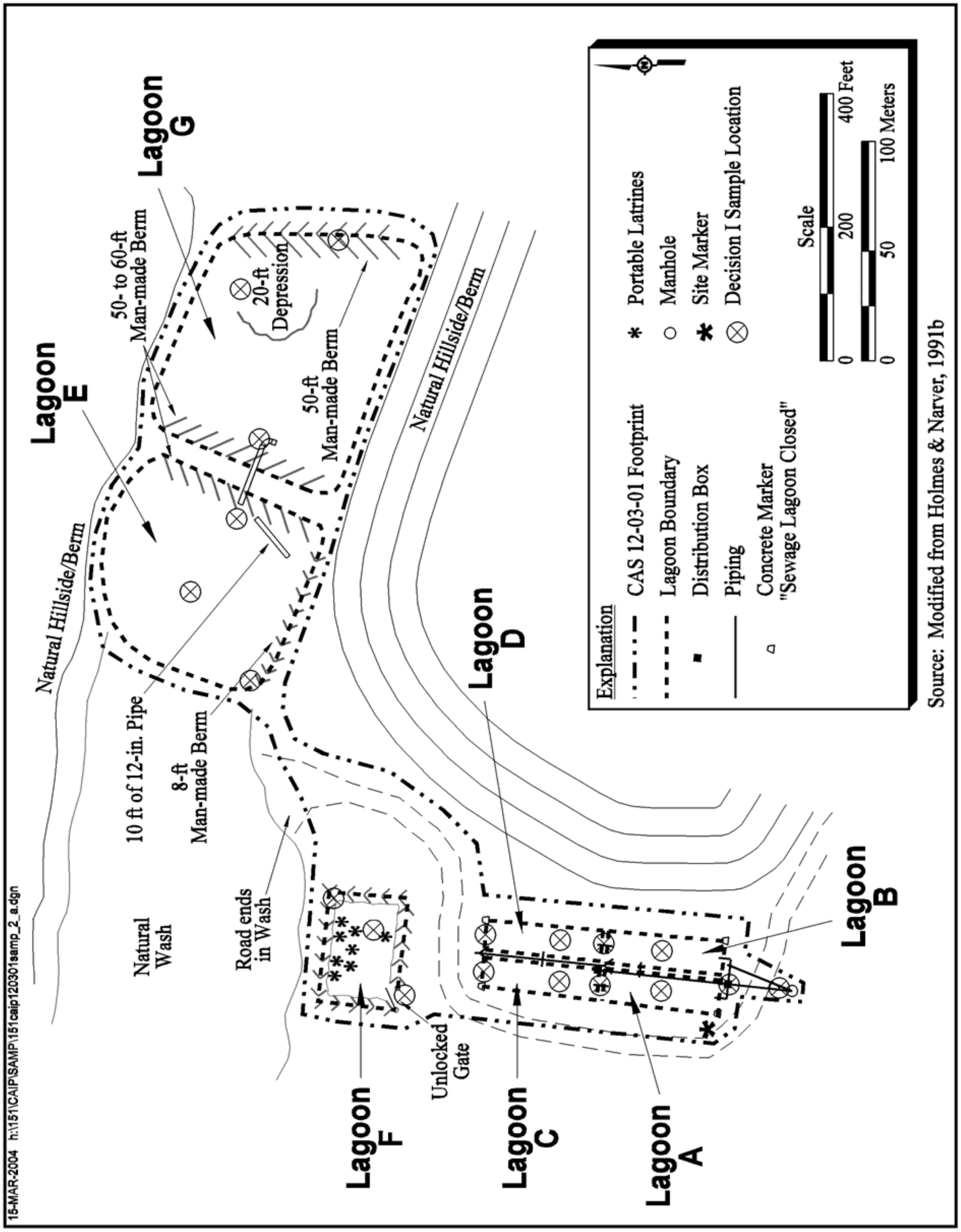


Figure 4-2
CAU 151, CAS 12-03-01 Sample Locations

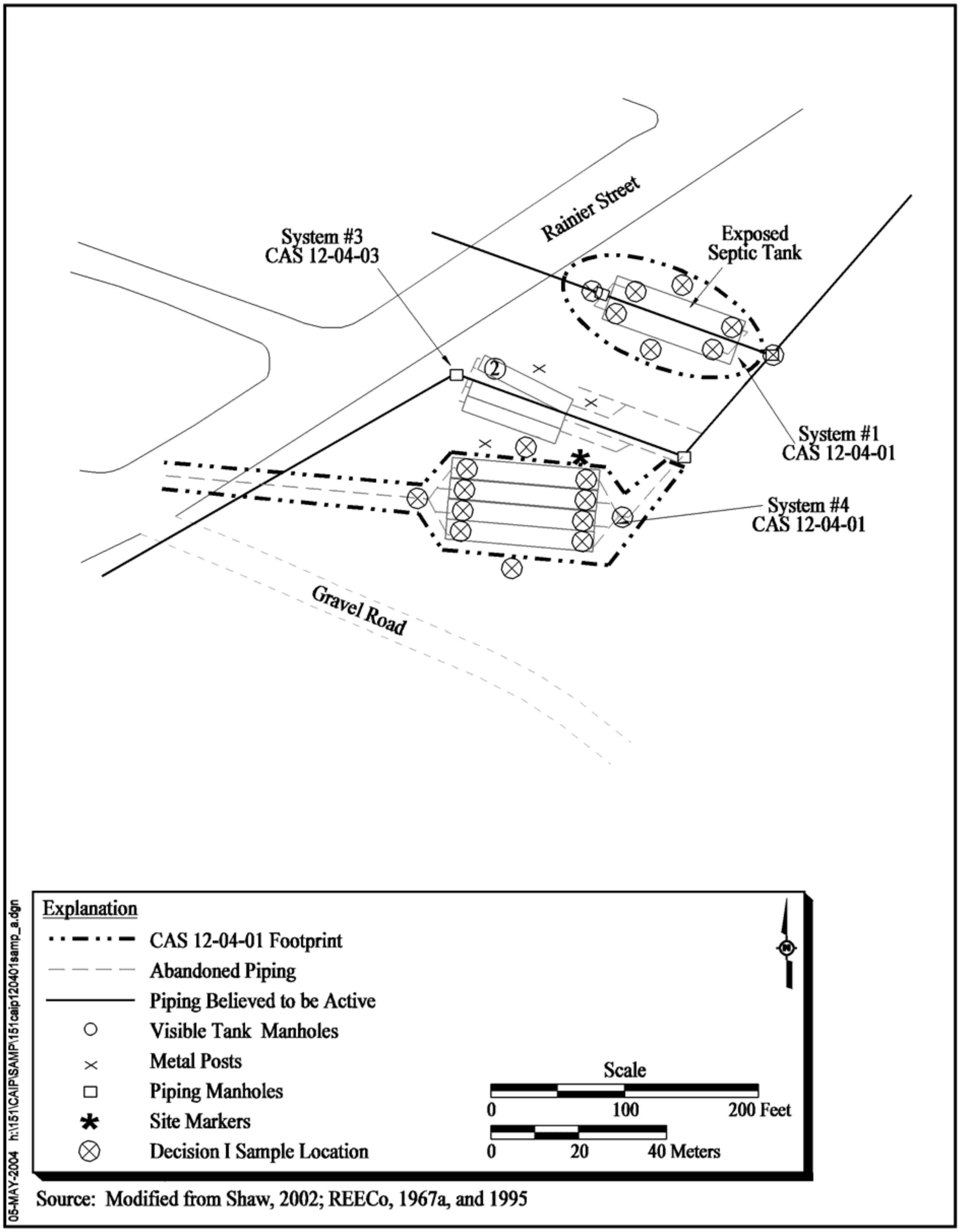


Figure 4-3
CAU 151, CAS 12-04-01 Sample Locations

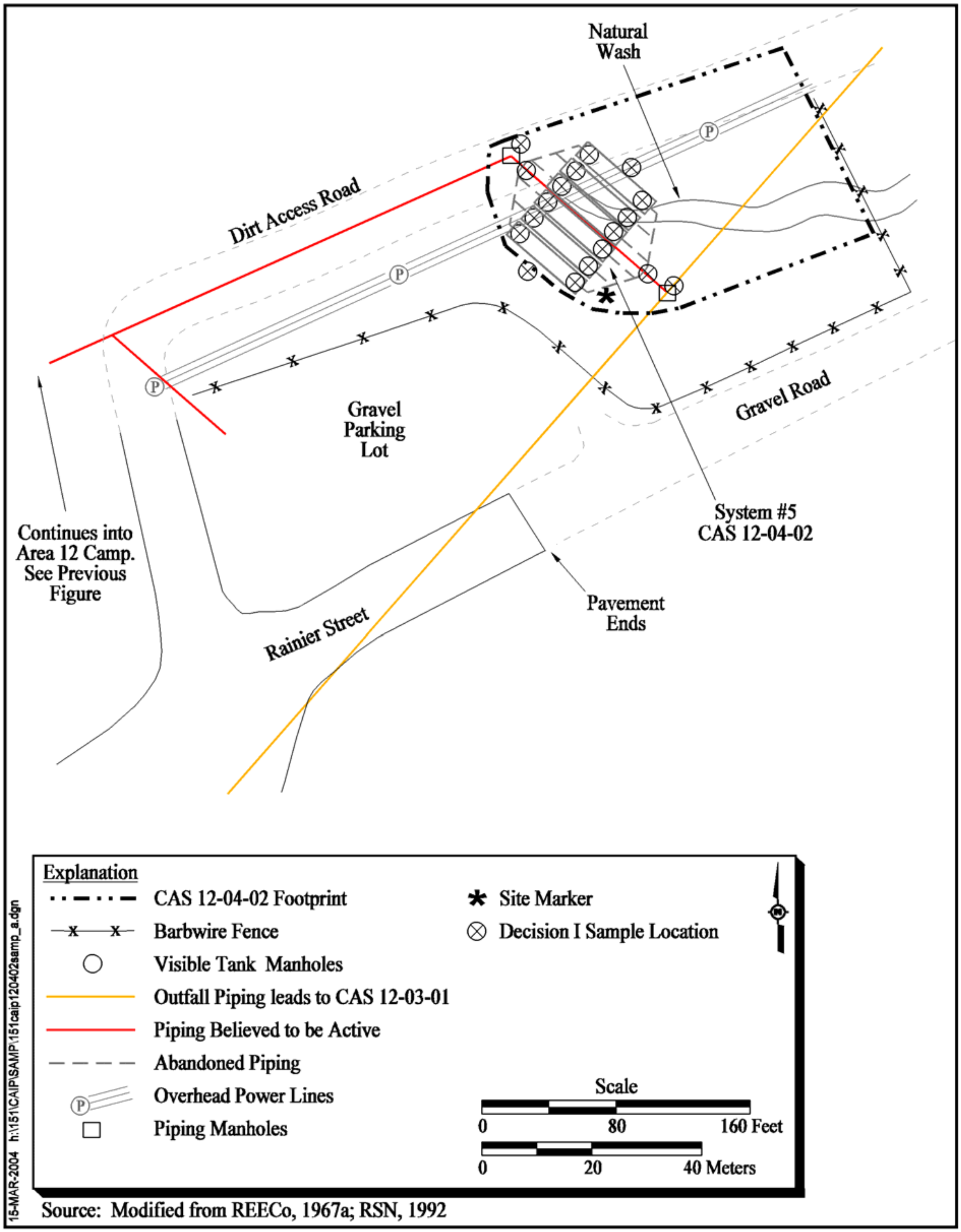


Figure 4-4
CAU 151, CAS 12-04-02 Sample Locations

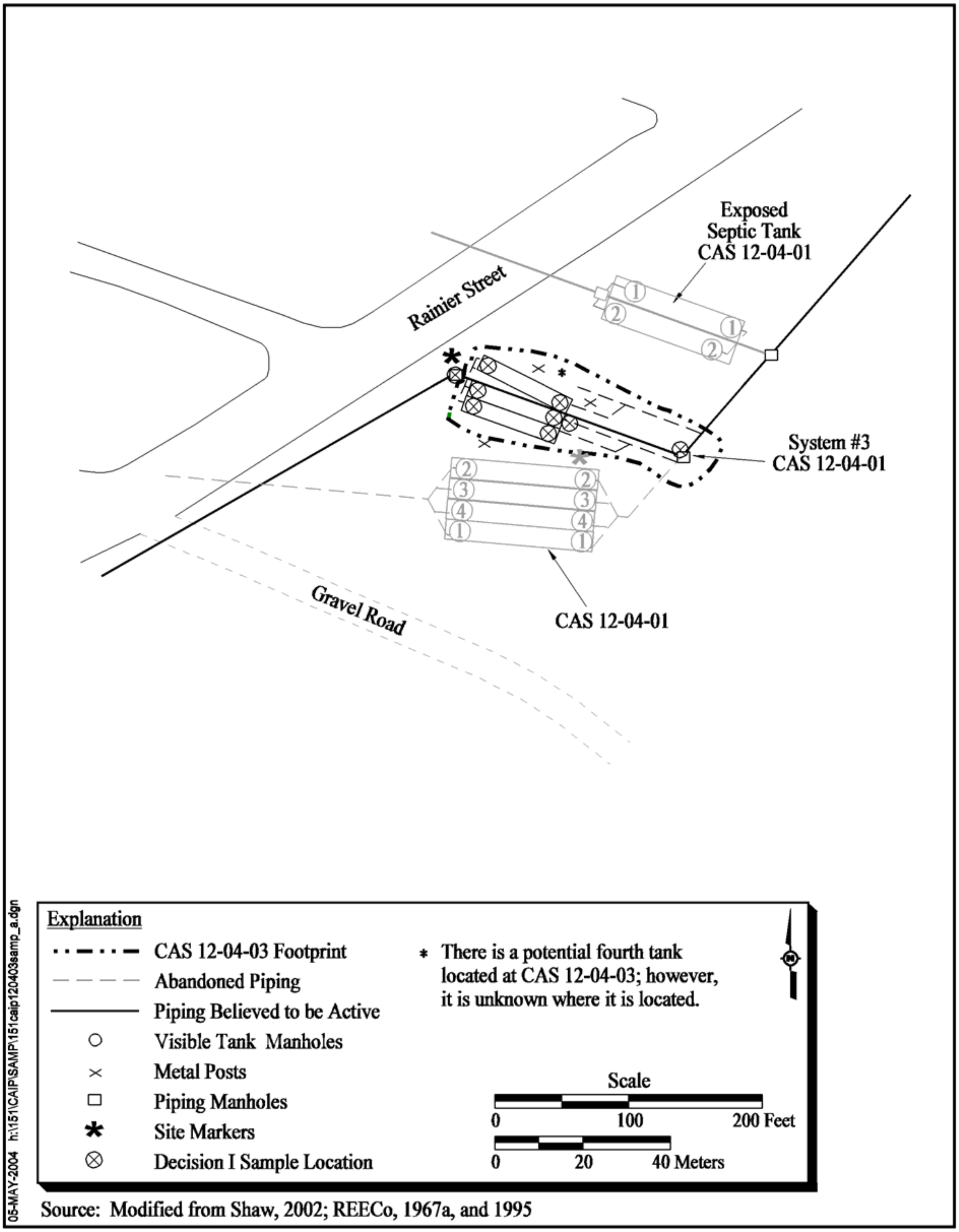


Figure 4-5
CAU 151, CAS 12-04-03 Sample Locations

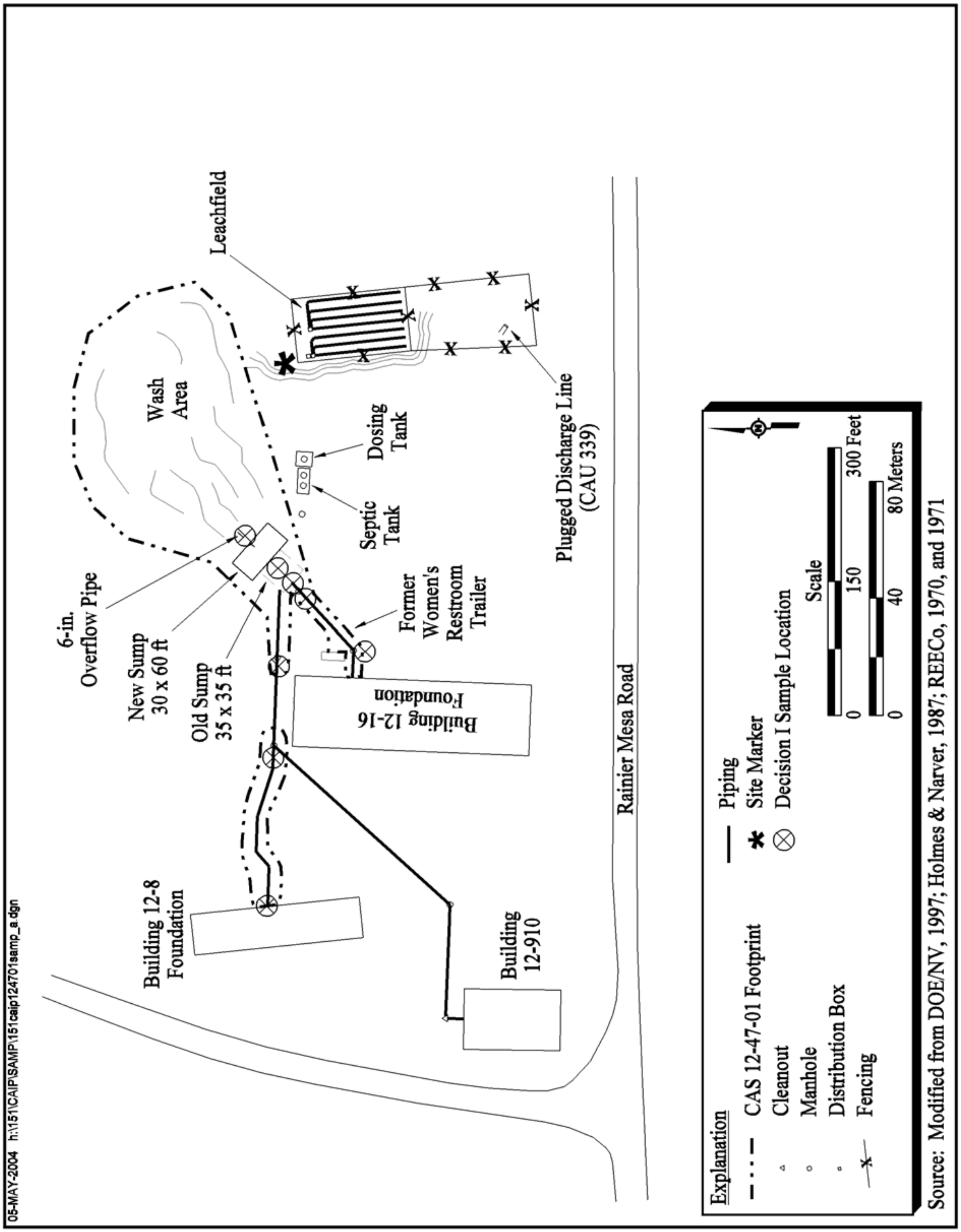
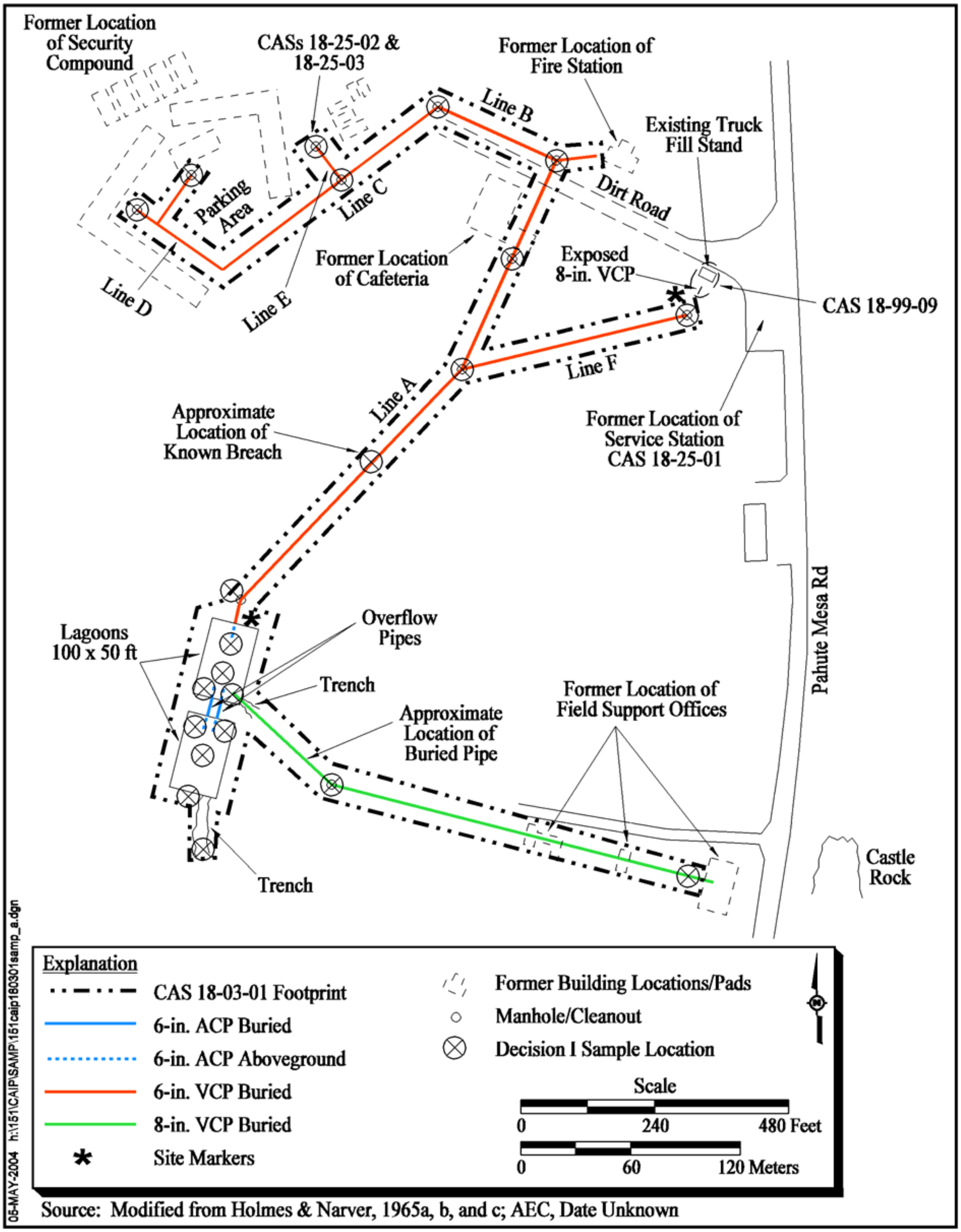


Figure 4-6
CAU 151, CAS 12-47-01 Sample Locations



Source: Modified from Holmes & Narver, 1965a, b, and c; AEC, Date Unknown

Figure 4-7
CAU 151, CAS 18-03-01 Sample Locations

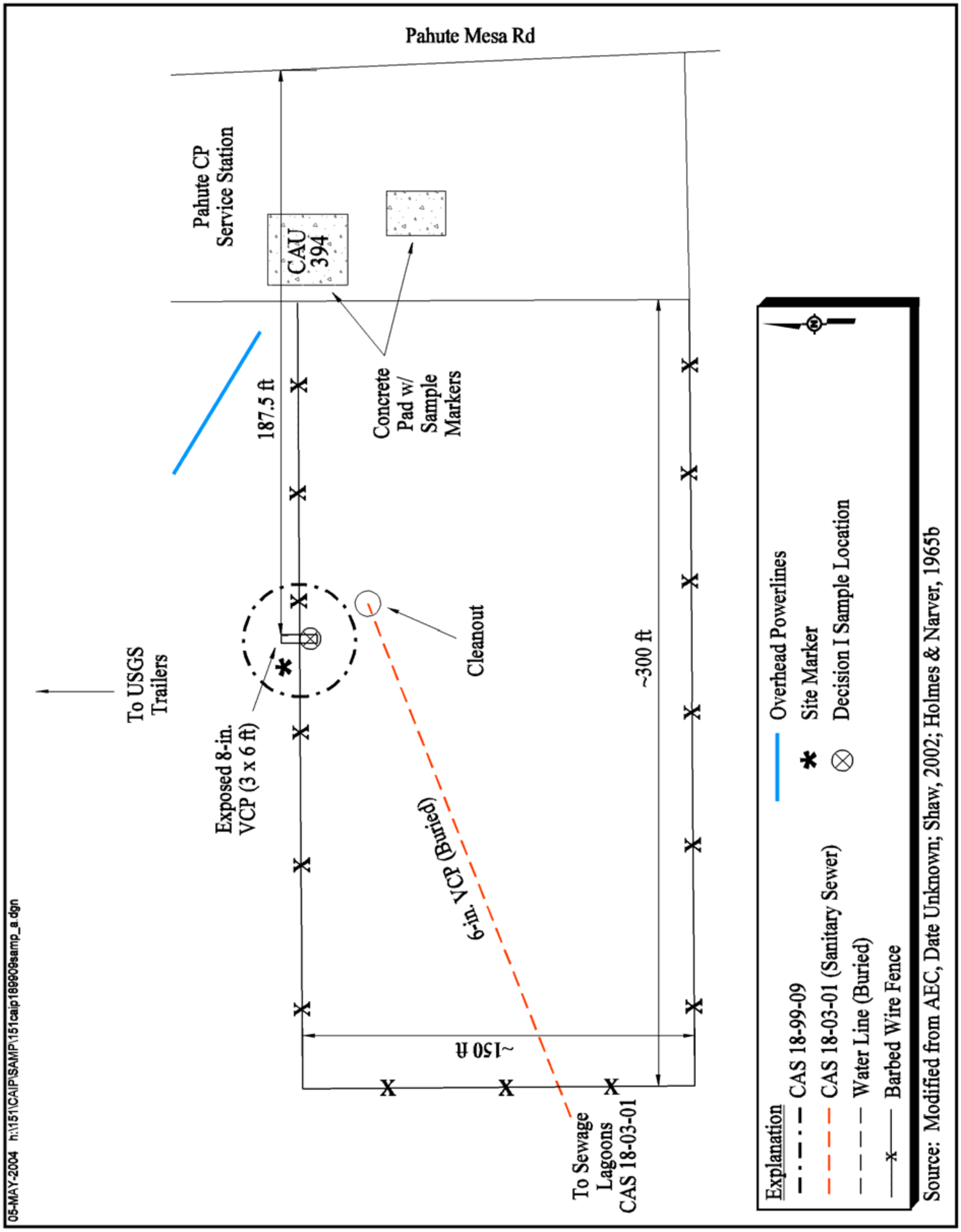


Figure 4-8
CAU 151, CAS 18-99-09 Sample Locations

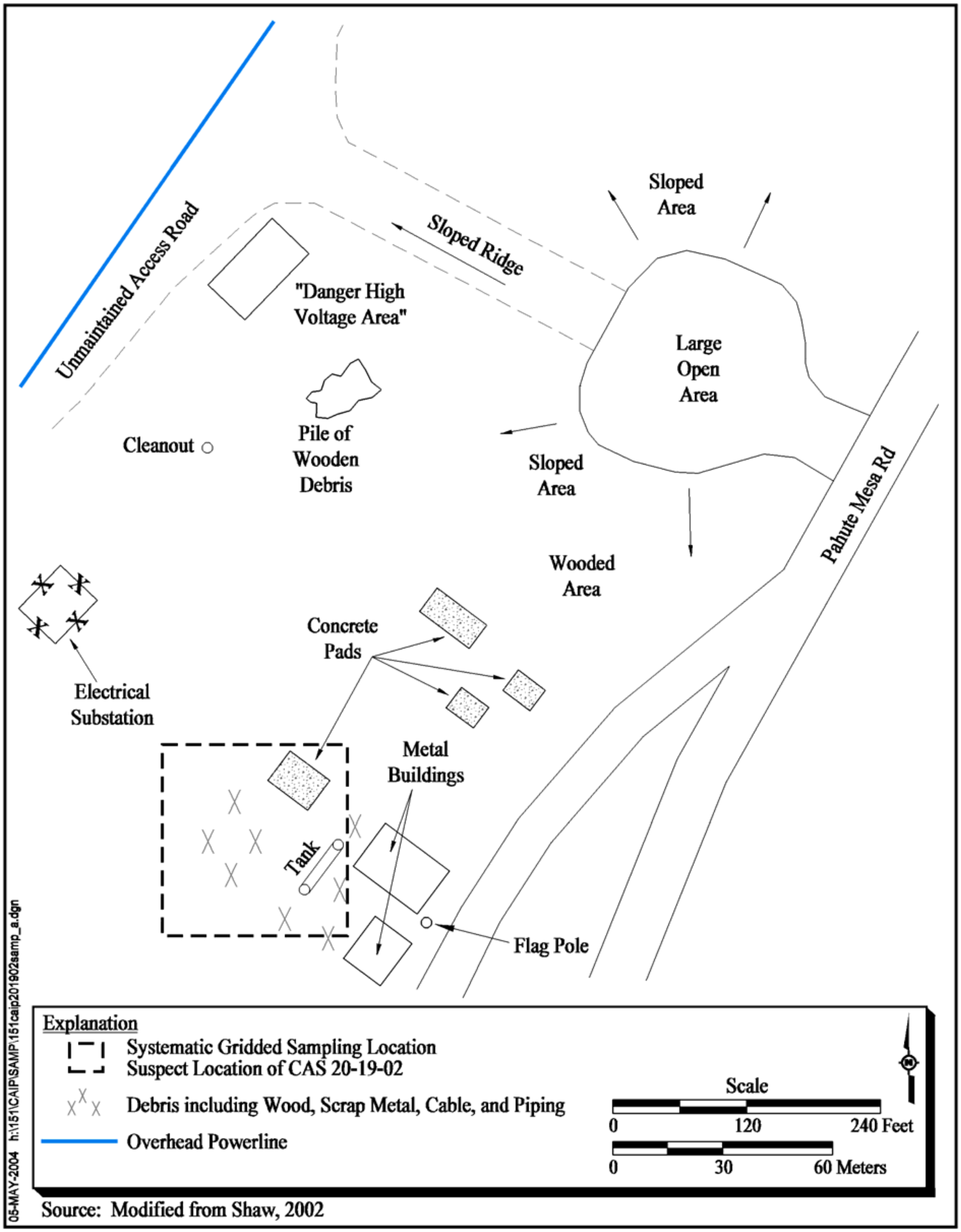


Figure 4-9
CAU 151, CAS 20-19-02 Sample Locations

the box. Residual material, including soil, sludge, or water, in these features will be sampled, if present. Only the inactive features will be sampled and accessed for the purposes of this investigation. If a feature is broken or breached in a way that a release may have occurred, then samples will be collected from below the feature to ensure that a release has not occurred that may impact the environment. Decision II samples vertically from the base will be collected based on FSL exceedances and at additional locations encompassing the features.

4.2.5.3 Septic Systems

Each of the CASs 12-04-01, 12-04-02, and 12-04-03 has at least three septic tanks. The tank configurations are similar for each site. Intrusive verification activities at CAS 12-04-03 may be necessary to locate each of the tanks because investigations have inconclusive evidence whether or not there are three or four tanks. Activities at CASs 12-04-01, 12-04-02, and 12-04-03 include visual inspection of the inside of the septic tank and collecting Decision I samples for laboratory analysis from the tank residual if present. If sampling of residual material is necessary, samples of multi-phased liquid, sludge, and solids will be collected in their distinct phases using the appropriate methods. Decision I soil samples will be collected beneath the inlet and outlet end pipes, in the soil horizon underlying the base of the septic tanks, and in areas of potential overflow. Decision II samples in the area encompassing the tanks will be collected to define the lateral and vertical extent of the contamination.

4.2.5.4 Lagoons/Sumps/Ponds

Corrective Action Sites 02-05-01, 12-03-01, 12-47-01, and 18-03-01 each have a lagoon or lagoon-like (i.e., sump) component. Decision I activities at these CASs will consist of locating the distribution pipe or discharge area for each lagoon and collecting Decision I samples of lagoon sediments and soil beneath the lagoon at the native soil interface at the proximal, midpoint, and distal ends. In the case of CAS 02-03-01, UE-2ce Pond, the discharge point is an open trench area. This will also be sampled at the proximal end beneath the wellhead. Decision II samples will be collected vertically at Decision I locations if FSLs are exceeded and until FSRs are less than FSLs and at locations encompassing the CAS. Decision II samples will also be collected at the perimeter locations of the lagoons.

For sites within CASs 12-03-01 and 12-47-01, the lagoons/sumps have been filled in. A similar strategy will be used to approach these sites; however, sample locations will need to be excavated to the native soil interface and collected. By trenching across the lagoons the varying soil interfaces (e.g., fill, clay, and native soil) should be apparent. Any staining or odors identified will be chased to have the nature and extent defined during the investigation. Decision II samples will be required at any anomalous locations within the lagoons.

4.2.5.5 Surface Discharge

Corrective Action Site 20-19-02, Photochemical Drain, is a surface discharge. Because the physical location of the surface discharge has not been precisely identified, for Decision I(a), a systematic grid-based sampling event has been proposed to determine the location of the surface discharge. If the systematic grid-based samples identify a location of the surface discharge, Decision I(b) activities at this CAS will consist of defining the contaminants of the location as defined in Table A.1-3. Decision II samples will be collected vertically and horizontally to define the boundaries of the discharge. Decision II samples will be collected vertically at Decision I(b) locations if FSLs are exceeded and until FSRs are less than FSLs and at locations encompassing the CAS.

Due to the uncertainty of the exact location Trailer 992 drained the wastes in Area 20, a comprehensive sampling effort will be conducted at the Area 20 Camp to locate CAS 20-19-02. This strategy was developed for an area of approximately 396 by 528 ft in the Area 20 Camp based on interview information and process knowledge about the possible location of the site and the buildings around the location. Assuming a hot spot size of at least 15-ft radius exists in this area, the Visual Sample Plan (VSP) software calculates that the surface soil samples need to be collected from 270 locations to be 95 percent confident that the surface discharge is identified for CAS 20-19-02 based on a Singer and Wickman algorithm (Gilbert, 1987; PNNL, 2002).

The strategy for sample collection at this CAS is to hand auger, excavate, or use other appropriate methods to define the discharge location for Decision I(a) and be submitted for total Ag to the laboratory for analysis. Decision I(b) and II samples may need the use of a backhoe to determine the depth of the CAS.

In April 2004, samples were collected from the systematic grid-based sampling area identified. The results of this effort concluded that no silver was detected above background levels from the biased sample locations and from the systematic grid-based sample locations. A collective agreement to move this CAS into CAU 5000, Archived Corrective Action Sites.

4.3 Field-Screening Levels

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

- The radiological (alpha and beta/gamma) FSL of the mean background activity plus two times the standard deviation of the mean background activity collected from undisturbed locations within the vicinity of the site (Adams, 1998).
- VOC FSRs greater than 20 ppm or 2.5 time background, whichever is greater.
- 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 be in decontamination rinsate. The FSL for TPH is 75 ppm.

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

4.4 Geotechnical/Hydrological Analysis

If capping is evaluated as a viable corrective action alternative, it will be necessary to measure the geotechnical/hydrological parameters of one or more of the CASs. Samples to be analyzed for these parameters will be collected in brass sleeves (or other containers, as appropriate) to maintain the natural physical characteristics of the soil. Table 4-1 lists general geotechnical and hydrological parameters of interest. The testing methods shown are minimum standards, and other equivalent or superior testing methods may be used.

Table 4-1
General Geotechnical and Hydrological Analysis

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

[a]American Society of Testing and Materials (ASTM, 1996)
[b]U.S. Army Corps of Engineers (USACE), 1970
[c]Methods of Soil Analysis (MOSA) (SSSA, 1986)
[d]van Genuchten, 1980
[e]Karathanasis and Hajek, 1982

4.5 Bioassessment Tests

If organic COCs are present and natural attenuation or biodegradation are evaluated as corrective action alternatives, bioassessment may be conducted on the contaminated media. Bioassessment is a series of tests designed to evaluate the physical, chemical, and microbiological characteristics of a site. Bioassessment tests are used to determine nutrient availability, pH, microbial population density, and the ability of the microbial population to grow under enhanced conditions.

4.6 Safety

A current version of the Environmental Services A-E Contractor's HASP will accompany the field documents, and a SSHASP will be prepared and approved prior to the field effort. As required by the DOE Integrated Safety Management System (ISMS) (DOE/NV, 1997b), these documents outline the requirements for protecting the health and safety of the workers and the public, and the procedures for protecting the environment. The ISMS program requires that site personnel will reduce or eliminate the possibility of injury, illness, or accidents, and to protect the environment during all project activities. The following safety issues will be taken into consideration when evaluating the hazards and associated control procedures for field activities discussed in the SSHASP:

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

- Proper training of all site personnel to recognize and mitigate the anticipated hazards

- Work controls to reduce or eliminate the hazards including engineering controls, substitution of less hazardous materials, and use of appropriate personal protective equipment (PPE)

- Occupational exposure monitoring to prevent overexposures to hazards such as radionuclides, chemicals, and physical agents (e.g., heat, cold, and high wind)

- Radiological surveying for alpha/beta and gamma emitters to minimize and/or control personnel exposures; use of the "as-low-as-reasonably-achievable" principle when dealing with radiological hazards

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

5.0 Waste Management

Management of IDW will be based on regulatory requirements, field observations, process knowledge, and laboratory results from CAU 151 investigation samples.

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

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

5.1 Waste Minimization

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

5.2 Potential Waste Streams

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

- PPE and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls)

- Decontamination rinsate
- Environmental media (e.g., soil)
- Surface debris in investigation area (e.g., construction waste, scrap metal)
- Field screening waste (e.g., spent solvent, disposable sampling equipment, and/or PPE contaminated by field-screening activities)

Office trash and lunch waste will be sent to the sanitary landfill by placing the waste in the dumpster.

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. Each waste stream generated will be reviewed and segregated to the greatest extent possible at the point of generation.

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

5.3.1 Sanitary Waste

Sanitary IDW generated at each CAS will be collected in plastic bags, sealed, labeled with the CAS number from each site in which it was generated, and dated. The waste will then be placed in a roll-off box located in Mercury, or other approved roll-off box location. The number of bags of sanitary IDW placed in the roll-off box will be counted as they are placed in the roll-off box, noted in a log, and documented in the field activity daily log. These logs will provide necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill or other approved landfill.

Table 5-1
Waste Management Regulations and Requirements

Waste Type	Federal Regulation	Additional Requirements
Solid (nonhazardous)	NA	NRS[a] 444.440 - 444.620 NAC[b] 444.570 - 444.7499 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], 40 CFR 260-282	NRS[a] 459.400 - 459.600 NAC[b] 444.850 - 444.8746 POC[g]
Low-Level Radioactive	NA	DOE Orders and NTSWAC[h]
Mixed	RCRA[f], 40 CFR 260-282	NTSWAC[h] POC[g]
Hydrocarbon	NA	NTS Landfill Permit SW13.097.02[i]
Polychlorinated Biphenyls	TSCA[j], 40 CFR 761	NRS[a] 459.400 - 459.600 NAC[b] 444.940 - 444.9555
Asbestos	TSCA[j], 40 CFR 763	NRS[a] 618.750-618.840 NAC[b] 444.965-444.976

[a]*Nevada Revised Statutes* (NRS, 2003a, b, c)
[b]*Nevada Administrative Code* (NAC, 2002a, b, c, d)
[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, 2003a)
[g]*Nevada Test Site Performance Objective for the Certification of Nonradioactive Hazardous Waste* (BN, 1995)
[h]Nevada Test Site Waste Acceptance Criteria, Revision 5 (NNSA/NSO, 2003)
[i]*Area 6 Class III Solid Waste Disposal Site for Hydrocarbon Waste* (NDEP, 1997b)
[j]*Toxic Substance Control Act* (CFR, 2002, 2003b)

CFR = *Code of Federal Regulations*
DOE = U.S. Department of Energy
NA = Not applicable
NAC = *Nevada Administrative Code*
NDEP = Nevada Division of Environmental Protection
NRS = *Nevada Revised Statutes*
NTS = Nevada Test Site
NTSWAC = *Nevada Test Site Waste Acceptance Criteria*
POC = Nevada Test Site Performance Objective for the Certification of Nonradioactive Hazardous Waste
RCRA = *Resource Conservation and Recovery Act*
TSCA = *Toxic Substance Control Act*

5.3.2 Special Sanitary Waste

Soil and solid waste generated at the NTS will be managed as hydrocarbon-burdened when it is directly impacted hydrocarbons or associated with environmental samples exceeding 100 milligrams per kilogram (mg/kg) of TPH contamination (NAC, 2003). Hydrocarbon waste will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed of at a designated hydrocarbon landfill (NDEP, 1997b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with Nevada regulations.

Asbestos-containing materials that may be encountered or generated during this investigation will be managed and disposed of in accordance with appropriate federal (CFR, 2003c) and State of Nevada (NAC, 2002d) regulations.

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

5.3.3 Hazardous Waste

Corrective Action Unit 151 will have waste storage areas established according to the needs of the project. Satellite accumulation areas and hazardous waste accumulation areas will be managed consistent with the requirements of federal and state regulations (CFR, 2003a and NAC, 2002b). They will be properly controlled for access and equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers. All containerized waste will be handled, inspected, and managed in accordance with Title 40 CFR 265, Subpart I (CFR, 2003a). These provisions include managing the waste in containers compatible with the waste type, and segregating incompatible waste types so that in the event of a spill, leak, or release, incompatible wastes shall not contact one another.

Hazardous waste accumulation areas will be covered under a site-specific emergency response and contingency action plan until such time that the waste is determined to be nonhazardous or all containers of hazardous waste have been removed from the storage area. Hazardous wastes will be characterized in accordance with the requirements of 40 CFR 261 (CFR, 2003a). No RCRA “listed” wastes have been identified at CAU 151. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT to a permitted treatment, storage, and disposal facility (CFR, 2003a).

5.3.3.1 Management of Personal Protective Equipment

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

5.3.3.2 Management of Decontamination Rinsate

Rinsate at this CAU will not be considered hazardous waste unless there is evidence that the rinsate would display a RCRA characteristic. Evidence may include such things as the presence of a visible sheen, pH, or association with equipment/materials used to respond to a release/spill of a hazardous waste/substance. Decontamination rinsate that is potentially hazardous (using associated sample results and/or process knowledge) will be managed as “characteristic” hazardous waste (CFR, 2003a). The regulatory status of the potentially hazardous rinsate will be determined through the application of associated sample results or through direct sampling. If determined to be hazardous, the rinsate will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. If the associated samples do not indicate the presence of hazardous constituents, then the rinsate will be considered to be nonhazardous.

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

- Rinsate that is determined to be nonhazardous and contaminated to less than 5x *Safe Drinking Water Standards* (SDWS) is not restricted as to disposal. Nonhazardous rinsate which is contaminated at 5x to 10x SDWS will be disposed of in an established infiltration basin or solidified and disposed of as sanitary waste or low-level waste in accordance with the respective sections of this document.

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

5.3.3.3 Management of Soil

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

5.3.3.4 Management of Debris

The management plan for debris waste can vary widely depending on historical site knowledge, contaminants present, debris type, and future land use for the CAU. Debris that requires disposal must be characterized for proper management and disposal. Historical knowledge of the waste generation process, field observations, field-monitoring/screening results, radiological survey/swipe results, analytical results from direct sampling of debris, visual inspection for stains, discoloration, and gross contamination may be obtained to characterize debris. Debris that is managed and disposed of during the investigation will be in full compliance with the federal/state requirements, DOE orders, and agreements. Detailed management of the debris is discussed in the field instruction for each CAS, as appropriate.

5.3.3.5 Field-Screening Waste

The use of field test kits and/or instruments may result in the generation of small quantities of hazardous wastes. If hazardous waste is produced by field screening, it will be segregated from other IDW and managed in accordance with the hazardous waste regulations (CFR, 2003a). 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 5.3.6 of this document.

5.3.4 Polychlorinated Biphenyls

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) (USC, 1976) and its implementing regulations at 40 CFR 761 (CFR, 2003b). Polychlorinated biphenyls contamination may be found as a sole contaminant or in combination with any of the types of waste discussed in this document. For example, PCBs may be a co-contaminant in soil that contains a RCRA "characteristic" waste (PCB/hazardous waste), or in soil that contains radioactive wastes (PCB/radioactive waste), or even in mixed waste (PCB/radioactive/hazardous waste). The IDW will initially be evaluated using analytical results for media samples from the investigation. If any type of PCB waste is generated, it will be managed according to 40 CFR 761 (CFR, 2003b) as well as State of Nevada requirements, (NAC, 2002c) guidance, and agreements with NNSA/NSO.

5.3.5 Low-Level Waste

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

Low-level radioactive waste, if generated, will be managed in accordance with the contractor-specific waste certification program plan, DOE Orders, and the requirements of the current version of the Nevada Test Site Waste Acceptance Criteria (NTSWAC) (NNSA/NV, 2003). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated Radioactive Materials Area (RMA) or radiologically controlled area when full or at the end of an investigation phase. The waste drums will remain at the RMA pending certification and disposal under NTSWAC requirements (NNSA/NV, 2003).

5.3.6 Mixed Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA (CFR, 2003a) or subject to agreements between NNSA/NSO and the State of Nevada, as well as DOE requirements for radioactive waste. The waste will be marked with the words "Hazardous Waste Pending Analysis and Radioactive Waste Pending Analysis." Waste characterized as mixed will not be stored for a period of time that exceeds the requirements of RCRA unless subject to agreements between NNSA/NSO and the State of Nevada. The mixed waste shall be transported via an approved hazardous waste/radioactive waste transporter to the NTS transuranic waste storage pad for storage pending treatment or disposal. Mixed waste with hazardous waste constituents below Land Disposal Restrictions may be disposed of at the NTS Area 5 Radioactive Waste Management Site if the waste meets the requirements of the NTSWAC (NNSA/NV, 2003). Mixed waste not meeting land disposal restrictions will require development of a treatment and disposal plan under the requirements of the Mutual Consent Agreement between DOE and the State of Nevada (NDEP, 1995).

6.0 Quality Assurance/Quality Control

The overall objective of the characterization activities described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each CAS in CAU 151. Section 6.1 and Section 6.2 discuss the collection of required QC samples in the field and QA requirements for laboratory/analytical data to achieve closure. Section 6.3 provides QA/QC requirements for radiological survey data. Unless otherwise stated in this CAIP or required by the results of the DQO process (see Appendix A.1), this investigation will adhere to the Industrial Sites QAPP (NNSA/NV, 2002).

6.1 Quality Control Field Sampling Activities

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

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

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

6.2 Laboratory/Analytical Quality Assurance

Criteria for the investigation, as stated in the DQOs (Appendix A.1) and except where noted, require laboratory analytical quality data be used for making 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.

6.2.1 Data Validation

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

6.2.2 Data Quality Indicators

Data quality indicators are qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of data. The principal DQIs are precision, accuracy, representativeness, comparability, and completeness. A sixth DQI, sensitivity, has also been included for the CAU 151 investigation. Data quality indicators are used to evaluate the entire measurement system and laboratory measurement processes (i.e., analytical method performance) as well as to evaluate individual analytical results (i.e., parameter performance).

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

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

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

6.2.3 Precision

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

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

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 151 Data Quality Indicators

Data Quality Indicator	Performance Criteria	Potential Impact on Decision if Performance Criteria Not Met
Precision	Variations between duplicates (laboratory and field) and original sample should not exceed analytical method-specific criteria discussed in Section 6.2.3.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for precision are not met.
Accuracy	Laboratory control sample, matrix spike, and surrogate results should be within specified acceptance windows.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for accuracy are not met.
Sensitivity	Laboratory detection limits must be less than or equal to respective PALs.	Cannot determine if COCs are present or migrating at levels of concern; therefore, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.
Comparability	Equivalent samples analyzed using same analytical methods, the same units of measurement and detection limits must be used for like analyses.	Inability to combine data with data obtained from other sources and/or inability to compare data to regulatory action levels.
Representativeness	Correct analytical method performed for appropriate COPC; valid data reflects appropriate target population.	Cannot identify COC or estimate concentration of COC; therefore, cannot make decision(s) on target population.
Nature Completeness	80% of the CAS-specific analytes identified in the CAIP have valid results.	Cannot make decision on whether COCs are present.
Extent Completeness	90% of analytes used to define extent of COCs are valid.	Extent of contamination cannot be determined.
Clean Closure Completeness	90% of the analytes of COC identified to define nature and extent are valid.	Cannot determine if COCs remain in soil.

6.2.3.1 Precision for Chemical Analysis

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

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

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

6.2.3.2 Precision for Radiochemical Analysis

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

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

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

6.2.4 Accuracy

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

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

6.2.4.1 Accuracy for Chemical Analyses

The criteria to be used for assessment of accuracy are the parameter-specific criteria listed in Table 3-5. Accuracy for chemical analyses will be evaluated based on results from three types of spiked samples: MS, LCS, and surrogates.

For organic analyses, laboratory control limits are used for evaluation of percent recovery. The acceptable control limits for organic analyses are established in the EPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, 1991).

The percent recovery parameter performance criteria for accuracy will be compared to percent recovery results of spiked samples. This will be accomplished as part of the data validation process.

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

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

6.2.4.2 Accuracy for Radiochemical Analysis

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

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

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

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

6.2.5 Representativeness

Representativeness is the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition

(EPA, 1987). Representativeness is assured by a carefully developed sampling strategy, collecting the specified number of samples from proper sampling locations, and analyzing them by the approved analytical methods. An evaluation of this qualitative criterion will be presented in the CADD.

6.2.6 Completeness

Completeness is a quantitative and qualitative evaluation of measurement system performance. The criterion for meeting completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. An evaluation of this qualitative criterion will be presented in the CADD.

The quantitative measurement to be used to evaluate completeness is presented in Table 6-1 and is based on the percentage of measurements made that are judged to be valid. If these criteria are not achieved, the dataset will be assessed for potential impacts on making DQO decisions.

6.2.7 Comparability

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

6.2.8 Sensitivity

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

6.3 Radiological Survey Quality Assurance

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

7.0 Duration and Records Availability

7.1 Duration

The following is a tentative duration of activities (in calendar days) for corrective action investigation activities:

- Duration 10 days, site preparation
- Duration 76 days, field work preparation and mobilization
- Duration 55 days, sampling
- Duration 160 days, data assessment
- Duration 180 days, waste management

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.

8.0 References

AEC, see U.S. Atomic Energy Commission.

ARL/SORD, see Air Resources Laboratory/Special Operations and Research Division.

ASTM, see American Society for Testing and Materials.

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

Air Resources Laboratory/Special Operations and Research Division. 2003. "Air Resources Laboratory/Special Operations and Research Division" web site. As accessed at http://www.sord.nv.doe.gov/arlsord-1.htm on 10 April.

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

American Society for Testing and Materials. 2000a. *Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy*, C1001-2000. Philadelphia, PA.

American Society for Testing and Materials. 2000b. *Standard Test Method for Strontium-90 in Water*, D5811-2000. Philadelphia, PA.

American Society for Testing and Materials. 2002a. *Standard Test Method for Isotopic Uranium in Water by Radiochemistry*, D3972-2002. Philadelphia, PA.

American Society for Testing and Materials. 2002b. *Standard Test Method for Plutonium in Water*, D3865-02. Philadelphia, PA.

American Society for Testing and Materials. 2002c. *Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectroscopy*, C1000-2000. Philadelphia, PA.

BN, see Bechtel Nevada.

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

Bechtel Nevada. 1997. *Descriptive Narrative for the Hydrogeologic Model of Western and Central Pahute Mesa Corrective Action Units*. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV.

Bechtel Nevada. 1999. *Nevada Test Site Annual Site Environmental Report for Calendar Year - 1998 October 1999*, DOE/NV/11718-361. Prepared for U.S. Department of Energy Nevada Operations Office. Las Vegas, NV.

Bingham, F.E., Reynolds Electrical & Engineering Co., Inc. 1992. Letter to J.D. Stewart (DOE/NV) entitled, "Survey of Nevada Test Site (NTS) Abandoned Septic Tank Systems - Tiger Team Finding SW/CF-3," 2 January. Las Vegas, NV.

Bordelois, B., IT Corporation. 1998. Memorandum to R. Jackson and R. Bull (IT Corporation) entitled, "CAU 234, CAS 02-05-01 Sampling Report," 20 March. Las Vegas, NV.

CFR, see *Code of Federal Regulations.*

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

Code of Federal Regulations. 2003a. Title 40 CFR, Parts 260-282, "Hazardous Waste Management System: General." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2003b. Title 40 CFR, Parts 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2003c. Title 40 CFR, Part 763, "Asbestos." Washington, DC: U.S. Government Printing Office.

DOE, see U.S. Department of Energy.

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

DRI, see Desert Research Institute.

Desert Research Institute. 1987. *Hydrogeologic Investigations of Flow in Fractured Tuffs, Rainier Mesa, Nevada Test Site.* Prepared by C.E. Russell. Las Vegas, NV.

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

Desert Research Institute. 1996. *ER-12-1 Completion Report,* DOE/NV/10845-36. Prepared by C.E. Russell, D. Gillespie, J.C. Cole, S.L. Drellack, L.B. Prothro, P.H. Thompson, R.L. McCall, G.A. Pawloski, and R. Carlson. Las Vegas, NV.

EG&G/EM, see EG&G Energy Measurements.

EPA, see U.S. Environmental Protection Agency.

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

EG&G Energy Measurements. 1985. *An Aerial Radiological Survey of Areas 18 and 20 Nevada Test Site*, November. Las Vegas, NV.

EG&G Energy Measurements. 1989. Aerial Photograph 6613-106 showing the UE-2ce pond and trench, 23 September. Nellis Air Force Base, NV: Remote Sensing Laboratory Photo Library.

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

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

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

Gilbert, R. 1987. *Statistical Methods for Environmental Pollution Monitoring*. New York: John Wiley and Sons.

Holmes & Narver, see Holmes & Narver, Inc.

Haworth, O.L., Reynolds Electrical & Engineering Co., Inc. 1989. Letter to R.F. Friedricks (DOE/NV) entitled, "Sewage Lagoon Analysis Results and Proposed Monitoring Program," 5 April. Las Vegas, NV.

Holmes & Narver, Inc. 1965a. Engineering drawing 019-082-M10.1 entitled, "Nevada Test Site Pahute Mesa C.P. Sewage Dist. System Plans & Profiles," 1 February. Las Vegas, NV.

Holmes & Narver, Inc. 1965b. Engineering drawing 019-082-M5.5 entitled, "Nevada Test Site Pahute Mesa C.P. Water & Sewage Dist. System General Arrangement," 2 February. Las Vegas, NV.

Holmes & Narver, Inc. 1965c. Engineering drawing 019-082-M7.1 entitled, "Nevada Test Site Pahute Mesa C.P. Water & Sewage Distribution System Piping Details," 1 February. Las Vegas, NV.

Holmes & Narver, Inc. 1981. *Nevada Test Site Development Plan Area 2*. Las Vegas, NV.

Holmes & Narver, Inc. 1987. Engineering drawing JS-012-910-C1.1 entitled, "Crafts Bldg. 12-910 Plot Plan," June. Las Vegas, NV.

Holmes & Narver, Inc. 1991. Engineering drawing JS-012-078-T12 entitled, "Sewage Lagoons Title Sheet," 11 February. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 1998. *"Radiological Survey,"* 16 September. Las Vegas, NV.

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

LLNL, see Lawrence Livermore National Laboratory

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

Lawrence Livermore National Laboratory. 2003. *Hydrologic Resource Management Program and Underground Test Area Project FY 2001-2002 Progress Report*, August. Prepared by Eaton, G.F., A.B. Kersting, and T.P. Rose. Livermore, CA.

Maddox, J., EG&G Energy Measurements. 1991. Memorandum to distribution entitled, "EG&G/EM Trailer 992 at Area 20 -Nevada Test Site (NTS)," 2 July. Las Vegas, NV.

Mattes, J.J., Reynolds Electrical & Engineering Co., Inc. 1990. Memorandum entitled, "Sewage Lagoon RCRA Sampling Results," 4 January. Las Vegas, NV.

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

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

NCRP, see National Council on Radiological Protection and Measurement.

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

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

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

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

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

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

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

Nevada Administrative Code. 2003. NAC 445A, *"Water Controls."* Carson City, NV.

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

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

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

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

Nevada Division of Environmental Protection. 1997c (as amended in August 2000). *Class III Solid Waste Disposal Site; UIOC, Area 9 of the NTS,* Permit SW 13-097-03, Carson City, NV.

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

Nevada Revised Statutes. 2003a. NRS 444.440 - 444.620, "Collection and Disposal of Solid Waste." Carson City, NV.

Nevada Revised Statutes. 2003b. NRS 459.400 - 459.600, "Disposal of Hazardous Waste." Carson City, NV.

Nevada Revised Statutes. 2003c. NRS 618.750-618.801 "Disposal of Hazardous Waste." Carson City, NV.

Nicosia, W.C., Shaw Environmental, Inc. 2003. Memorandum to M. England (SAIC) entitled, "Radiological Land Area Surveys of Various Locations at the Nevada Test Site for Preliminary Assessments," 3 March. Las Vegas, NV.

PNNL, see Pacific Northwest National Laboratory.

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

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

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

RSN, see Raytheon Services Nevada.

Raytheon Services Nevada. 1992a. Engineering drawing JS-012-002-C92 entitled, "Area 12 Camp Site Plan Map," 29 December. Las Vegas, NV.

Raytheon Services Nevada. 1992b. Engineering drawing JS-090-094-C135 entitled, "Nevada Test Site -- LLNL -- Area 2 Planning and Power Distribution Map." Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1967a. Engineering drawing RE-12-M21 entitled, "Modifications to Sewage Treatment System Stabilization Ponds," 31 August. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1967b. Engineering drawing RE-12-M22 entitled, "Modifications to Sewage Treatment System," 31 August. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1967c. Engineering drawing RE- 12-M23 entitled, "Modifications to Sewage Treatment System," 31 August. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1970a. Engineering drawing 12-SP-C1 entitled, "Area 12 Utilities Sewage Pond & Line Extension Plot Plan & Topography," Sheet 1 of 1, 15 December. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1971. Engineering drawing 12-16-E9 entitled, "Building 16 Womens Restroom Trailer Plans, Detail & Notes," Sheet 1 of 1, 7 June. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1992a. Engineering drawing 12-SD-C1.1 entitled, "Fleet Operations Sewage Disposal System Plan, Profile & Section," Sheet 1 of 1, 27 May. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1992b. *Work Plan Phase 1 Preliminary Characterization of Abandoned Septic Tank Systems*. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1995. *Preliminary Characterization of Abandoned Septic Tank Systems,* Vols. 1 and 2. Las Vegas, NV.

SAIC, see Science Applications International Corporation.

Shaw, see Shaw Environmental, Inc.

SNJV, see Stoller-Navarro Joint Venture.

SSSA, see Soil Science Society of America.

Science Applications International Corporation. 2003. *Surface Geophysical Survey Final Report Corrective Action Unit 151 Nevada Test Site.* Prepared for Shaw Environmental, Inc. Harrisburg, PA.

Shaw Environmental, Inc. 2002. Site sketch from the CAU 151 Project Files. Las Vegas, NV.

Shaw Environmental, Inc. 2003b. *Results of Geophysical Survey Selected FFACO Sites, Nevada Test Site*. Las Vegas, NV.

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

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

Stoller-Navarro Joint Venture. 2004. *Results of the Geophysical Surveys at CASs 12-03-04 and 18-99-09, Nevada Test Site.* Las Vegas, NV

Templeton, W., Bechtel Nevada. 2004. Record of telecon with J. Dale (SNJV) regarding CAS 20-19-02, 18 February. Las Vegas, NV.

Trump, D.E., Reynolds Electrical & Engineering Co., Inc. 1992. Memorandum to D. Peck (REECo) entitled, "Request for Updated Information on Sampling Results," 2 November. Las Vegas, NV.

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

USGS, see U.S. Geological Survey.

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

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

U.S. Atomic Energy Commission. Date Unknown. Engineering drawing entitled, "Pahute Mesa Control Point Master Plan." Las Vegas, NV.

U.S. Department of Energy. 1988a. *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada*, DOE/EH/OEV-15-P. Washington, DC: Environment, Safety, and Health Office of Environmental Audit.

U.S. Department of Energy. 1988b. *Environmental Survey Sampling and Analysis Plan*. Washington, DC: Environment, Safety, and Health Office of Environmental Audit.

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

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

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2003. *Nevada Test Site Waste Acceptance Criteria*, DOE/NV--325, Rev. 5. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. Date unknown. *Environmental Baseline Information for the Nevada Test Site, Hydrology.* Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1986. *Radionuclide Migration Program Strategy Document,* NVO-298. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1990. *Environmental Survey Action Plan, Nevada Test Site, Mercury, Nevada*. Las Vegas, NV.

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

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

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

U.S. Department of Energy, Nevada Operations Office. 1997a. *Closure Report for CAU 339: Area 12 Fleet Operations Steam Cleaning Discharge Area Nevada Test Site,* DOE/NV–11718-167. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1997b. *Integrated Safety Management Policy*, DOE Order NV P 450.4. Las Vegas, NV.

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

U.S. Department of Energy, Nevada Operations Office. 1998b. *Work Plan for Leachfield Corrective Action Units: Nevada Test Site and Tonopah Test Range, Nevada,* DOE/NV--514. Las Vegas, NV.

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

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

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

U.S. Environmental Protection Agency. 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA 600/4-80-032 (NTIS/PB80-224744; CD ROM; NEPIS/http://www.epa.gov/cincl). Washington, DC.

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

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

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

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

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

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

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

U.S. Environmental Protection Agency. 1996. *Test Method for Evacuating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, CD-ROM PB97-501928GEI. Washington, DC.

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

U.S. Environmental Protection Agency. 2000. *Data Quality Objectives Process for Hazardous Waste Site Investigations,* EPA QA/G-4HW, EPA/600/R-00/007. Washington, DC.

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

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

U.S. Environmental Protection Agency. 2002a. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA/540/R-01/008. Washington, DC.

U.S. Environmental Protection Agency. 2002b. *Guidance for Quality Assurance Project Plans,* EPA QA/G-5, EPA/240/R-02/009. Washington, DC.

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

U.S. Geological Survey. 1959. *A Summary Interpretation of Geologic, Hydrologic, and Geophysical Data for Yucca Valley, Nevada Test Site, Nye County, Nevada.* Prepared by V.R. Wilmarth, D.L. Healey, A. Clebsch, I.J. Winograd, I. Zietz, H.W. Oliver for the U.S. Atomic Energy Commission.

U.S. Geological Survey. 1963. *Stratigraphy and Structure of the Rainier and USGS Tunnel Areas Nevada Test Site.* Prepared for U.S. Atomic Energy Commission. Las Vegas, NV.

U.S. Geological Survey. 1965. *Perched Ground Water in Zeolitized-Bedded Tuff, Rainier Mesa and Vicinity, Nevada Test Site, Nevada*, USGS Report TEI-862. Prepared by W. Thordarson.

U.S. Geological Survey. 1968a. "Geologic Structure of Yucca Flat Area, Nevada." In *Nevada Test Site.* Prepared by E.N. Hinrichs. Denver, CO.

U.S. Geological Survey. 1968b. "Surficial Deposit of Yucca Flat Area, Nevada Test Site." In *Nevada Test Site*. Prepared by A.T. Fernald, G.S. Corchary, W.P. Williams, and R.B. Colton. Denver, CO.

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

U.S. Geological Survey. 1996. *Summary of Hydrogeologic Controls on Ground-Water Flow at the Nevada Test Site, Nye County, Nevada*, WRIR 96-4109. Prepared by R.J. Laczniak, J.C. Cole, D.A. Sawyer, and D.A. Trudeau. Denver, CO.

U.S. Geological Survey and U.S. Department of Energy. 2003. USGS/DOE Nevada Well EU-2ce. Accessed at http://nevada.usgs.gov/doe_nv/area2/ue-2ce.asp Site Page on 11 February.

van Genuchten, M. 1980. "A Closed Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils." In *Soil Science Society of America Journal*, 44: 892-898. Madison, WI.

Appendix A.1

Data Quality Objectives

A.1 Seven-Step DQO Process for CAU 151 Investigation

The DQO process described in this appendix is a seven-step strategic planning approach based on the scientific method. It is used to plan data collection activities at CAU 151, Septic Systems and Discharge Area. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommended corrective actions (i.e., no further action, closure in place, or clean closure). Existing information about the nature and extent of contamination at each CAS in CAU 151 is insufficient to evaluate and select preferred corrective actions; therefore, a CAI will be conducted.

The CAU 151 investigation will be based on the DQOs presented in this appendix as developed by representatives of the NDEP and the NNSA/NSO. This document identifies and references the associated EPA Quality System Documents entitled *Data Quality Objectives for Hazardous Waste Site Investigation* (EPA, 2000a) and *Guidance on Choosing a Sampling Design for Environmental Collection Data* (EPA, 2000b) upon that the DQO process presented herein is based.

A.1.1 CAS-Specific Information

Corrective Action Unit 151, Septic Systems and Discharge Area, consists of the following nine CASs:

- 02-05-01, UE-2ce Pond
- 12-03-01, Sewage Lagoons (6)
- 12-04-01, Septic Tanks
- 12-04-02, Septic Tanks
- 12-04-03, Septic Tank
- 12-47-01, Wastewater Pond
- 18-03-01, Sewage Lagoon
- 18-99-09, Sewer Line (Exposed)
- 20-19-02, Photochemical Drain

The nine CASs are located in Areas 2, 12, 18, and 20 of the NTS as shown in Figure A.1-1. The following sections present CAS-specific information on the physical setting, operational history, sources of potential contamination, previous investigation results, and COPCs. Of the nine CAU 151 CASs listed above, three (CASs 12-04-01, 12-04-02, and 12-04-03) have been combined for

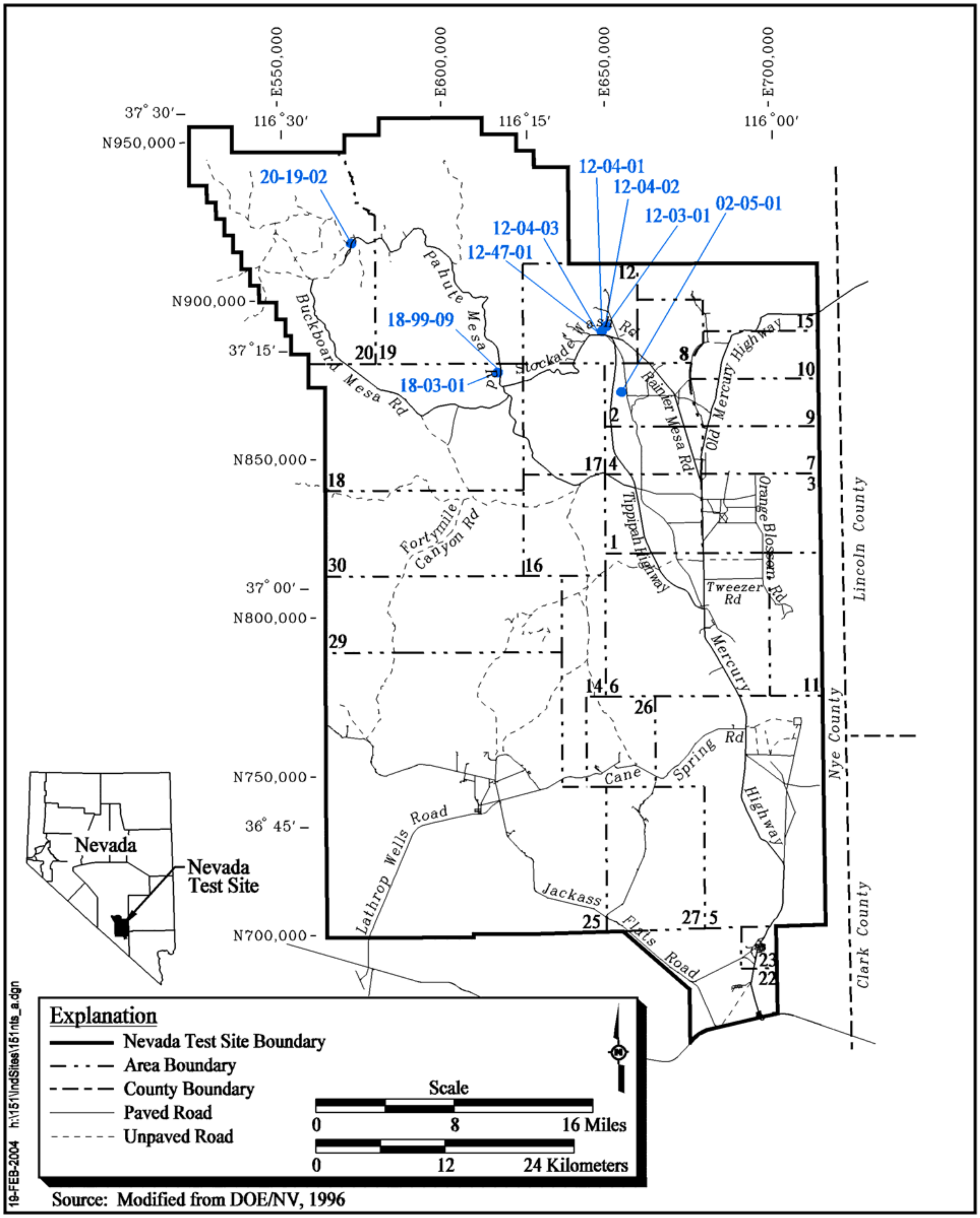


Figure A.1-1
CAU 151, CAS Location Map

discussion purposes because each represents a component of the same septic system. Septic tank contents and residual media will be characterized for waste disposal purposes.

Previous investigation data for the CAU 151 CASs are limited. Additionally, many of the COPCs are based on knowledge of activities conducted rather than specific knowledge of a release. As a result, many of the Decision I COPCs for the CAI are considered the class of contaminants for a given analytical suite. Polychlorinated biphenyls, beryllium, and the radionuclides uranium-234, uranium-235, and uranium-238, americium-241, cesium-137, strontium-90, plutonium-238, and plutonium-239/-240 are included as COPCs for all CASs because of common NTS concerns. Other COPCs are included if specifically mentioned in the operational history documentation or previous sampling events. Table A.1-1 lists the COPCs per CAS.

Table A.1-1
Decision I Contaminants of Potential Concern Per CAS[a]

COPC	CAS					
	02-05-01	12-03-01	12-04-01, 12-04-02, 12-04-03	12-47-01	18-03-01, 18-99-09	20-19-02
Organics						
VOCs[a]	X	X	X	X	X	X
SVOCs[a]	X	X	X	X	X	X
TPH	--	X	X	--	--	--
PCBs[a]	X	X	X	X	X	X
Metals						
RCRA Metals[a]	X	X	X	X	X	X
Beryllium	X	X	X	X	X	X
Other Parameters						
Pesticides	--	--	--	X	X	--
Radionuclides						
Gamma Emitting Radionuclides	X	X	X	X	X	X
Tritium	X	--	--	--	--	--
Strontium-90	X	--	--	--	--	--
Isotopic Plutonium	X	X	X	X	X	X
Isotopic Uranium	X	X	X	X	X	X

[a]For those COPCs identified that include multiple parameters, the parameters with PALs will be evaluated using EPA *Region IX Risk-Based Preliminary Remediation Goals* for chemical contaminants in industrial soils (EPA, 2002b)

X = COPCs

A.1.1.1 Corrective Action Site 02-05-01, UE-2ce Pond

Physical Setting and Operational History - Corrective Action Site 02-05-01 consists of an excavated pond, surrounding bermed area, and a surface trench running between the pond and the UE-2ce Well. The pond measures approximately 68 by 50 ft and is dry. A 6-ft high berm surrounds the pond, except on the east side of the pond, where the berm is 10 ft high. There is a gravel mound within the pond that is approximately 3 ft tall, 4 ft wide, and 60 ft long. In addition to the mound, there is miscellaneous debris including cables, scrap metal, and wood scattered in the bottom and around the pond. The 4 in. deep and 12 in. wide surface trench leading from the pond to the well is approximately 60 ft long and contains small pieces of wood debris and vegetation. Boundaries of this CAS are well defined by the surficial features. Figure A.1-2 shows the location of the CAS and the adjacent features.

The UE-2ce Well was drilled in 1977 to collect post-test radiological data of the geologic conditions from the Nash test conducted in 1967 (DOE/NV, 1986). According to the *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada* (DOE, 1988a), the satellite well was drilled to a depth of 502 m, which is 138 m deeper than the Nash explosion level. The well was created to produce water from the carbonate rock. The water was sampled and the results indicated that the Nash test forced the contaminants into the newly formed fractures. Sampling was performed on the well to study radionuclide migration from the unsaturated zone to the saturated zone. During construction of the well, the adjacent pond was constructed to receive tritium contaminated water from the adjacent well. The UE-2ce well and the adjacent pond are connected by a 60-ft trench. As the well was sampled and tests were conducted in the well, the excess water was pumped into the UE-2ce pond. Pumping was discontinued in 1986 when the pump was no longer functional and was not repaired or replaced. Today, hand bailers are used to collect water for the samples from the well.

Sources of Potential Contamination - The sources of potential contamination at CAS 02-05-01 are based on documentation of the Nash test. The primary source of contamination to the pond is the result of discharged effluent from the adjacent UE-2ce well. Radionuclides identified during the sampling of the well included tritium, krypton-85, isotopic plutonium, and isotopic uranium (DRI, 1988).

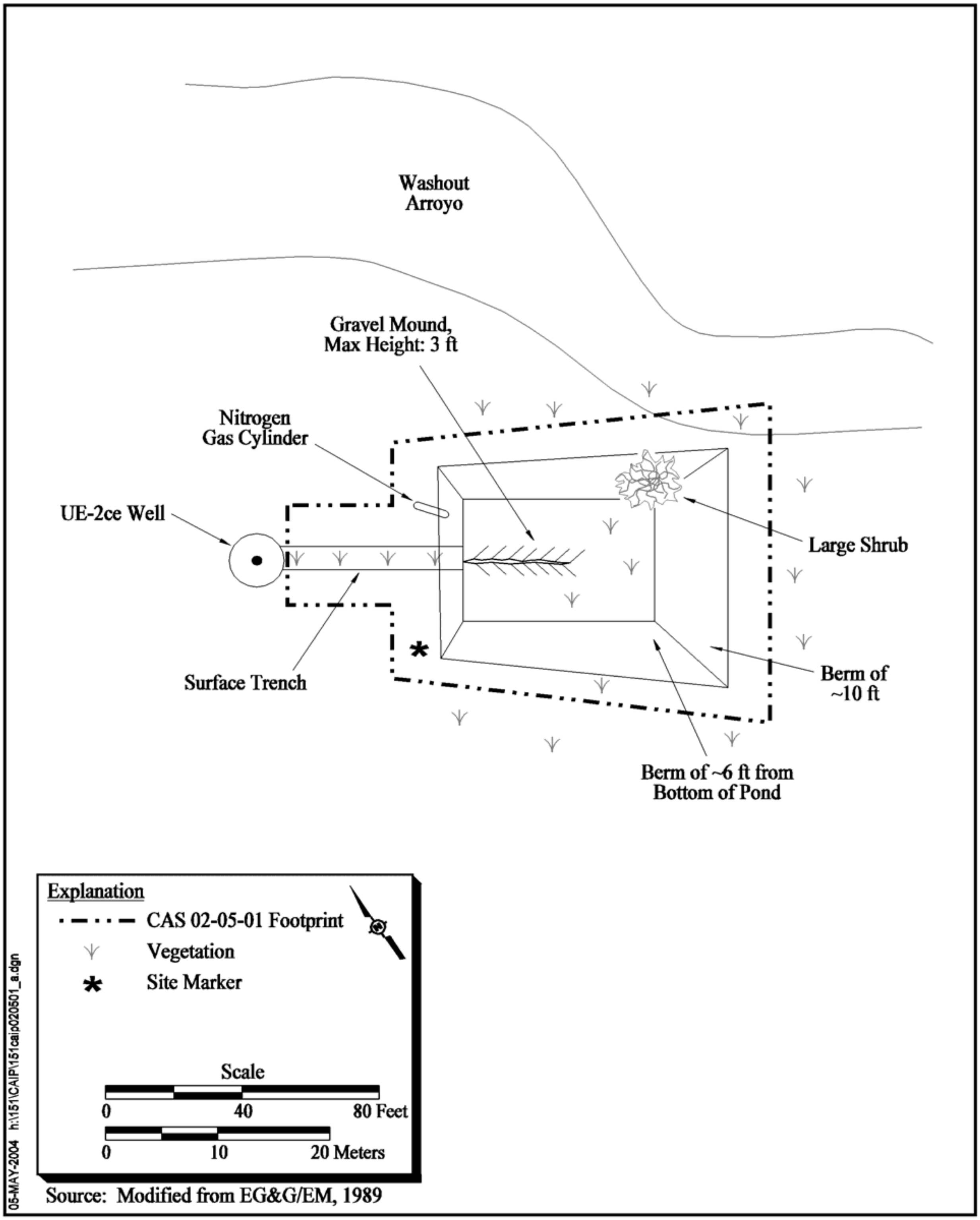


Figure A.1-2
CAU 151, CAS 02-05-01 Site Map

Previous Investigation Results - The following are previous investigation results from water and soil sampling conducted on the well and the pond at CAS 02-05-01:

- Soil sampling was conducted at the UE-2ce pond on August 27, 1997. The intent of the sampling was to collect soil from the most contaminated location within the UE-2ce pond. Samples were submitted for laboratory analysis for total VOCs, SVOCs, PCBs, total RCRA-8 metals, and radionuclides. Reported concentrations of arsenic and lead did not exceed industrial PRGs (Bordelois, 1998). Other chemical contaminants detected were acetone; ethylenebenzene; methylene chloride; tetrachloroethene; toluene; trichloroethlene; xylenes; bis (2-ethylhexyl) phthalate; 4,4,-DDT; arsenic; chromium; barium; and lead. Other radiological contaminants include gross alpha, lead-212, lead-214, and potassium-40 (Bordelois, 1998). Lead-212, lead-214, and potassium-40 are naturally occurring radionuclides.

- A radiological survey was conducted in 1998 at the west side of the pond. The results show a reading of 423 dpm alpha and 1,008 dpm beta. The document states that the waste of concern is located at the surface and that the level of contamination was above background. The site has never undergone any remedial actions, but there are no radiological signs posted. The radiological readings were slightly above background (IT, 1998).

- The UE-2ce well was sampled using a wireline bailer as a part of the Hot Well Program in August 2001. The sampling depth was 472.5 m. The results indicated that tritium activity was 1.4×10^5 nCi/L. There were low uranium concentrations (0.39 μg/L) and plutonium results were below the detection limit of 0.6 picograms/L (LLNL, 2003).

Contaminants of Potential Concern - Based on UE-2ce well and the operations conducted therein, the COPCs for CAS 02-05-01 are:

- Tritium, isotopic uranium, and isotopic plutonium associated with the discharge of well water from UE-2ce.

- Analytical results suggest the following COPCs may also be present acetone; ethylenebenzene; methylene chloride; tetrachloroethene; toluene; trichloroethlene; xylenes; bis (2-ethylhexyl) phthalate; 4,4,-DDT; arsenic; chromium; barium; lead; and tritium.

- Because the historical documentation is not definitive, total VOCs, total SVOCs, and TPH have been added to the analytical suite.

- NTS-specific analytes shall be added to the suite if not already identified from historical or process knowledge. These analytes include gamma-emitting radionuclides, PCBs, and RCRA metals and beryllium.

A.1.1.2 Area 12 Camp Septic Systems Background

Five of the CASs in CAU 151 are located in Area 12 Camp. The Area 12 Camp was built in 1957 for mining activities and became a support area for tunnels projects (specifically B and E Tunnels) in the Rainier Mesa area in the early 1960s. The camp was active through the early 1990s when operations were discontinued in 1992 (Rarrick, 2003). Most of the camp has been abandoned and demolished; however, a few operational buildings still remain occupied in the area. Four of the five CASs in CAU 151 are interconnected; CASs 12-03-01, Sewage Lagoons (6) is the endpoint for the septic systems, CASs 12-04-01, Septic Tanks; 12-04-02, Septic Tanks; and 12-04-03, Septic Tanks. The fifth, CAS 12-47-01, Wastewater Pond, includes of two sumps that the discharges from three buildings fed into. As the activities at the camp grew, the demand for updated systems was identified and the CASs that comprise the systems included in CAU 151 became obsolete. As new systems were built in the late 1980s, the old systems were bypassed to maintain the integrity of the piping of the system in order to replace the older components with updated systems to support the activities. A 1989 aerial photo showed that use of the old systems had ceased and operations at the new sewage lagoons were active. There is no evidence that any of the old piping systems were physically removed in rerouting the Area 12 Camp effluents to the newer lagoons. As a result, the CASs of CAU 151 in Area 12 Camp are identified as components of the old, replaced system.

In the early 1960s, CASs 12-04-01, 12-04-02, and 12-04-03 serviced the majority of the Area 12 Camp and discharged effluent into the six sewage lagoons (CAS 12-03-01). Documentation suggests that the facilities that discharged into these systems included the cafeteria, recreation hall, change house, and housing trailers (Haworth, 1989). From the description of the buildings that are associated with the system, it is speculated that only sanitary effluent was discharged into the tanks; however, due to the uncertainties of the activities at the NTS during the system’s operational time frame, the investigation will account for other constituents that may be present.

For CAS 12-47-01, the women’s restroom trailer, Building 12-8 Area 12 Construction Shop, Building 12-16 Motor Pool Equipment Maintenance Shop, and Building 12-910 Crafts Building all fed into the sump system. However, there is no evidence that these buildings were connected to the septic systems and lagoons in CAU 151 (Holmes & Narver, 1987; REECo, 1971).

A.1.1.3 Corrective Action Site 12-03-01, Sewage Lagoons (6)

Physical Setting and Operational History - Corrective Action Site 12-03-01 consists of seven lagoons that were constructed in the late 1960s and early 1980s (Figure A.1-3). For this CAS, the features have been identified as Lagoons A through G to the features within this system. Table A.1-2 provides a summary of the lagoons and their current conditions. These lagoons are associated with the septic systems from the Area 12 Camp (CASs 12-04-01, 12-04-02, and 12-04-03).

The known piping and any closed/abandoned piping directly associated with the layout are included in the scope of the CAS. There is piping leading into the lagoons from the Area 12 Camp septic systems that previously fed into the lagoons, but has been diverted to the new lagoons located east of 12-01 Road. This piping remains active and is not associated or included in the scope of this CAS. However, piping from the old lagoons to the point of diversion to the new system (indicated by a manhole) is included in the scope of this CAS. Documentation indicates that the primary lagoons are connected to the two adjacent lagoons via an underground system, and that the two closed distribution boxes, manholes, and cleanouts are included in the scope of this CAS. None of the piping is visible from the ground surface with the exception of the piping between Lagoons E and G (REECo, 1967a, b, and c).

Sources of Potential Contamination - The sources of potential contamination at CAS 12-03-01 include:

- The sewage lagoons were associated with the Area 12 Camp. Septic systems used at this location discharged into these lagoons.
- The piping systems associated with the lagoons may be asbestos-containing material (ACM) (REECo, 1967b).
- The tunnels associated with the nuclear tests in the Rainier Mesa area had holding ponds with tritiated water. According to interviews, it is possible that these ponds were discharged into the lagoons at CAS 12-03-01 (Rarrick, 2003).

Previous Investigation Results - There have been several sampling events associated with CAU 12-03-01. A description of identified results are as follows:

- Water samples were collected from the Area 12 sewage lagoons between 1982 and 1985. Data was collected for pH, total suspended solids, fecal coliform, BOD, COD, and DO.

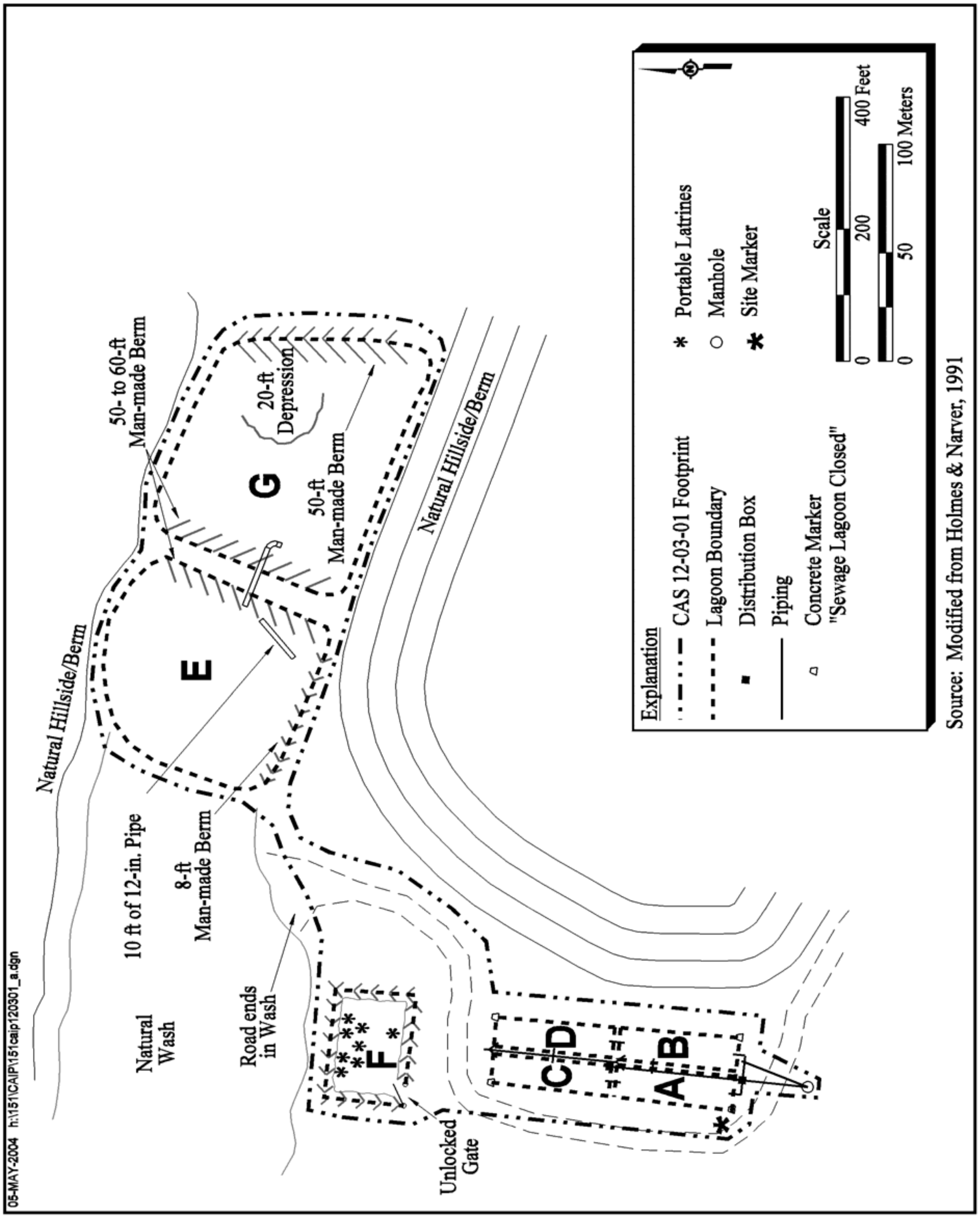


Figure A.1-3
CAU 151, CAS 12-03-01 Site Map

Table A.1-2
Physical Setting for CAS 12-03-01

Lagoon	Purpose	Construction	Dimensions	Current Physical Setting
A	Southwest Primary Lagoon	1966 to 1967	344 x 158 ft	These four lagoons are adjoined and filled with soil. There are four concrete monuments that denote the corners and are posted as closed. A distribution box is in the center of the four lagoons.
B	Southeast Primary Lagoon			
C	Northwest Secondary Lagoon			
D	Northeast Secondary Lagoon			
E	West Evaporation Lagoon (Old Evaporation Pond)	1985 to 1989	400 x 300 x 35 ft	This lagoon has bermed walls and contains greyish-white mud, vegetation, and soil throughout the bottom.
F	Stabilization Pond		151 x 116 x 20 ft	This lagoon is backfilled and graded. The surface is covered with gravel.
G	East Evaporation Lagoon	Approximately 1972	400 x 400 x 50 ft	The lagoon contains vegetation on the west side and there is dried, red-colored mud throughout the bottom. There is piping debris throughout the bottom that does not appear to be connected to any systems.

EG&G, 1989; Holmes & Narver, 1972; REECo, 1967a; Shaw, 2003b

Based on the collected data, the lagoons would have not met the standard set by 40 CFR 141.23 under the SDWA (DOE, 1988a).

- Soil/sediment samples were collected from the lagoons in 1989 for analysis to determine if hazardous materials were present. Lead was detected in Lagoons B, C, and E. (Haworth, 1989).

- In 1990, soil samples were collected from Lagoons A, B, and G; however, only Lagoons A and B had reported results. For both lagoons, toluene (7.9 μg/L), barium (1.0 mg/L), benzyl alcohol (21 μg/L), acetophenone (5.2 μg/L), phenol (2.5 μg/L), and bis (2-ethylhexyl) phthalate (3.2 μg/L) were detected in the samples. This event did not distinguish between lagoons A and B, but presented both locations as one lagoon (Mattes, 1990).

- In 1992, soil samples were collected from Lagoon E, and the results were determined to be below the EPA PRGs; however, there were detects for barium, chromium, PCBs, methylene chloride, acetone, tetrachloroethene, and toluene. It was indicated that PCBs may be related to pesticides because of the detections. Acetone and methylene chloride were also detected in the laboratory QC blank, so the results may be erroneous due to laboratory artifact (Trump, 1992).

Contaminants of Potential Concern - The COPCs for CAS 12-03-01 were established as a part of the known investigations and historical knowledge of this site. The analytes are as follows:

- Analytical results suggest that lead, barium, chromium, PCBs, acetone, benzol alcohol, acetophenone, phenol, bis (2-ethylhexyl) phthalate, methylene chloride, tetrachloroethene, and toluene are COPCs specific to this CAS.
- CASs 12-04-01, 12-04-02, and 12-04-03 discharged into the lagoons. For characterization purposes, all of the COPCs listed in Table A.1-3 are included in this CAS if they have not already been identified in previous analytical results from CAS 12-03-01.
- Due to uncertainties of activities associated with the tritiated water holding ponds located at the B and E Tunnels, tritium has been added as a COPC for CAS 12-03-01.
- Because the historical documentation is not definitive, total VOCs and total SVOCs have been added to the analytical suite.
- NTS-specific analytes shall be added to suite if not already identified from historical or process knowledge. These analytes include gamma-emitting radionuclides, and RCRA metals with beryllium.
- Based on the historical and process knowledge of this CAS, pH has been added to the list of analytes used to determine soil characteristics. Historical documentation suggests that acids and bases may have been discharged into the lagoons.
- Asbestos is associated with the adjoined piping and considered for health and safety purposes.
- Sewage sludge, if encountered, will also be analyzed for fecal coliform bacteria for health and safety purposes.

A.1.1.4 Corrective Action Sites 12-04-01, 12-04-02, and 12-04-03, Septic Tanks

Physical Setting and Operational History - Corrective Action Sites 12-04-01, 12-04-02, and 12-04-03 are located in the Area 12 Camp at the NTS (Figure A.1-4). The CAS consists of four separate septic systems named Systems #1, #3, #4, and #5. These systems are associated with and discharged into CAS 12-03-01, Sewage Lagoons (6).

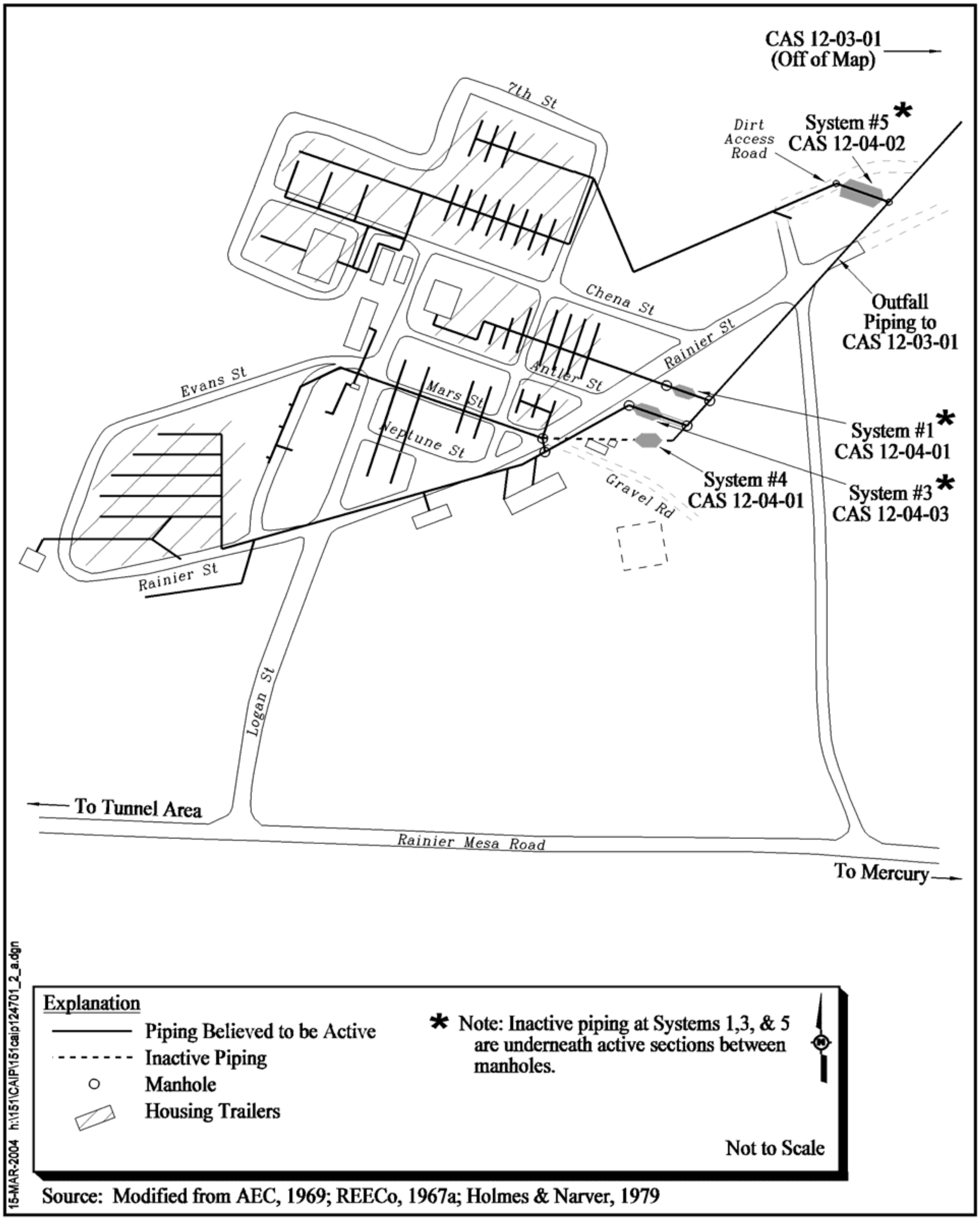


Figure A.1-4
CAU 151, CAS 12-04-01, 12-04-02, and 12-04-03

Corrective Action Site 12-04-01 addresses Systems #1 and #4. System #1 was installed around 1961 and consists of two septic tanks, two manholes, four access covers, and the associated 6-in. VCP. There is approximately 5,000 gal of septage and liquid in each tank. System #4 was constructed prior to 1961 and originally contained only two septic tanks and associated VCP. This system was updated between 1961 and 1965 to include two additional tanks. This system (named A121 on engineering drawings) is comprised of four tanks that contained 3,500 gal of liquid at the time of the survey. All of the tanks in Systems #1 and #4 are documented as 8 by 25 ft with a 7,500-gal capacity (Bingham, 1992; REECo, 1967a, 1992a and b, and 1995). Figure A.1-5 depicts the layout of Systems #1 and #4.

Corrective Action Site 12-04-02 includes System #5. This system was constructed between 1961 and 1962 and consists of six septic tanks, two manholes, and eight visible access covers. The same 6-in. VCP and tank size applies to this system as for Systems #1 and #4. This system (named A125 on engineering drawings) is comprised of six tanks, which each contained approximately 3,500 to 5,000 gal. Figure A.1-6 provides the configuration of System #5 (Bingham, 1992; REECo, 1992a and 1995).

Corrective Action Site 12-04-03 addresses System #3. Originally the CAS included System #2; however, System #2 may have never been completed. Geophysical surveys are planned to verify the absence or presence of this system. System #3 consists of two manholes, one visible access cover, and 6-in. VCP associated with the tanks. This system (named A124 west on engineering drawings) is shown on engineering drawings to have a total of four tanks, but after excavation, only three tanks were identified during the sampling event in 1995 (REECo, 1995). In the three identified tanks, there was approximately 5,000 gal of liquid and sludge remaining in each tank. There was a solid cover of vegetation over the liquid and sludge in two of the tanks. The vegetation cover was approximately 4 to 6 in. thick and there was approximately 3 ft of liquid underneath the cover. Figure A.1-7 provides the layout of System #3 (Bingham, 1992; REECo, 1992a and 1995).

Sources of Potential Contamination - Sources of influent (liquid and/or sludge) to these three CASs are from buildings within Area 12 Camp. Although a sanitary system, there is a potential for industrial waste to have been disposed of via these septic systems. The Area 12 Camp is still partially active. Although these systems are connected to active and inactive portions of the camp, the piping

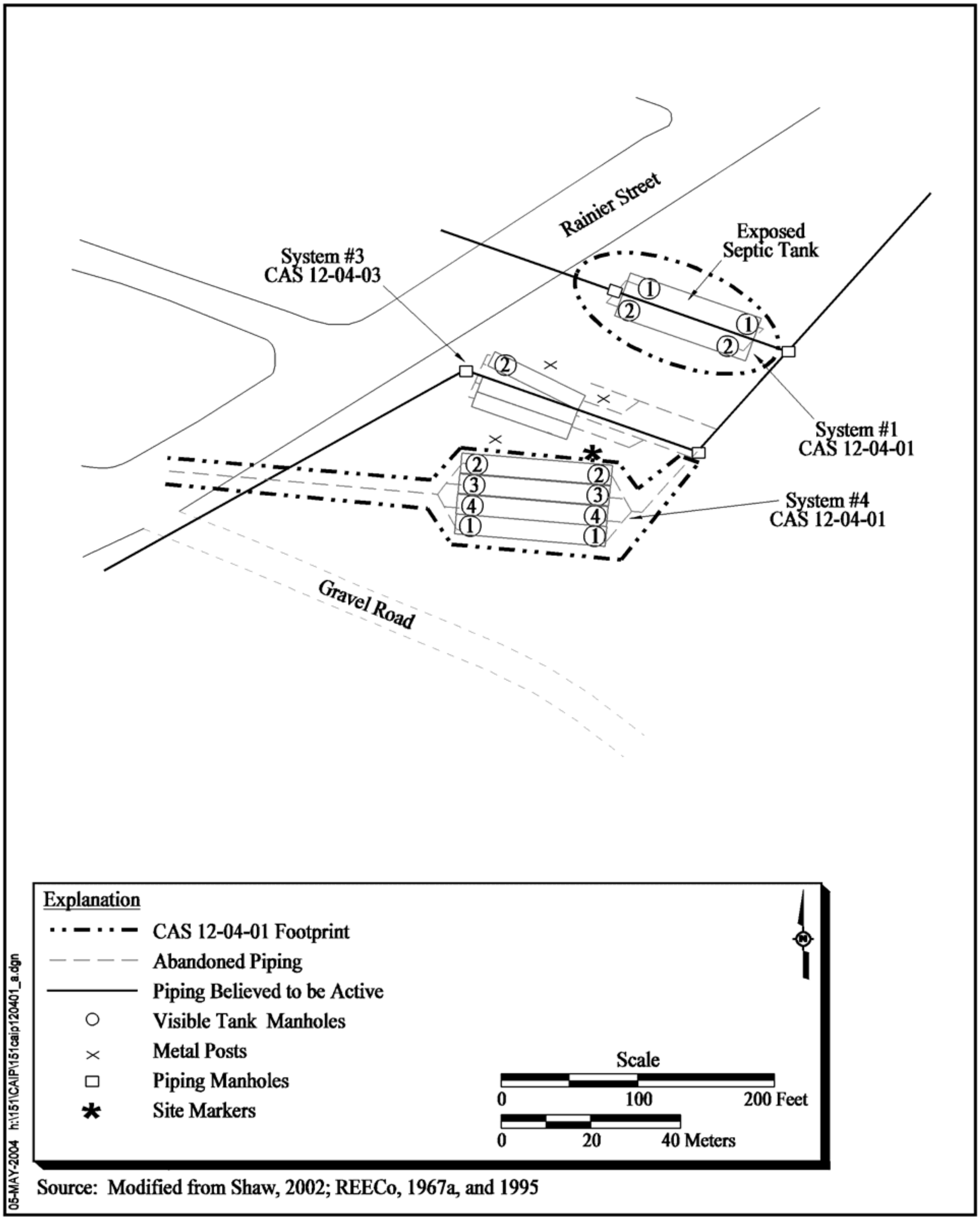


Figure A.1-5
CAU 151, CAS 12-04-01 Site Map

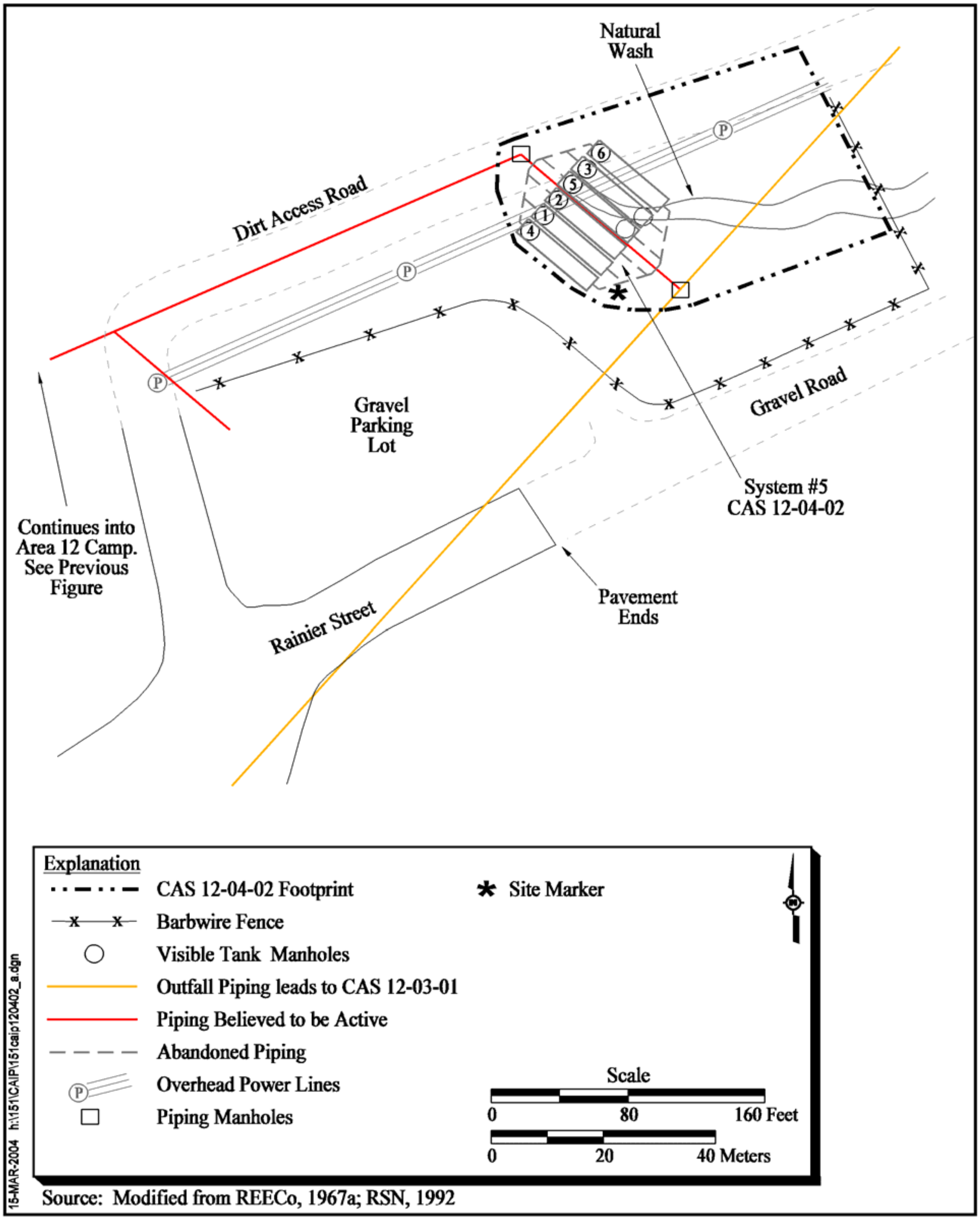


Figure A.1-6
CAU 151, CAS 12-04-02 Site Map

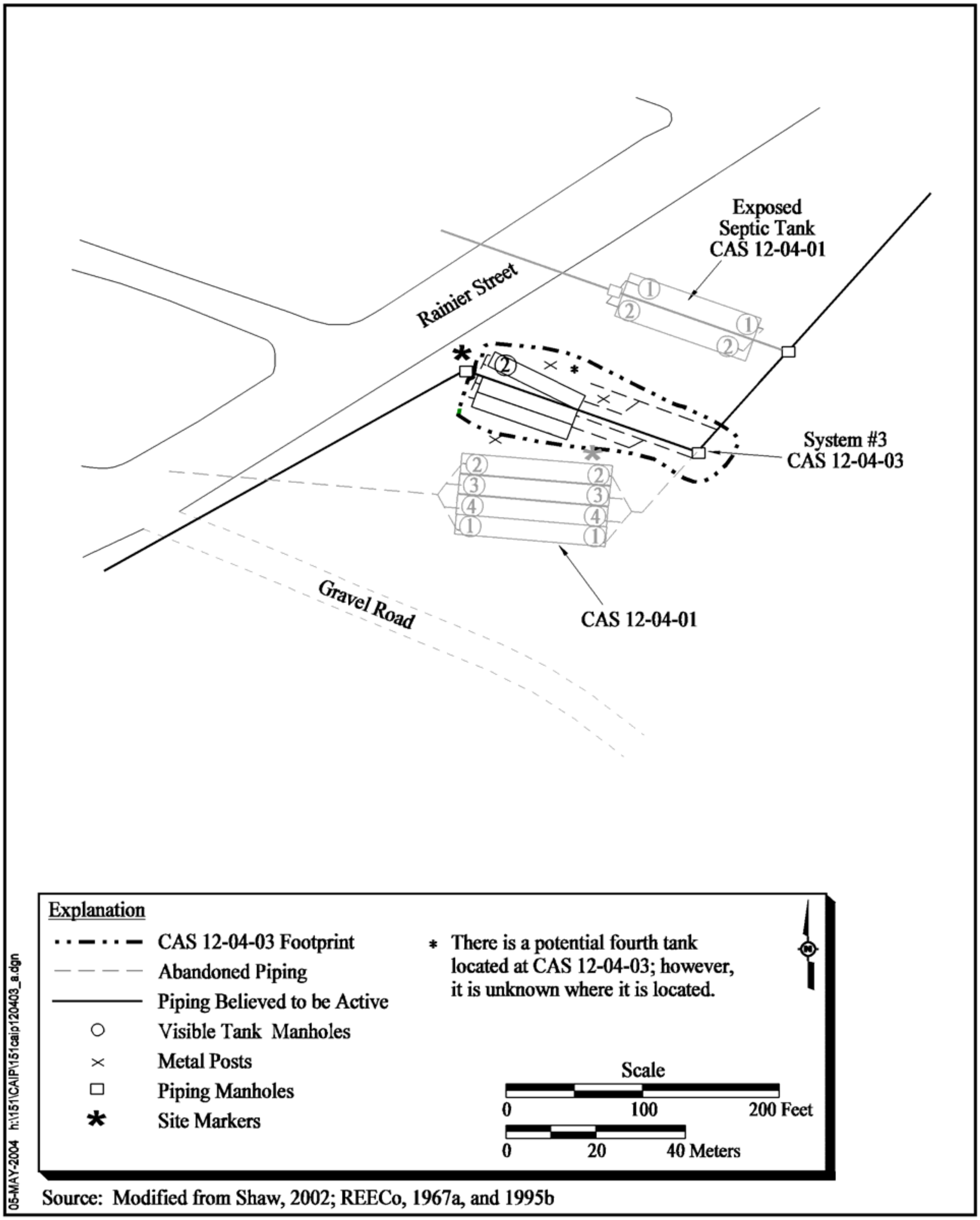


Figure A.1-7
CAU 151, CAS 12-04-03 Site Map

associated with these tanks has been bypassed into active systems; therefore, only inactive piping directly adjacent to the tanks is subject to this investigation. The piping is likely to be ACM.

Previous Investigation Results - The following results were identified for the Septic Systems #1, #3, #4, and #5:

- Septic System #1: Samples were collected from each tank and submitted for laboratory analysis. One sludge sample contained trichloroethylene at 13 mg/L. The TPH oil sludge samples had results of 4,700; 300; and 4,900 mg/kg. Analytes detected in sludge include barium; chlorobenzene; 1,4-dichlorobenzene; m,p-cresol; 1,1-dichloroethlyene; methyl ethyl ketone; tetrachloroethylene; PCBs; and vinyl chloride. Liquid detects include trichloroethene; toluene; 1,2-dichloroethene; 1,4-dichlorobenzene; and petroleum oil and diesel (REECo, 1995).

- Septic System #3: Of the liquid and sludge samples collected, petroleum hydrocarbons as oil were above the TPH action levels of 100 ppm (NAC, 2003). 1,4-dichlorobenzene was identified in two samples with levels of 0.05 and 160 mg/L. Detects were identified in liquid samples for the following constituents: barium; mercury; TPH as diesel, gas, and oil; acetone; toluene; bis(2-ethylhexyl) phthalate; 1,4-dichlorobenzene; 4-chloroaniline; 1,2-dichlorobenzene; 2-methylphenol; and 4-methylphenol. Sludge detects were identified for the following constituents: barium; TPH as diesel, gas, and oil; trichloroethene; 2-methylphenol; chlorobenzene; methyl ethyl ketone; tetrachloroethylene; 4-methylphenol; and PCBs. Radiochemcial samples were collected for analysis of gamma, tritium, and plutonium (REECo, 1995).

- Septic System #4: Liquid and sludge samples were collected from the interior of each of the tanks and submitted for laboratory analysis. Petroleum hydrocarbons were identified in all sludge samples with levels ranging from 480 to 2,100 mg/kg. There were three detects in liquid for acetone (0.017 mg/L), barium (0.016 mg/L), and for 1,4-dichlorobenzene at 3.9 mg/L. Analytes, that were detected in sludge include barium; methyl ethyl ketone; trichloroethylene; chlorobenzene; acetone; 1,2-dichlorobenzene; 1,4-dichlorobenzene; diesel; gasoline; and PCBs. Radioanalytical results had detects for gamma, tritium, and plutonium (REECo, 1995).

- Septic System #5: The liquid material was sampled, but the solid material was not sampled because there was such a small amount present and it was likely that soil had fallen into the tank and had collected. Liquid and sludge samples were collected. 1,4-dichlorobenzene and barium were detected in the liquid samples. Sludge samples identified hydrocarbons (oil) with results of 200 mg/kg. Other analytes detected in sludge were acetone; barium; benzoic acid; bisphthalate (2-ethylhexyl); chromium; 1,4-dichlorobenzene; 2,4-dichlorophenol; di-n-butylphthalate; methyl ethyl ketone; pyrene; pyride; TPH for gas; diesel, and oil; PCBs; benzene; chlorobenzene; dichloromethane; mercury; and tetrachloroethene.

- Geophysical surveys were conducted for CAU 151 during March 2003. The survey conducted for CAS 12-04-01 identified Anomaly "A" as System #1 and Anomaly "C" as System #4. System #1 showed the presence of two tanks, while System #4 identified the presence of four tanks. All tanks appeared to trend in an east-west direction. System #1 appeared to be about 3 to 5 ft bgs, while System #4 appeared to be about only 1 to 2 ft bgs. An underground utility was observed in the vicinity of System #1 that was consistent with the location of the sanitary sewer line that was identified in the engineering drawing that was used. There were utilities identified for System #4. The document states that a video inspection team that was conducting surveys in the area reported that some of the piping was greater than 4 ft bgs and was of vitrified clay construction. The document also includes the figures showing the results of the survey (SAIC, 2003).

- Geophysical surveys were conducted for CAU 151 during March 2003. The results of the survey for CAS 12-04-02 indicated that an anomaly was identified that was consistent with the location of the suspected septic tank field. There were no anomalies identified for the piping; however, there were two manhole covers observed in the location believed to be where the piping fed into the tanks. There are six septic tanks suspected, with a soil covering of 0 to 5 ft. The document also includes the figures showing the results of the survey (SAIC, 2003).

- Geophysical surveys conducted for CAU 151 during March 2003. The survey conducted for CAS 12-04-03 identified Anomaly "B" as System #3, showing the presence of four tanks. All tanks appeared to trend in an east-west direction. The tanks are between 3 and 5 ft bgs. The presence of piping at Anomaly "B" could not be confirmed. The document also includes the figures showing the results of the survey (SAIC, 2003). Although the results state that all four tanks appear to still be present, only three of the four tanks were identified during the sampling activities in 1994 and 1995.

- Geophysical surveys were conducted at CAS 12-04-03 to verify the absence or presence of System #2. The geophysical surveys indicated that there are no tanks in the location identified on previous engineering drawings where System #2 was to be installed (SNJV, 2004). Based on engineering drawings and this geophysical survey, it is determined that although System #2 was proposed, later engineering drawings support that this system was never installed and System #3 was used to support the housing trailers (REECo, 1967a).

- Walk-over surveys were conducted on February 18 and February 19, 2003, to determine if radiological contamination was present in surficial soil concentrations statistically greater than surficial soil from undisturbed background locations. The survey that was conducted for CASs 12-04-01 and 12-04-03 encompassed an area of approximately 38,500 ft^2. A total of 4,929 data points were recorded with a mean gamma radiation emission rate of 198 cps versus the mean undisturbed background gamma radiation emission rate of 181 cps. The maximum gamma radiation emission rate was 277 cps. With the exception of a few elevated gamma emissions in the surficial soil, the gamma radiation emission rate is uniformly distributed. The document states that currently the site poses no risk to individuals from residential radiological contamination. The document also includes a figure showing the results of the survey (Nicosia, 2003).

Contaminants of Potential Concern - The COPCs for CASs 12-04-01, 12-04-02, and 12-04-03 were established as a part of the known investigations and historical knowledge of this site. The analytes are as follows:

- General COPCs associated with the discharge of effluent into the septic tanks includes sewage and chemical discharges from the Area 12 Camp.
- Analytical results suggest that analytes were identified during previous sampling events. Table A.1-3 identifies the suspected contaminants for each septic system.
- Because the historical documentation is not definitive, total VOCs, total SVOCs, and TPH have been added to the analytical suite.
- NTS-specific analytes shall be added to suite if not already identified from historical or process knowledge. These analytes include gamma-emitting radionuclides, PCBs, and RCRA metals with beryllium.
- Based on the historical knowledge of this CAS, pH has been added to the list of analytes determine soil characteristics. Historical documentation suggests that acids and bases may have been discharged into the septic tanks.
- Asbestos is associated with the inactive system piping and considered for health and safety purposes.
- Sewage sludge, if encountered, will also be analyzed for fecal coliform bacteria for health and safety purposes.

A.1.1.5 Corrective Action Site 12-47-01, Wastewater Pond

Physical Setting and Operational History - Corrective Action Site 12-47-01 consists of two sumps (evaporation ponds) and associated inactive piping located at the Area 12 Fleet Operations at the NTS (Figure A.1-8). It is documented that three buildings and a women's restroom trailer fed into these sumps: Building 12-8, Area 12 Construction Shops, was constructed before 1964 and demolished in 2002; Building 12-16, Motor Pool Equipment Maintenance Shop, was constructed around 1965 and was demolished in 2002; while Building 12-910, Crafts Building, was constructed in 1987 and its wastewater was diverted to the new septic tank and leachfield system that was constructed in the late 1980s or early 1990s, and the women's restroom trailer was added in 1971. Both sumps were constructed to receive sewage waste from Buildings 12-8 and 12-16. However, when the new sump was built in 1970, sewage from both buildings were diverted to the new sump, as were

Table A.1-3
Suspected Contaminants for CASs 12-04-01, 12-04-02, and 12-04-03[a]

COPC	CAS 12-04-01, System #1	CAS 12-04-03, System #3	CAS 12-04-01, System #4	CAS 12-04-02, System #5
Organics				
VOCs				
1,1-Dichlorobenzene	X	--	--	--
1,4-Dichlorobenzene	X	X	X	X
Acetone	--	--	--	X
Benzene	X	X	X	X
Chlorobenzene	X	X	X	X
Dichloromethane	--	--	--	X
Methyl Ethyl Ketone	X	X	X	X
Tetrachloroethylene	--	X	--	--
Toluene	X	X	--	--
Trichloroethylene	X	--	X	--
Vinyl Chloride	X	--	--	--
SVOCs				
1,2-Dichlorobenzene	--	X	X	--
2-Dichlorophenol	--	--	--	X
2-Methylophenol	--	X	--	--
4-Chloroaniline	--	X	--	--
4-Methylphenol	--	X	--	--
Benzoic Acid	--	--	--	X
Bis (2-Ethyl) Hexyl Phthalate	--	X	--	X
Di-n-Butyl Phthalate	--	--	--	X
m,p-Cresol	X	--	--	--
Pyrene	--	--	--	X
TPH				
Diesel	X	X	X	X
Gas	--	X	X	X
Other				
PCBs	X	X	X	X
Metals				
Barium	X	X	X	X
Chromium	--	--	--	X
Mercury	--	X	--	X
Radionuclides				
Radiological Constituents[b]	X	X	X	X

[a]REECo, 1995
[b]Radiological constituents include Americium-241, Cesium-137, Plutonium 238, Plutonium-239/240, Strontium-90, Uranium-234, Uranium-235, and Uranium-238.

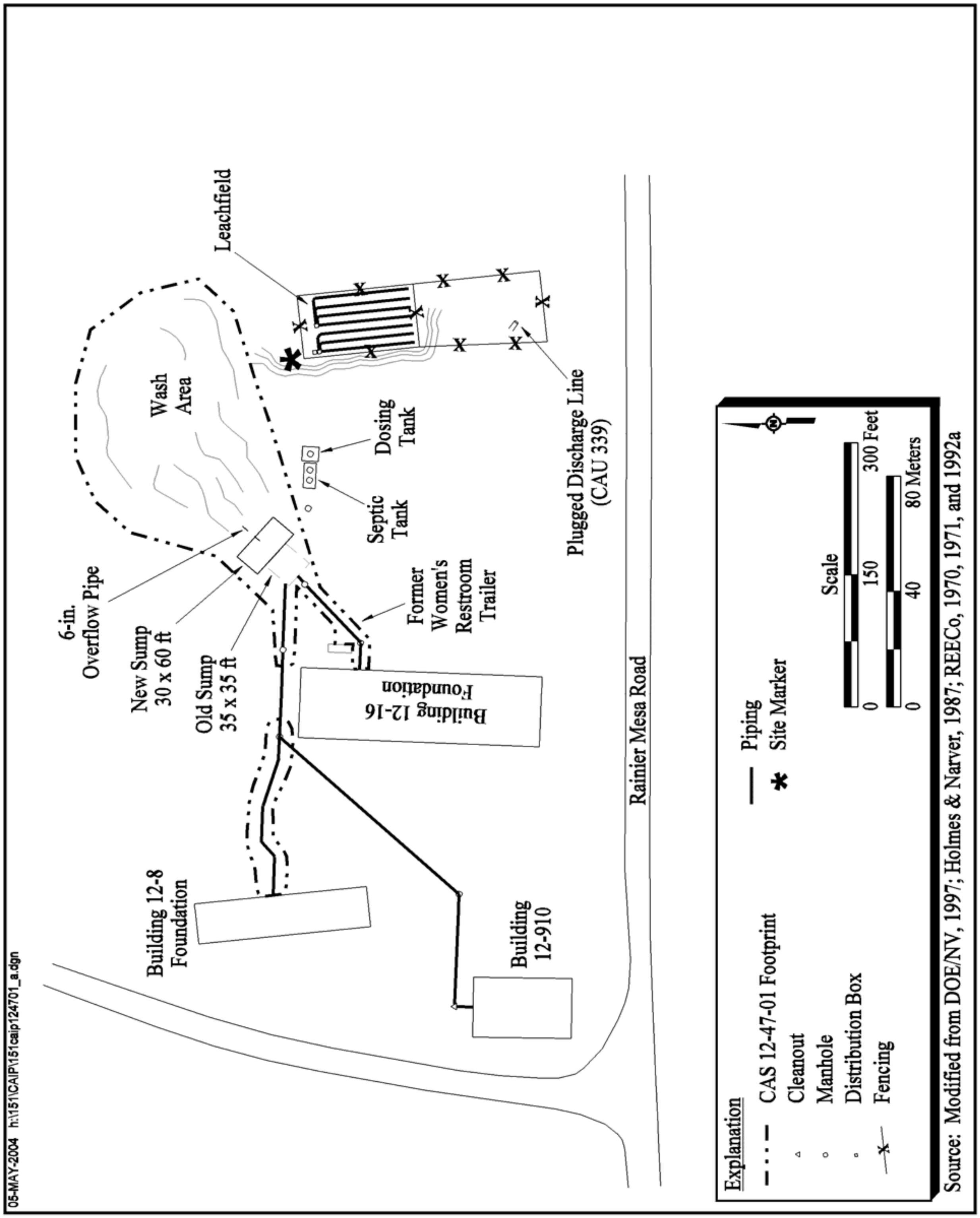


Figure A.1-8
CAU 151, CAS 12-47-01 Site Map

Building 12-910 and the women's restroom trailer. The old unlined sump is approximately 35 by 35 ft and was constructed between 1964 and 1966. This sump is located southwest to the new sump. The new sump, which is also included in this CAS, is approximately 30 by 60 ft and was constructed around 1970. In the late 1980s it was proposed to replace these sumps with a septic tank and a leachfield. On as-built drawings from 1992 the new leachfield and septic system replaced this system. The added system (e.g., two septic tanks and a leachfield) facilitate Building 12-910 and is currently active. At the time of the addition of the septic tanks and leachfield, the new sump and the old sump were backfilled. Additionally, it has been well documented that the sumps have overflown on occasion onto the surrounding area (DOE, 1988 a and b).

In addition to the sanitary effluent drains from Buildings 12-8, 12-16, and 12-910, there are drains located within Building 12-16 that were used during steam cleaning and vehicle maintenance activities. Documentation suggests that these drains may have been discharged into the new sump. It has been documented that the effluent discharged into these sumps may have been hazardous (DOE, 1988 a and b).

Sources of Potential Contamination - There are several sources of contamination for CAS 12-47-01. The following are a list of activities that contributed to the contamination at this location:

- Building 12-8 included two toilets, two urinals, and three sinks that were connected to the system. This building discharged into both the old and new sumps at CAS 12-47-01 (DOE, 1988 a and b).

- Building 12-16 included three toilets, three urinals, two sinks, and one floor drain that was connected to the system. This building discharged into both the old and new sumps at CAS 12-47-01. This building was used as the Motor Pool Equipment Maintenance Shop and prior to 1990 discharged the effluent from the steam-cleaning jenny onto the soil outside of Building 12-16 (CAU 339). Documentation suggests that the discharge may have been routed into the drain that discharges into the new sump (DOE/NV, 1990).

- A new women's restroom trailer was added to the area in 1971 that discharged into the new sump (REECo, 1971).

- Building 12-910 includes, two toilets, one urinal, two sinks, a janitor's sink, three floor drains, one lunchroom sink, and two drinking fountains that are connected to the system. This building only discharged into the new sump (Holmes & Narver, 1987).

Previous Investigation Results - Two documents provided information on sampling that was performed at this CAS and at the discharge area east of Building 12-16:

- In April 1989, samples were collected from one of the unspecified sumps and analyzed for RCRA hazardous wastes. The results included detections for 1,2-dichlorobenzene; 1,4-dichlorobenzene; and pyrene (Haworth, 1989).
- CAU 339, Area 12 Fleet Operations Steam Cleaning Discharge Area, is adjacent to CAS 12-47-01. The discharge east of Building 12-16 revealed that TPH exceeded guidelines for oil at this location. Other analytes detected include acetone, 2-hexanone, methylene chloride, methyl ethyl ketone, methyl-isobutyl-ketone, and toluene (DOE/NV, 1997). Although this location is not included in CAU 151, the proximity of the building to the CAS provides current information of contaminants that may be associated with CAU 151.

Contaminants of Potential Concern **-** The COPCs for CAS 12-47-01 were established as a part of the known investigations and historical knowledge of this site. The analytes are as follows:

- General COPCs associated with the discharge of effluent into the sumps includes sewage and chemical discharges from the Area 12 Fleet Operations.
- Analytical results indicate that oil; 1,2- dichlorobenzene; 1,4-dichlorobenzene; pyrene; acetone; 2-hexanone; methylene chloride; methyl ethyl ketone; methyl-isobutyl-ketone; and toluene are suspected COPCs for this CAS (DOE/NV, 1990; Haworth, 1989).
- Because oil was a constituent at CAU 339 (DOE/NV, 1997), it is added to this CAS based on previous operational documentation.
- Because the historical documentation is not definitive, total VOCs, total SVOCs, and TPH have been added to the analytical suite.
- NTS-specific analytes shall be added to suite if not already identified from historical or process knowledge. These analytes include gamma-emitting radionuclides, PCBs, and RCRA metals with beryllium.
- Asbestos is associated with the system piping and considered for health and safety purposes.
- Sewage sludge, if encountered, will also be analyzed for fecal coliform bacteria for health and safety purposes.

A.1.1.6 Area 17 Camp Background

Two of the CASs in CAU 151 are located in Area 17 Camp. A background of the entire camp has been provided to explain how the systems in the camp interact and may impact both of the CASs in CAU 151. Area 17 Camp was constructed during the early 1960s and was inactive and abandoned by the late 1980s. The camp provided support services for drilling activities on Pahute Mesa. Activity within the camp was highest from the mid to late 1960s; thereafter, the camp was likely used only intermittently. While active, the Area 17 Camp contained many facilities including a security compound, the cafeteria and restrooms, fire station and first aid building, U.S. Geological Survey (USGS) compound, service station, and construction area. The construction area included the teamsters shop, carpenter shop, electricians shop, linemans shop, laborer shop, painter shop, ironworkers shop, and a pipefitters shop (American Aerial Survey, Inc., Date Unknown a; DRI, 1988).

Two CASs in CAU 151 are located in the Area 17 Camp. The facilities listed above fed into the system and into the lagoons between the northern and southern piping. For CAS 18-03-01, Sewage Lagoon, all of the buildings associated with the Area 17 Camp are associated with this system. The other CAS 18-99-09, Sewer Line (Exposed), is not very well defined and may be linked to the system of CAS 18-03-01 (AEC, Date Unknown).

A.1.1.7 Corrective Action Site 18-03-01, Sewage Lagoons

Physical Setting and Operational History - Corrective Action Site 18-03-01, Sewage Lagoons, is located in the Area 17 Camp of Area 18 at the NTS (Figure A.1-9). This site includes two septic lagoons and the associated piping that was constructed during the early 1960s and was active until the late 1980s (Shaw, 2003a). The lagoons will be referred to as the northern and southern lagoons. The northern lagoon measures 163 by 93 ft and is approximately 18 ft deep. The southern lagoon is 141 by 113 by 10 ft. Both of the lagoons are dry and contain vegetation. The partially exposed VCP (CAS 18-99-09) is located northeast of the lagoons and may not be associated with these lagoons. There are no drawings that indicate CAS 18-99-09 and CAS 18-03-01 are connected, and geophysical survey results did not indicate a tie-in of the pipe to the sewage lagoon (AEC, Date Unknown; SAIC, 2003; Shaw, 2003b).

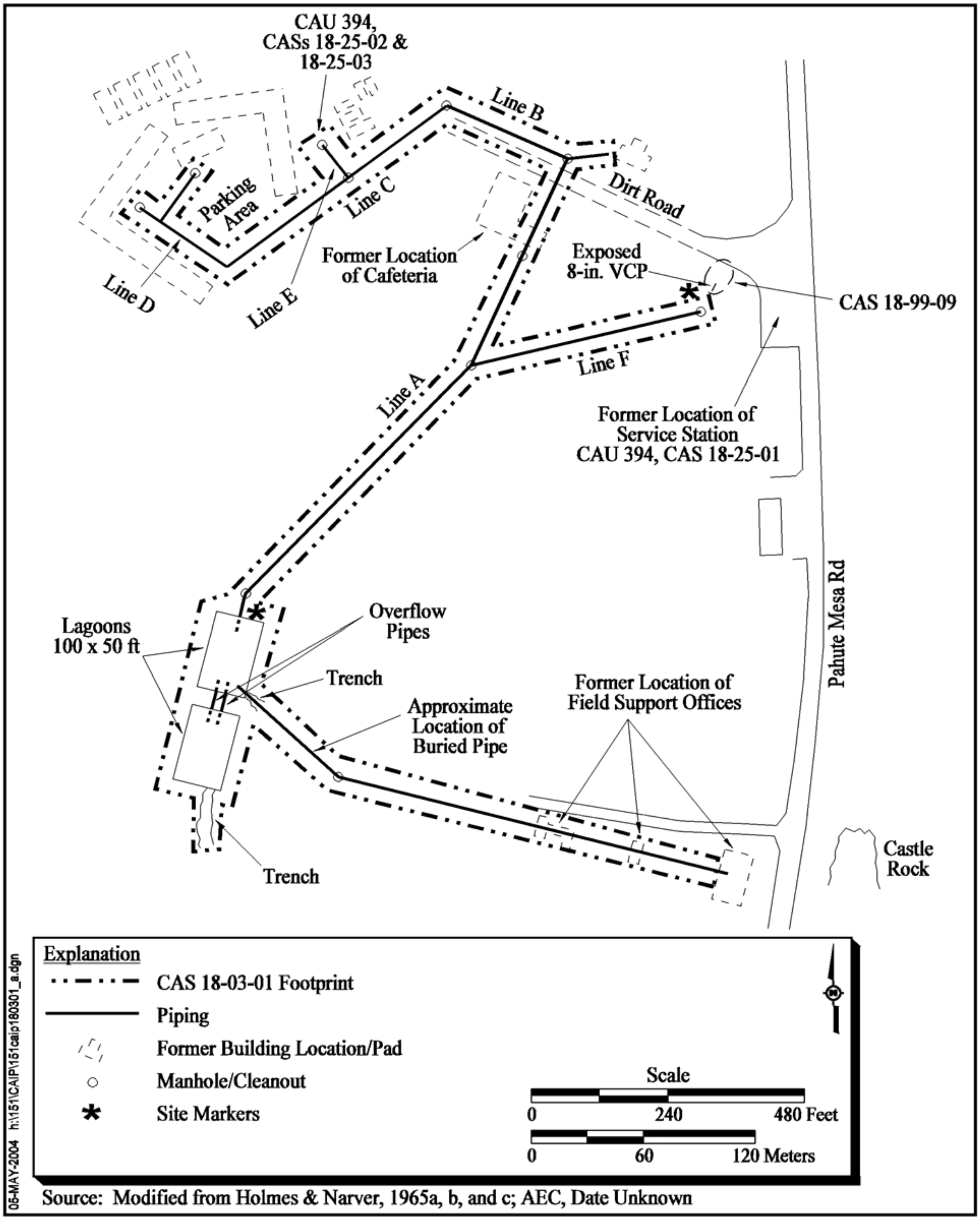


Figure A.1-9
CAU 151, CAS 18-03-01 Site Map

Because the drawing and surveys indicate that the CASs 18-03-01 and 18-99-09 are not related, they shall remain separate CASs and approached separately unless the investigation determines that they are connected.

Sources of Potential Contamination - The sources of potential contamination at CAS 18-03-01 include:

- The sewage lagoons were associated with the Area 17 Camp in Area 18. Restrooms discharged into these lagoons from the Area 17 Camp (Holmes & Narver, 1965a, b, and c).
- The piping systems associated with the lagoons may have been constructed using asbestos.

Previous Investigation Results - There are no prior sampling results available for this CAS.

Contaminants of Potential Concern - Based on the process knowledge, domestic sewage is the probable contaminant for this CAS. However, based on previous site investigations, it is known that similar facilities at the NTS may have not been used for their intended purpose. Other chemicals may have been discharged into drains; therefore, an array of chemicals used at adjacent facilities may have been disposed of into this system. Indicators for potential contamination include total VOCs, total SVOCs, TPH, and pesticides. In addition, to maintain continuity with the NTS list of common analytes to this suite, NTS-specific analytes shall be added to suite including gamma-emitting radionuclides, PCBs, and RCRA metals with beryllium.

Asbestos is associated with the lagoon system piping and considered for health and safety purposes. Sewage sludge, if encountered, will also be analyzed for fecal coliform bacteria for health and safety purposes.

A.1.1.8 Corrective Action Unit 18-99-09, Sewer Line (Exposed)

Physical Setting and Operational History - Corrective Action Site 18-99-09, Sewer Line (Exposed), is located in the Area 17 Camp of Area 18 at the NTS (Figure A.1-10). This 6-in. VCP is in the vicinity of CAS 18-03-01, Sewage Lagoons; however, documentation and geophysical surveys indicate that the pipe is not attached to the system associated with the sewage lagoons. There is approximately 3 ft of the pipe exposed at the surface under a fence. The southern end of the pipe is elbowed downward. The origin and terminus of the pipe are not known and there is minimal

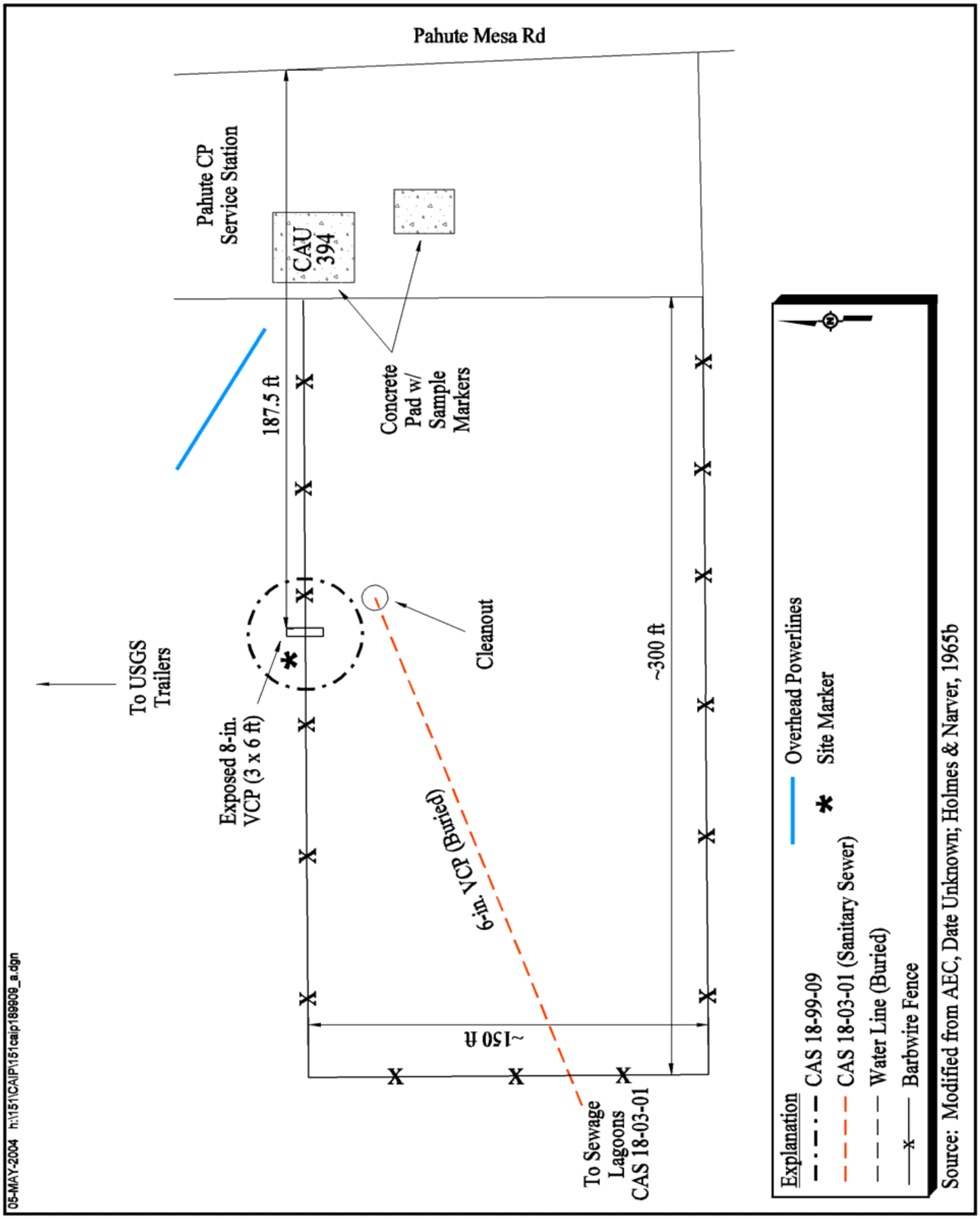


Figure A.1-10
CAU 151, CAS 18-99-09 Site Map

documentation as to what structures are associated with this pipe. The timeline for the site is assumed to be the same as the Area 17 Camp, that was constructed in the early 1960s and was abandoned and inactive by the late 1980s.

Sources of Potential Contamination - The origin and terminus are unknown for this CAS. Since there is no definitive information for this site, the COPC list has not been determined based on process knowledge or previous sampling activities. However, knowing that the type of pipe is the same and its proximity is close to the sewage line from CAS 18-03-01, it can be assumed that if this location is associated, then the COPCs will be the same as those established for CAS 18-03-01.

Previous Investigation Results - No previous analytical investigation results are available for CAS 18-99-09.

Geophysical survey were conducted at CAS 18-99-09 between March 5 and 27, 2003. The report states that the CAS consists of a partially exposed VCP sewer pipe located on the west side of the abandoned Area 17 Camp gas station. The pipe is 8 in. in diameter and approximately 10 ft long. A barbwire fence runs east to west, perpendicular to the pipe. The origin and termination points for the exposed pipe are unknown; thus, the purpose of the survey was to determine the origin, terminus, and location of the clay pipe within the survey area and to determine if a leachfield or tank is associated with the piping. Four distinct anomalies were identified in the survey. Anomaly A runs east to west and is believed to be related to the barbwire fence that bisects the site. Anomaly B and C both run northwest to southeast and are believed to be underground utilities. Anomaly B was traced to the southeast to where it terminated at a 6-in. diameter steel pipe outfall opening to a drainage swale. The origin of this facility could not be determined. Anomaly C was traced to wooden markers and signs that were labeled as underground cable. Finally, Anomaly D was characterized as a group of isolated targets that are most likely metallic debris contained within a drainage swale that parallels the west side of road RSMP P38. No features characteristic of a septic tank were identified within the limits of the survey.

Ten survey traverses were also conducted in the vicinity of the exposed pipe and the suspected underground utility. The survey traverses seemed to indicate a weak existence of an underground utility. These results suggest that the exposed pipe continues a north-south trend and extends beyond the limits of the survey area. The origin and termination points of this utility were not determined (SAIC, 2003).

Radiological surveys of Areas 18 and 20 were conducted during October 10 through November 13, 1985 (EG&G/EM, 1985). Surveys of the two areas were conducted simultaneously and exposure rate contour maps for total terrestrial gamma-ray activity were generated for both areas. The most frequently occurring range of exposure rates was 17 to 25 FR/h for both areas. Background for the NTS is 10 to 20 FR/h. To show the extent of man-made contamination in Area 18, an isocount rate contour map showing the distribution of count rates measured in a spectral window sensitive to cobalt-60 was used (EG&G/EM, 1985).

Contaminants of Potential Concern - The same suite of analytes for CAS 18-03-01 will be used for this site due to the proximity and uncertainties of the CAS.

A.1.1.9 Corrective Action Site 20-19-02, Photochemical Drain

Physical Setting and Operational History - Corrective Action Site 20-19-02, Photochemical Drain, consists of a surface discharge from a drain in a photoprocessing Trailer 992 at the Area 20 Camp (Figure A.1-11). The discharge of photochemicals from Trailer 992 onto the soil beneath the trailer occurred during the operations of the trailer for film processing from 1967 through 1991. The trailer was not active the entire year, but was operational a few weeks of each year to support the tests conducted in the area (Maddox, 1991).

Area 20 Camp was used as a support camp. After 1991, portions of the camp were demolished. Presently there are two metal buildings and concrete pads that remain at the camp. It is not known, nor documented, whether or not the site had been graded as a part of the demolition activities. The location of Trailer 992 has not been determined. Discussions with employees who have worked at the Area 20 Camp indicate that the trailer may have been located approximately 100 ft west of the metal buildings (Templeton, 2004).

Although CAS 20-19-02 has been identified in audits and is documented, it has not been physically identified during field visits. Documentation suggests that the discharge of the photochemicals was directly onto the ground surface. However, in 1990 the operations at the trailer changed and the

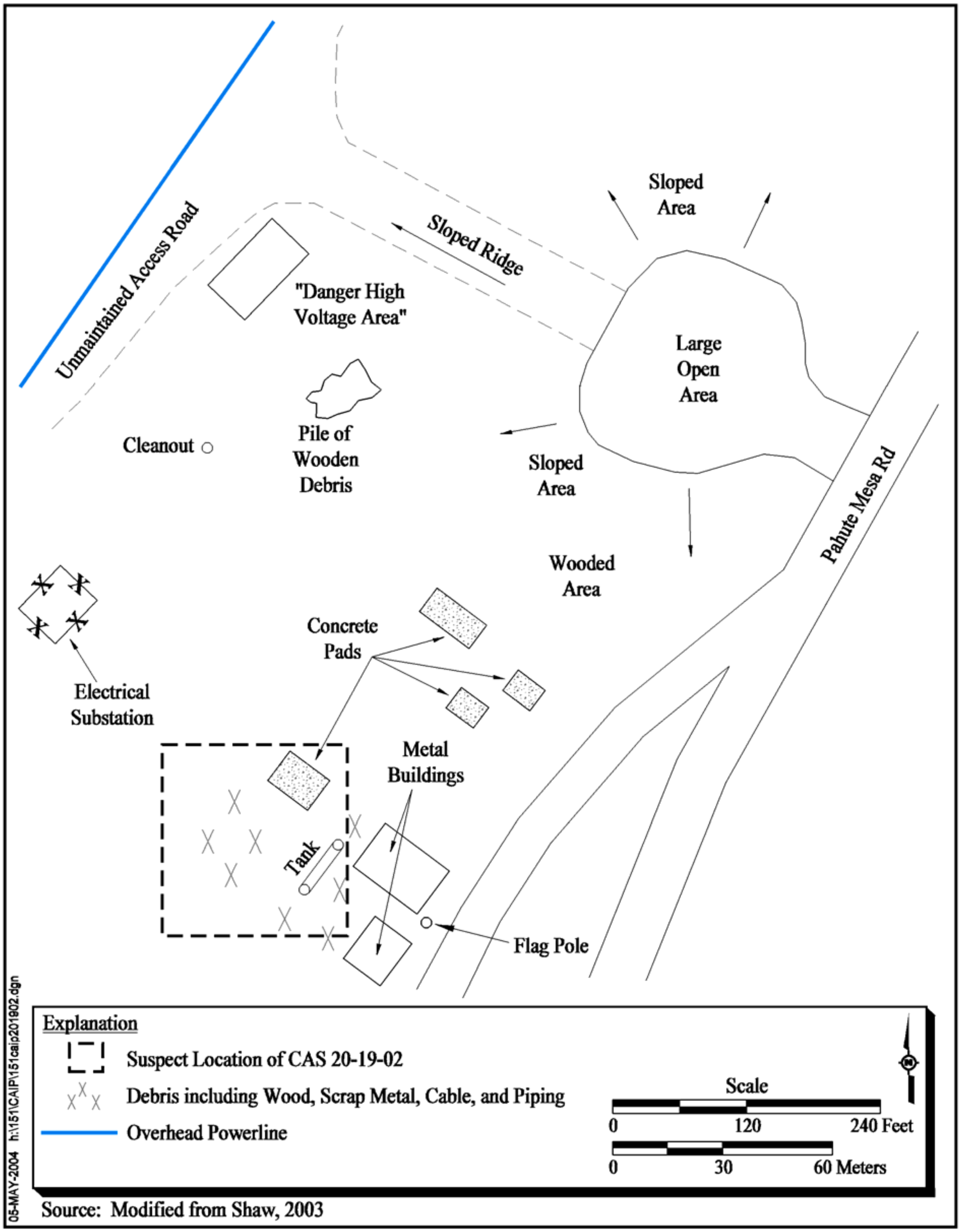


Figure A.1-11
CAU 151, CAS 20-19-02

photochemicals would be contained in 55-gal drums that were stored alongside the trailer (Maddox, 1991).

Sources of Potential Contamination - Photoprocessing was conducted in Trailer 992 for the Area 20 tests performed from 1967 through 1991. Trailer 992 discharged into a "photochemical drain" below the trailer to the surface and subsurface (Maddox, 1991).

Previous Investigation Results - An aerial radiological survey was performed on Areas 18 and 20 in November 1985 and the results of the survey are consistent with the activities associated with testing in the area. The exposure rate for the vicinity of CAS 20-19-02 was 17 to 20 microrem/hour. Background for the NTS is 10 to 20 FR/h (EG&G/EM, 1985). Radiological contamination is not expected to be a concern at the Area 20 Camp; however, due to the uncertainty of activities at NTS, radiological constituents will remain a COPC for this CAS.

No extended assessments directly related to the photochemical drain were identified.

Contaminants of Potential Concern - The COPCs for CAS 20-19-02 were established as a part of the known investigations and historical knowledge of this site. The analytes are as follows:

- General COPCs associated with the discharge of photoprocessing chemicals onto the surface of a location within the Area 20 Camp.
- Suspected COPCs identified for CAS 20-19-02 are silver and silver compounds, hydroquinone and potassium hydroxide (Maddox, 1991; Moeller, 2003). These COPCs have been identified as the best possible analytical indicators.
- Because the historical documentation is not definitive, total VOCs, total SVOCs, and TPH have been added to the analytical suite.
- NTS-specific analytes shall be added to suite if not already identified from historical or process knowledge. These analytes include gamma-emitting radionuclides, PCBs, pH, and RCRA metals with beryllium.

A.1.2 Step 1 – State the Problem

This initial step of the DQO process identifies the planning team members and decision makers, describes the problem that has initiated the CAU 151 CAI, and develops the CSM.

A.1.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NSO, Stoller-Navarro Joint Venture (SNJV), and Bechtel Nevada (BN). The primary decision-makers include NDEP and NNSA/NSO representatives. Table A.1-4 lists representatives from each organization in attendance at the March 31, 2004, DQO planning meeting.

Table A.1-4
DQO Meeting Participants

Participant	Affiliation
Greg Raab	NDEP
Kevin Cabble	NNSA/NSO
Brian Hoenes	SNJV
David Strand	SNJV
Jill Dale	SNJV
Lynn Kidman	SNJV
C.H. Tung	SNJV
Barbara Quinn	SNJV
Charlotte Franky	SNJV
Jack Ellis	SNJV
Jeanne Wightman	SNJV
Julie Snelling-Young	SNJV
Kathy Umbarger	BN

BN – Bechtel Nevada
SNJV – Stoller-Navarro Joint Venture
NDEP – Nevada Division of Environmental Protection
NNSA/NSO – U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office

A.1.2.2 Describe the Problem

Corrective Action Unit 151, Septic Systems and Discharge Areas, is being investigated because effluent potentially contaminated with hazardous and/or radioactive constituents may have discharged to the various systems that comprise the unit. Designed releases to lagoons, ponds, sumps, and drains could have resulted in contamination of the native soils associated with the CASs. Additionally, accidental releases caused by breaches in associated piping systems, overflow of collection systems (e.g., lagoons, ponds, sumps, septic tanks), or potential spills could have resulted in surface or subsurface soils contamination. The problem statement for CAU 151 is:

> "Existing information on the nature of potential contaminants and, if present, the extent of contamination is insufficient to evaluate and recommend corrective action alternatives for CAU 151."

A.1.2.3 Develop A Conceptual Site Model

Conceptual site models describe the most probable scenarios for current conditions at a CAS and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. They are the basis for assessing how contaminants could reach receptors both in the present and future by addressing contaminant nature and extent, transport mechanisms and pathways, potential receptors, and potential exposures to those receptors. Accurate CSMs are important because they serve as the basis for all subsequent inputs and decisions throughout the DQO process. Land-use descriptions help define exposure scenarios that are the basis for assessing how contaminants could reach potential receptors both in the present and future. Table A.1-5 summarizes the land-use designations and associated descriptions for the CAU 151 CASs (DOE/NV, 1998b). Based on land use, current and future receptors is limited to industrial and construction workers as well as military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials.

The graphical CSM for CAU 151 (Figure A.1-12), is a general model that shows the affected media, transport mechanisms, preferential pathways, and release points common to the various CASs within CAU 151. The CSM addresses the associated components common to the CASs and addresses associated systems with subsurface piping and captures the commonalities of the CASs. This will apply to all of the CASs with the exception of CAS 20-19-02, which has a separate CSM (Figure A.1-13). The CSMs for CAU 151 were developed using information from the physical setting, potential contaminant sources, knowledge from similar sites, release information, historical background information, and physical and chemical properties of the potentially affected media and COPCs. The CAU 151 CASs included in each model are divided based on the function of the system components and the varying potential for contamination based on applicable components as they apply to each CAS. The CSM for septic and/or discharge collection systems is based on the *Work*

Table A.1-5
Land Use

Land-Use Designation	Land-Use Description	CASs
Nuclear and High Explosive Test Zone	The area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities.	02-05-01, 12-03-01, 12-04-01, 12-04-02, 12-04-03, and 12-47-01
Nuclear Test Zone	This area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.	20-19-02
Reserved Zone	This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Central training and U.S. Department of Defense land-navigation exercises and training.	18-03-01 and 18-99-09

Plan for Leachfield Corrective Action Units: Nevada Test Site and Tonopah Test Range, Nevada (DOE/NV, 1998a). As shown in Table A.1-6, the general components of the CAU 151 CASs are septic and/or discharge collection systems.

The piping element of the CSM applies to all of the CASs where piping is present. This component of the CSM covers the integrity of the pipe and whether or not the system has been breached. For all of the systems, only the inactive piping directly attached to a feature at the point where that pipe terminates or is intercepted by an active system applies. The exact configuration of distribution piping for CAS 18-99-09 is unknown; however, geophysical surveys will provide additional information about the configuration of the exposed 6-in. VCP. Although inactive piping is a part of active systems for CASs 12-03-01, 12-04-01, 12-04-02, 12-04-03, and 12-47-01, systems will be verified to the extent of the inactive portion of the system only as it is connected to other components of the CSM (i.e., septic tank, manhole, lagoon).

The septic tank component of the CSM applies to CASs 12-04-01, 12-04-02, and 12-04-03 within CAU 151. The component of the CSM includes the tanks and their contents. For this component of the CSM, the effluent, upon release from the source (i.e., restroom, floor drain in a building), travels through discharge lines and is routed into the system element (i.e., septic tank).

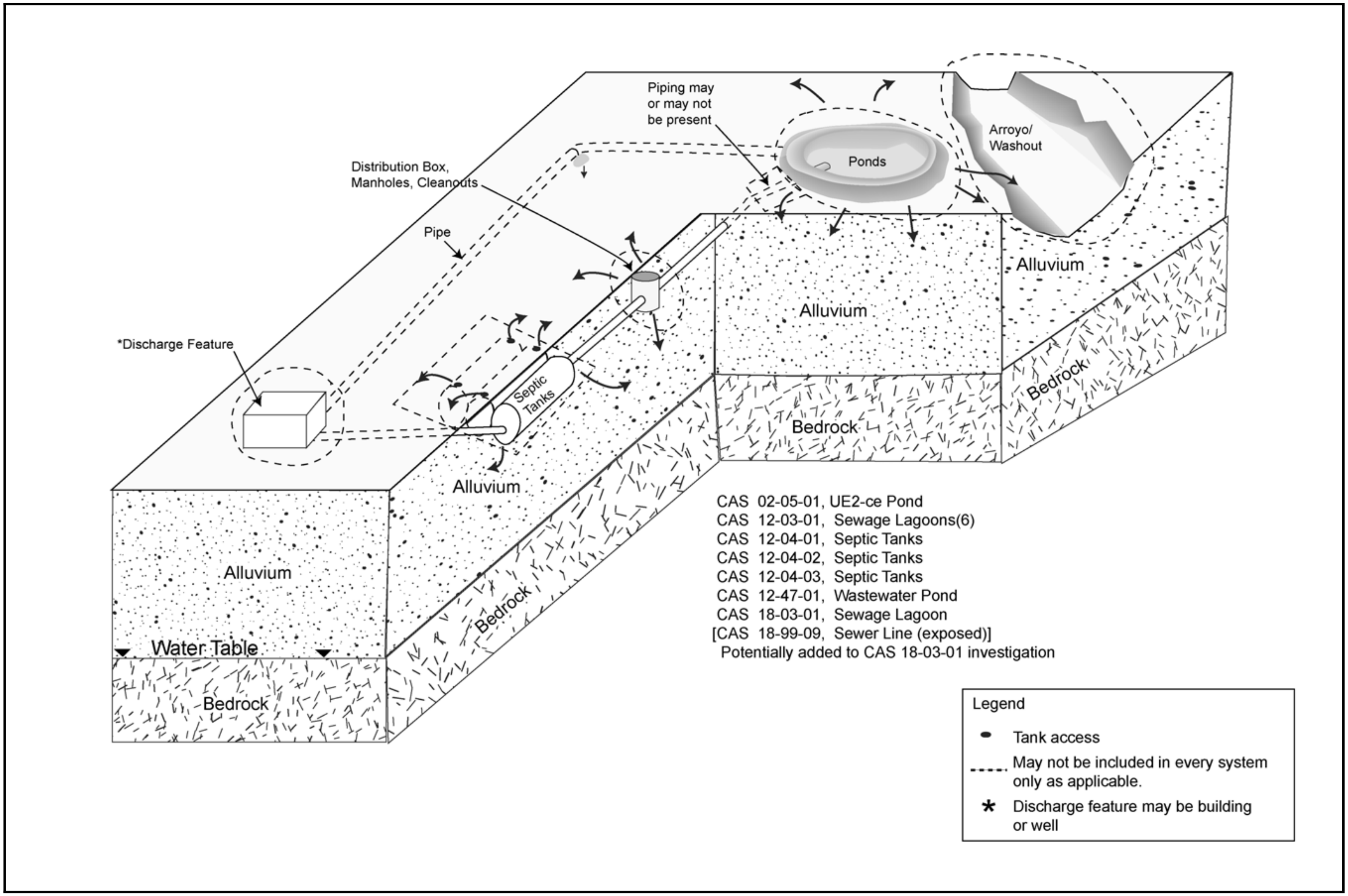


Figure A.1-12
CSM Type 1 - Septic and/or Discharge Collection Systems

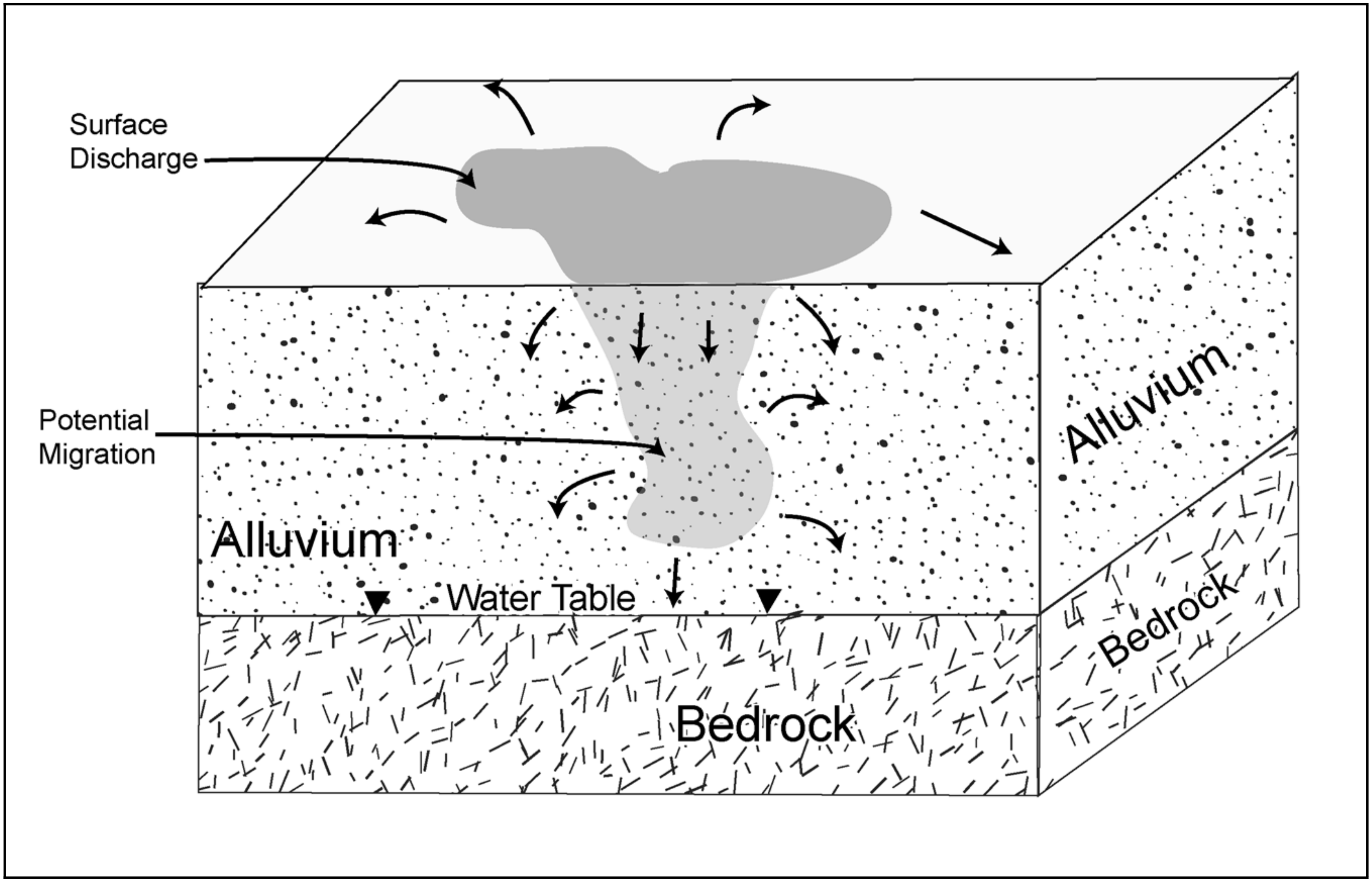


Figure A.1-13
CSM Type 2 - Surface Release

Table A.1-6
Conceptual Site Model Components, Elements, and Applicable CASs

CSM	CSM Component	Corrective Action Site						
		02-05-01	12-03-01	12-04-01, 12-04-02, 12-04-03	12-47-01	18-03-01	18-99-09	20-19-02
Septic Component CSM	Piping	---	Interconnecting Piping Between Lagoons/Ponds	Piping Associated with the Septic System	Piping from Activities Associated with Sumps	Piping Associated with the Sewage Lagoons	Exposed 6-in. VCP	---
	Manholes, Cleanouts, and Distribution Boxes	---	Distribution Boxes (2) and Manhole (1)	Manholes and Cleanouts	Manholes and Cleanouts	Manholes and Cleanouts	---	---
	Septic Systems	---	---	Septic tanks (4)	---	---	---	---
	Lagoons/Sumps or Ponds	Pond	Lagoons and Ponds (7 total)	---	Old and New Sumps	Sewage Lagoons (2)	---	---
Surface Release CSM	Unconfined Surface Discharge	---	---	---	---	---	---	Surface/ Subsurface Discharge

The lagoon, sump, and pond component of the CSM applies to CASs 02-05-01, 12-03-01, 12-47-01, 18-03-01, and potentially 18-99-09. Effluent was dispersed throughout the feature by way of distribution pipes located in the subsurface or from a surface trench. Initially lagoons/sumps were constructed to contain and act as a holding area for effluent and eventually allow liquid to percolate down into the underlying native soil. Systems were eventually updated or the areas were closed and these components were either bypassed or became obsolete. Documentation suggests that many of these systems experienced overflow in the past; therefore, areas outside of the bermed areas will be included in the boundaries of this component.

A separate CSM applies to CAS 20-19-02, Photochemical Drain. This CSM shows conceptually that effluent was released via direct discharge at the surface and was assumed to be unconfined. This component is a surface discharge of effluent for disposal purposes where liquids were allowed to evaporate as well as percolate down into the underlying native soil.

If components are identified during the CAI that are not covered by the CSM or if the investigation extends beyond the spatial boundaries for the CAS(s), the planned approach will be to rescope the boundaries of the investigation. The DQOs will be reviewed and any significant deviation from the approved plan will be presented with corrective recommendations for approval.

Affected media - The following information provides the affected media per component of the CSM:

- The affected media within the piping element is the pipe and the surrounding soil.

- Within the manholes, cleanouts, and distribution boxes, the affected media includes the component itself. If the component overflowed, then the surface soils surrounding the component may be affected by the release of effluent. If the manhole, cleanout, or distribution box was broken or had been impacted by the closure of these systems, then the subsurface soils may have been impacted by a release of effluent.

- For the septic component of the CSM, the affected media is the underground storage tank (UST) that came in direct contact with the effluent and the subsurface soil surrounding these structures if a breach or rupture of the system occurred. Surface soils adjacent to the tank or distribution box structure may be impacted if an overflow or accidental spill occurred.

- The affected media for the lagoon, sump, and pond component are subsurface soil immediately beneath the effluent pipe or discharge point and the extent of the affected area within the lagoon (i.e., lagoon bottom, outfall). Berms and/or the surface soil adjacent to the lagoon may have been impacted if an overflow of the feature occurred. It is not known if the soil covers placed over the features are affected. At several locations, there are arroyos/washouts adjacent or within the boundary of the CAS, contamination due to overflow may have impacted the soils and has the potential to have been transported via this feature.

- For the surface discharge CSM for CAS 20-19-02, the affected media is the surface and subsurface soils at the location.

Location of Contamination/Release Points - For the CAU 151 CASs, the presence of COPCs in soils may have resulted from designed or accidental releases as previously discussed and depicted on the CSM (Figure A.1-12 and Figure A.1-13). The location of contamination at the CAU 151 CASs is assumed consistent with the CSM.

Transport Mechanisms - An important element of a CSM is the expected fate and transport of contaminants in the environment. The transport mechanism infers how contaminants move through site media and where they can be expected in the environment. The expected fate and transport is based on distinguishing physical and chemical characteristics of the suspected contaminants and media. Contaminant characteristics include biodegradation potential, solubility, density, and affinity for nonmobile particles (adsorption). Media characteristics include permeability, porosity, hydraulic conductivity, total organic carbon content, 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 are more susceptible to factors that can move them through various media; therefore, can be expected to be found further from release points.

Migration of potential contamination is assumed to be minimal based on the affinity of the COPCs for soil particles, and the low precipitation and high evapotranspiration rates typical of the NTS environment. Run-off could cause lateral migration of contaminants over the ground surface for the release scenarios described. Contaminants may also have been transported by infiltration and percolation of precipitation through soil, that would serve as the primary driving force for downward migration. Mixing of the surface soil as a result of grading or construction activities could also move the COPCs into deeper intervals (e.g., the sumps within CAS 12-47-01). The migration of organic constituents (e.g., petroleum hydrocarbons, PCBs) can be controlled to some extent by their affinity for organic material present in soil. However, this mechanism is considered insignificant because of the lack of organic carbon in the desert soil. Migration of certain inorganic constituents (e.g., metals in waste oil) is controlled by geochemical processes, such as adsorption, ion exchange, and precipitation of solids from solution.

It is assumed that groundwater is not impacted because of its significant depth at the NTS. The groundwater level for CAU 151 are approximately 1,448 ft bgs in Area 2; 2,053 ft bgs in Area 12; 1,081 ft bgs in Area 18; and 2,050 ft bgs in Area 20. The average annual precipitation for the sites is less than 6 in. for Area 2; 8 to12 in. for Area 12; 8 in. for Area 18; and 7 in. for Area 20. Also, the environmental conditions at the NTS (i.e., arid climate, relatively low permeability soils) are not conducive to significant downward migration (DOE/NV, Date Unknown).

Airborne release subsequent to the initial contaminant release is not considered a significant release pathway. The main process of migration through the air would be through windblown dust. The COPCs adsorbed to the fine soil particles and migration could occur via the airborne pathway and this process could result in the deposition of contaminants beyond the CAS boundaries. For all transport mechanisms, it would be expected that contaminant levels decrease with distance from the point of release and distributed consistent with the prevailing wind direction.

Preferential Pathways - Preferential pathways for contaminant migration at the CAU 151 CASs are not expected to be present or have only had a minor impact on contaminant migration. The presence of relatively impermeable layers (e.g., caliche layers, concrete pads) may modify transport pathways both on the ground surface and in the shallow subsurface. Arroyos or washouts, if present, could channelize run-off and increase lateral transport prior to infiltration. When the systems were operational, a breach in distribution piping may have allowed liquids to contaminate soils preferentially along the pipeline due to the disturbed nature of the subsurface soils. Contamination could travel laterally to a small degree under these scenarios. Although the preferential pathways for contaminant migration will be considered in the development of sampling strategies and sampling contingencies discussed in the CAIP, primary consideration will be given to the release and transport mechanisms.

Lateral and Vertical Extent of Contamination - If contamination is present at a CAS, it is expected to be confined to the surface and shallow subsurface at the site. Concentrations of contaminants are expected to decrease with distance (both horizontally and vertically) from the release point(s). For releases at the surface, migration may occur as a result of storm events when precipitation rates exceed infiltration (stormwater run-off). Surface migration is a biasing factor considered in the selection of sampling locations. As stated previously, downward contaminant transport is expected to be limited, but is unknown because the quantities of hazardous material released is unknown. There is an exception for CAS 20-19-02, where the amount and type of contaminants are known; however, the location of the site has not been physically identified. Process knowledge and historical interviews indicate a possible location for this site.

A.1.3 Step 2 – Identify the Decision

Step 2 of the DQO process identifies the decisions statements and defines alternative actions. Also presented is this section is the decision logic for the entire process.

A.1.3.1 Develop Decision Statements

The primary problem statement is: "Existing information on the nature of potential contaminants and, if present, the extent of contamination is insufficient to evaluate and recommend corrective action alternatives for CAS (s)."

Therefore, the following two decision statements have been established for all of the CASs, except for CAS 20-19-02, as criteria for determining the adequacy of the data collected during the CAI to resolve the problem statement.

Because the location of CAS 20-19-02 has not been clearly defined, two Decision I statements have been developed for this CAS. Decision I(a) for CAS 20-19-02 is: "Where is the release location of the surface discharge?" The location of the surface discharge will be identified as any location with detection above PALs for total Ag. Decision I(b) for CAS 20-19-02 is: "Is a COPC present at a concentration that could pose an unacceptable risk to human health and the environment?" Any contaminant detected at a concentration exceeding the corresponding PAL, as defined in Section A.1.4.2, will be considered a COC. The presence of a contaminant within a CAS is defined as the analytical detection of a COC. Samples used to resolve Decision I statements for CAS 20-19-02 are referred to as Decision I(a) and Decision I(b) samples.

There is only one decision statement for all other CASs in CAU 151. Decision I (will be identified as Decision I/I(b) for the document): "Is a COPC present at a concentration that could pose an unacceptable risk to human health and the environment?" Any contaminant detected at a concentration exceeding the corresponding PAL, as defined in Section A.1.4.2, will be considered a COC. The presence of a contaminant within a CAS is defined as the analytical detection of a COC. Samples used to resolve Decision I are referred to as Decision I samples.

A Decision II statement has been developed to satisfy the results of COPCs identified from Decision I/I(b)

Decision II: "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?" Sufficient information is defined as the data needs identified in this DQO to include the lateral and vertical extent all COCs associated with a CAS. Samples used to resolve the decision are identified as Decision II samples.

A.1.3.2 Alternative Actions to the Decisions

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

Alternate action for Decision I(a) for CAS 20-19-02 is: "If the location of the surface discharge is not identified, the stakeholders will reconvene to determine the next course of action for the CAS." If the location is identified, resolve Decision I(b).

During the DQO meeting on March 31, 2004, it was determined that if there was no evidence of contamination to resolve the Decision I(a) statement, a decision would be made for further action at this site. In April 2004, samples were collected to resolve Decision I(a) for CAS 20-19-02, Photochemical Drain. Samples were collected in accordance with the systematic grid-based sampling method developed for this CAS. Two hundred ninety-three samples were submitted from the systematic grid and from biased locations determined from the field conditions and interviews. None of the results presented the evidence of CAS 20-19-02. It was determined by SNJV, NNSA, and NDEP to move this CAS to CAU 5000, Archived Corrective Action Sites, based on the research and results of the systematic grid-based sampling effort. Therefore, Decision I(b) will not be resolved during this investigation.

Alternate action for Decision I and I(b) (as identified as Decision I/I(b) for this document) is: "If a COC is not present, further assessment of the CAS is not required." If a COC is present, resolve Decision II.

Alternate action for Decision II is: "If the extent of the COC is defined in both the lateral and vertical direction, further characterization of the CAS is not required." If the extent of a COC is not defined, re-evaluate site conditions and collect additional samples.

A.1.4 Step 3 – Identify the Inputs to the Decisions

The objectives of Step 3 are to identify the information needed, determine sources for information, determine the basis for establishing action levels, and identify sampling and analysis methods that can meet the data requirements.

To determine if a COC is present, each sample result is compared to a PAL (Section A.1.4.2). Any COPC detected above its corresponding PAL is considered a COC.

A.1.4.1 Information Needs and Information Sources

Table A.1-7 lists the information needs, the source of information for each need, and the proposed methods to collect the data needed to resolve Decisions I(a), I/I(b), and II, as well as the QA/QC data type. The data type is determined by the intended use of the resulting data in decision making. Data types are discussed in the Industrial Sites QAPP (NNSA/NV, 2002). All data to be collected are classified into one of three measurement quality categories: quantitative, semiquantitative, and qualitative. Additionally, the status of obtaining the data needed is presented in the last column of Table A.1-7.

To determine the location of the surface release for the Decision I(a) statement for CAS 20-19-02, a systematic grid-based sampling method has been developed to identify a hot spot based on historical interviews and process knowledge. This method was developed using Visual Sample Plan software (PNNL, 2002) of a 396 by 528 ft area assuming a hot spot with a 15 ft radius in Area 20 Camp that conservatively encompasses the probable location of the surface discharge. Based on inputs, 270 sample locations were generated using a triangular grid. Assumptions about the area developed using methods from Gilbert (1987) are the following:

- The target (hot spot) is circular, the measurements (sample locations) are taken on a triangular grid.

Table A.1-7
Information Needs and Status to Resolve Decisions I and II
(Page 1 of 2)

Information Need	Information Source	Collection Method	Data Type/Metric	Status
Decision I(a): Determine the location of the surface discharge.				
Source and location of release points	Analytical results to identify hot spot	Perform sampling as determined by parameters, review, and interpret the results of the effort.	Quantitative - Sampling results will be submitted for laboratory analysis by ICP.	A systematic grid-based sampling event with a 95% confidence interval is proposed for this location to determine the location of the surface discharge at CAS 20-19-02.
Decision I/I(b): Determine if a COC is present. Criterion 1: 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. Complete for all CASs with the exception of CAS 20-19-09 where information is collected, but location of the discharge is unknown.	Qualitative - At present, CSM is assumed to be accurate.	Further investigation and background is being compiled about CAS 20-19-02 to determine the location.
	Site visit and field observations	Conduct site visits and document field observations.	Qualitative - At present, CSM is assumed to be accurate.	All sites have been visited, and it has been determined that further geophysical surveys shall be completed on CAS 12-04-03 to locate Septic System #2 and on CAS 18-99-03 to determine if the VCP ties in with any adjacent systems. During the field visit, it was observed that features are not locatable at CAS 12-47-01 to include one manhole on the southwestern portion of the site and the exact locations of the sumps are not clearly defined. Further site visits to confirm engineering drawings will be performed to verify. Additional information is being compiled about CAS 20-19-02 to determine the location.
	Aerial photographs	Review and interpret aerial photographs.	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3.	Completed.
	Radiological Survey	Review and interpret radiological surveys.	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3.	Completed.
	Geophysical Survey	Review and interpret survey results.	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3.	Geophysical surveys completed at applicable CASs. Additional locations have recently been identified for surveys to verify presence of systems that are conflicting between historical documentation and engineering drawings.
	Video Mole Survey	Review and interpret to identify breaches in the systems.	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3.	CAIP Implementation. At present assuming 100% coverage of abandoned lines. Piping currently in use will not be surveyed.

Table A.1-7
Information Needs and Status to Resolve Decisions I and II
(Page 2 of 2)

Information Need	Information Source	Collection Method	Data Type/Metric	Status
Source and location of release points (continued)	Field screening during sampling	Review and interpret field-screening results.	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3.	CAIP Implementation
Decision I/I(b): Determine if a COC is present. (continued) Criterion 2: Analyses must be sufficient to detect any COCs in samples.				
Identification of all potential contaminants	Process knowledge compiled during PA process and previous investigations of similar sites	Information reported in CSM and public reports - no additional data needed.	Qualitative - At present, CSM is assumed to be accurate.	Completed
Analytical results	Data packages	Appropriate sampling techniques and approved analytical methods will be used.	Quantitative - Detection limits will be less than PALs.	Post-CAIP Implementation
Decision II: Determine the extent of a COC.				
Identification of applicable COCs	Data packages	Review analytical results to select COCs.	Quantitative	Post-CAIP Implementation
Extent of Contamination	Field observations	Document field observations.	Qualitative - At present, CSM is assumed to be accurate.	CAIP Implementation
	Field screening	Conduct field screening with appropriate instrumentation.	Semiquantitative - FSRs will be compared to FSLs.	CAIP Implementation
	Decision 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.	Post-CAIP Implementation

- The distance between the grid points is much larger than the actual area sampled or cored, the target will have measurable contamination.

- There will be no measurement misclassification errors (e.g., no errors are made when a hot spot has been hit).

In order to determine if a COC is present at all CASs, the Decision I/I(b) samples must be collected and analyzed following these criteria: (1) samples must be collected in areas most likely to be contaminated, and (2) the analytical suites selected and associated method detection limits must be sufficient to detect a COC below its corresponding PAL. In order to determine the extent of contamination for a COC, Decision II samples will be collected to assess the lateral and vertical extent. Decision II samples will include the same analytical suites as the Decision I samples. The data required to satisfy the information needs for Decision II for each COC is a sample concentration that is below the corresponding PAL.

Biasing factors for sample collection include:

- Previous sample results, if available
- Documented process knowledge on source and location of release
- Experience and data from investigations of similar sites
- Field observations
- Aerial photograph review
- Radiological survey results
- Geophysical survey results
- Field-screening data including VOC, TPH, and radiological (Section A.1.4.3.2)
- Professional judgement

Step-out locations from either Decision I/I(b) or Decision II sample locations will be selected based on the CSM, biasing factors considered above, and FSRs. When FSRs or other biasing factors suggest that the COC concentrations at step-out location(s) may still exceed the PAL, then additional step-out distances will be used to define the lateral extent of contamination. If a location where the PAL is exceeded is surrounded by clean locations, then lateral step-outs may not be necessary. In that case, sampling may consist only of sampling from deeper intervals at or near the original location to determine the vertical extent of contamination.

Vertical extent samples will be collected from depth intervals that will meet DQOs and in a manner that will conserve resources during possible remediation. Biasing factors to support depth interval sampling will be primarily based on FSRs and professional judgement. Sampling locations may be moved due to access problems, underground utilities, or safety issues; however, the modified locations must meet the decision requirements and criteria necessary to fulfill the information needs.

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

Quantitative Data

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

Semiquantitative Data

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

Qualitative Data

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

A.1.4.2 Determine the Basis for the Preliminary Action Levels

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

- EPA *Region 9 Risk-Based Preliminary Remediation Goals* for Industrial Soils (EPA, 2002b).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered the mean plus two times the standard deviation of the mean based on data published in *Mineral and Energy Resource Assessment of the Nellis Air Force Range* (NBMG, 1998; Moore, 1999).
- TPH concentrations above the action level of 100 mg/kg per NAC 445A.2272 (NAC, 2003).
- For COPCs without established PRGs, a protocol similar to EPA Region IX will be used to establish an action level; otherwise, an established PRG from another EPA region may be chosen.
- The PALs for material, equipment, and structures with residual surface contamination are the allowable total residual surface contamination values for unrestricted release of material and equipment listed in DOE Order 5400.5 (DOE, 1993), which is also Table 4-2 of the NV/YMP RadCon Manual (DOE/NV, 2000).
- The PALs for radiological contaminants are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) scaled from 25- to 15-mrem per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). Table A.1-8 provides the radiological PALs.

The selected nonradiological PALs are based on the EPA Region IX Industrial Land Use PRGs (EPA, 2002b). The PRGs are risk-based tools for evaluating and cleaning up contaminated sites that estimate contaminant concentrations in environmental media (soil, air, and water) that EPA considers protective of humans (including sensitive groups) over a lifetime. The toxicity based PALs have been calculated for an industrial-use scenario. The industrial-use scenario is applicable to sites at the NTS

Table A.1-8
Preliminary Action Level Concentrations for Radionuclides

Isotope	PAL (pCi/g)
Am-241	7.62
Cs-137	7.30
Pu-238	7.78
Pu-239/240	7.62
Sr-90	503
Th-230[a]	5/15
Th-232[b]	5/15
U-234	85.9
U-235	10.5
U-238	63.2

References: (NCRP, 1999) and (DOE, 1993)

[a]Th-230 and its daughters Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, and Po-210 are considered to be in equilibrium and will use the DOE 5400.5 general guidance of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples.
[b]Th-232 and its daughters Ra-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Ac-228, Bi-212, Pb-212, Po-212, and Tl-208 are considered to be in equilibrium and will use the DOE 5400.5 general guidance of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples.

based on future land-use scenarios as presented in Section A.1.2.3 and agreements between NDEP and NNSA/NSO.

The conservative level of 100 ppm for TPH is based on the Nevada action limit for hydrocarbon-impacted soil from the State of Nevada and is used as a “clean-up” level (NAC, 2003).

A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods

As discussed in Section A.1.4.1, the collection, measurement, and analytical methods are selected so the results will be generated for all potential contaminants at CAU 151. Sampling and analysis of residual materials such as hold-up in piping, tank contents, etc. is included to support the decision-making process for waste management and to ensure an efficient field program.

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

Total silver will be the only analyte for Decision I(a) samples at CAS 20-19-02 because of the constituents known to be discharged at this site, it has been determined that silver is a defensible indicator of those constituents. The VOC and SVOC compounds expected to be analyzed for in Decision I/I(b) soil samples are listed in Table A.1-9 and Table A.1-10, respectively. The radionuclides, PCBs, and metals compounds expected to be analyzed for in Decision I soil samples are listed in Table A.1-11. The pesticide compounds are listed in Table A.1-12.

Table A.1-9
Analytes Reported from VOC Analysis

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

Table A.1-10
Analytes Reported from SVOC Analysis

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

(a) May be reported with VOCs

A.1.4.3.1 Video-Mole Survey

A video-mole survey of discharge and outfall lines may be conducted to inspect the current physical condition and layout of the CAS distribution systems, as necessary. Video-mole surveys allow a visual assessment of the system's integrity and can be used to identify breaches that may have resulted in a release. Subsurface features may be excavated to gain additional access for inspection or sampling or to introduce the video system. Piping that is currently in use will not be subject to video-mole surveys.

Table A.1-11
Analytes Reported from Radionuclides, PCB, and Metals Analyses

Radionuclides	PCB		Metals	
Gamma-emitting radionuclides	Aroclor-1016	Aroclor-1248	arsenic	lead
Strontium-90	Aroclor-1221	Aroclor-1254	barium	mercury
Uranium- 234, 235, 238	Aroclor-1232	Aroclor-1260	beryllium	selenium
Plutonium- 238, 239/240	Aroclor-1242		cadmium	silver
Tritium			chromium	

Table A.1-12
Analytes Reported from Pesticides Analyses

Pesticides	
alpha-BHC	Dieldrin
gamma-BHC (Lindane)	Endrine
Heptachlor	4,4'-DDD
Aldrin	Endosulfan II
beta-BHC	4.4'-DDT
delta-BHC	Endrin aldehyde
Heptachlor Epoxide	Methoxychlor
Endosulfan I	Endosulfan sulfate
gamma-chlordane	Endrin ketone
alpha-chlordane	Toxaphene
4,4'-DDE	

A.1.4.3.2 Field Screening

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

- Alpha and Beta/Gamma Radiation - a handheld radiological survey instrument or method will be used based on the possibility that radiologically contaminated or elevated measurements (i.e., hot spots) are present in soil, concrete, or other materials. If determined appropriate, on-site gamma spectroscopy or an equivalent instrument or method, may also be used to screen samples. The FSL for samples is the mean background activity plus two times the standard deviation of the mean background activity.

- VOCs - a photoionization detector (PID), or equivalent instrument or method, will be used for field screening of VOCs at the CAU 151 CASs. If PID results greater than 10 ppm are encountered, then headspace field screening will be performed. The FSL for the headspace analysis is 20 ppm or 2.5 times background, whichever is greater.

- 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 be in decontamination rinsate. The FSL for TPH is 75 ppm.

The techniques and FSLs are based on the applications for other CAU investigations and common NTS practices. These field-screening techniques will provide semiquantitative data that can be used to guide confirmatory soil sampling activities and waste management decisions.

A.1.4.3.3 Sampling Methods

Hand sampling, augering, direct-push, excavation, drilling, or other appropriate sampling methods will be used to collect soil samples. Sample collection and handling activities will only be conducted in accordance with approved Standard Quality Practices (SQPs). It may be appropriate to use excavation in selected areas to determine if contaminated soil has been covered with clean fill. The following details the components involved in the investigation at CAU 151.

Based on the results of the video-mole survey, piping will be excavated at points of suspected residual hold-up or breaches and visually inspected. If an adequate volume of residual material is present and accessible, samples will be collected. Soil beneath detectable breaches also will be sampled.

Liquid and sludge material in septic tanks will be sampled using a Composite Liquids Waste Sampler (COLIWASA) (with extensions as necessary), bailer, bacon bomb sampler, or similar device. An attempt will be made to collect a column sample that represents the entire depth of the liquid phase and then a separate column sample representing the entire depth of the solid phase. In the event that the tank contents are dry, a long-handled tool such as a rake or shovel may be used. Contents in distribution boxes, manholes, and cleanouts will be sampled in a similar manner.

For lagoons and ponds that have not been filled in, the sampling method will be surface and subsurface collection via hand auger or backhoe for locations that extend past the use of hand augers. The proximal, distal, midpoint, and lowest point will be sampled from within the feature. Lagoons, ponds, and sumps that have been filled in will have a cross section excavated to determine the horizons and the native soil interface. At these locations, the proximal, distal, and midpoint will be sampled. Soils with apparent staining will be sampled and the horizon below the feature will be sampled. If historical or engineering drawings provide information about engineered low points, they will be sampled.

For CAS 20-19-02, a systematic sampling method to determine a hot spot has been developed using Visual Sample Plan software (PNNL, 2002) around a potential biased location. The methodology assumes a sample area of 396 by 528 ft and the surface discharge (hot spot) has a 15-ft radius. The samples will be gridded in a triangular pattern and will be approximately 29 ft apart. The samples will be collected using hand collection method.

A.1.4.3.4 Analytical Methods

The analytical program for CAU 151 CASs shown in Table A.1-13 has been developed based on the COPC information presented in Section A.1.1 and summarized in Table A.1-1. Section 3.0 and Section 6.0 of the CAIP provide additional analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) to be followed during this CAI. Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory requirements. Analytical requirements (e.g., methods, detection limits, precision, and accuracy) are specified in the Industrial Sites QAPP (NNSA/NV, 2002), unless superseded by the CAIP. These requirements will ensure that laboratory analyses are sufficient to detect contamination in samples at concentrations exceeding the minimum reporting level (MRL). Specific analyses, if any, required for the disposal of IDW are identified in Section 5.0 of the CAIP.

A.1.5 Step 4 - Define the Study Boundaries

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

A.1.5.1 Define the Target Population

Decision I(a) target populations are represented by a systematic grid as defined by known parameters to identify a hot spot and using Ag as an indicator of contamination. Decision I/I(b) target populations represent locations that are most likely to contain COCs and residual materials in piping, tanks, and other features. Decision II target populations include vertical delineation of COCs at Decision I/I(b) sample locations if suspected based on exceedance of FSLs, COC concentrations at the perimeter of CAS investigation area(s) to assess nature and extent of COCs, and step-out locations adjacent to Decision II sample locations if biasing factors indicate COC concentrations extend beyond the present investigation area of a CAS. The target population for Decision II step-out locations are COC concentrations in samples adjacent to contaminated areas that are less than PALs.

Table A.1-13
Analytical Methods for Laboratory Analysis

Analytical Parameter	Analytical Method	
	Liquid	Soil/Sediment/Sludge
Volatile Organic Compounds	SW-846 8260B[a]	SW-846 8260B[a]
Semivolatile Organic Compounds	SW-846 8270C[a]	SW-846 8270C[a]
RCRA Metals plus beryllium	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)
Pesticides	SW 846-8081[a]	SW-846 8081[a]
Asbestos	NA	Visual Inspection of Piping
Gamma Spectroscopy (to include Cesium-137, Americium-241, Cobalt-60)	EPA Procedure 901.1[b]	HASL-300[c]
Strontium-90	ASTM D5811-00[d]	HASL-300[c]
Tritium	EPA 906.0	Lab Specific
Isotopic Plutonium	ASTM D3865-02[e]	ASTM HASL-300[f]
Isotopic Uranium	ASTM D3972-02[g]	ASTM C1000-00[h]

ASTM = American Society for 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* (DOE, 1997)
[d]*Standard Test Method for Strontium-90 in Water* (ASTM, 2000)
[e]*Standard Test Method for Plutonium in Water* (ASTM, 2002)
[f]*General Radiochemistry and Routine Analytical Services Protocol* (GRASP) (EG&G, Rocky Flats, 1991). The chemical yield only applies to plutonium, uranium, and strontium.
[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 Spectroscopy* (ASTM, 2002c)

A.1.5.2 Identify the Spatial and Temporal Boundaries

The spatial boundaries (geographic) boundaries are defined as the expected maximum vertical or horizontal extent of COCs. Intrusive sampling activities are not intended to extend into the boundaries of neighboring areas of environmental concern (e.g., other CASs). The horizontal boundaries at each CAS reflects the investigation area (i.e., the suspected lateral extent of contamination) where COCs potentially exist. The spatial boundaries as presented in Table A.1-14 may be further refined based on visual inspection of the CASs.

Temporal boundaries are time constraints due to time-related phenomena, such as weather conditions, seasons, activity patterns, etc. Significant temporal constraints due to weather conditions are not expected; however, snow events may affect site activities during winter months. Moist weather may place constraints on sampling and field screening of contaminated soils because of the attenuating effect of moisture in samples. There are no time constraints on collecting samples.

A.1.5.3 Identify Practical Constraints

The primary practical constraints anticipated at the CASs are the presence of underground utilities, posted contamination area requirements, physical barriers (e.g., fences) and areas requiring access authorization. Utility 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. Additionally, piping that is still in use will not be video surveyed or sampled. No other practical constraints have been identified.

A.1.5.4 Define the Scale of Decision Making

For CAU 151, the scale of decision making for Decision I(a) and Decision I/I(b) are defined as presence of COCs. The scale of decision making for Decision II is defined as the extent of COC contamination originating from individual CASs.

A.1.6 Step 5 – Develop a Decision Rule

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

A.1.6.1 Specify the Population Parameter

The population parameter for Decision I(a) at CAS 20-19-02 is data collection from the systematic grid sampling event to identify a hot spot with a given dimension with concentrations above PALs for silver.

Table A.1-14
Decisions I and II Spatial Boundaries
(Page 1 of 2)

CAS	Spatial Boundaries
CAS 02-05-01, UE-2ce Pond	For lagoons, sumps, and ponds: Locations for Decision II samples are not to exceed 20 ft from feature, and for step-out locations not to exceed 20 ft from feature and 100 ft in the arroyo or washout.
CAS 12-03-01, Sewage Lagoons (6)	For lagoons, sumps, and ponds: Locations for Decision II samples are not to exceed 20 ft from feature, and for step-out locations not to exceed 20 ft from feature and 100 ft in the arroyo or washout. For piping, distribution boxes, cleanouts, and manholes: Decision II samples will be collected at Decision I locations laterally and vertically where the FSRs are below FSLs not to exceed 20 ft from feature. For Decision II step-out samples, the boundary is not to exceed 20 ft laterally or vertically.
CAS 12-04-01, Septic Tanks	For septic tanks: Locations for Decision II samples are not to exceed 20 ft from feature, and for step-out locations not to exceed 20 ft from feature and 100 ft in the arroyo or washout. For piping, distribution boxes, cleanouts, and manholes: Decision II samples will be collected at Decision I locations laterally and vertically where the FSRs are below FSLs not to exceed 20 ft from feature. For Decision II step-out samples, the boundary is not to exceed 20 ft laterally or vertically.
CAS 12-04-02, Septic Tanks	For septic tanks: Locations for Decision II samples are not to exceed 20 ft from feature, and for step-out locations not to exceed 20 ft from feature and 100 ft in the arroyo or washout. For piping, distribution boxes, cleanouts, and manholes: Decision II samples will be collected at Decision I locations laterally and vertically where the FSRs are below FSLs not to exceed 20 ft from feature. For Decision II step-out samples, the boundary is not to exceed 20 ft laterally or vertically.
CAS 12-04-03, Septic Tanks	For septic tanks: Locations for Decision II samples are not to exceed 20 ft from feature, and for step-out locations not to exceed 20 ft from feature and 100 ft in the arroyo or washout. For piping, distribution boxes, cleanouts, and manholes: Decision II samples will be collected at Decision I locations laterally and vertically where the FSRs are below FSLs not to exceed 20 ft from feature. For Decision II step-out samples, the boundary is not to exceed 20 ft laterally or vertically.

Table A.1-14
Decisions I and II Spatial Boundaries
(Page 2 of 2)

CAS	Spatial Boundaries
CAS 12-47-01, Wastewater Pond	For lagoons, sumps, and ponds: Locations for Decision II samples are not to exceed 20 ft from feature, and for step-out locations not to exceed 20 ft from feature and 100 ft in the arroyo or washout. For piping, distribution boxes, cleanouts, and manholes: Decision II samples will be collected at Decision I locations laterally and vertically where the FSRs are below FSLs not to exceed 20 ft from feature. For Decision II step-out samples, the boundary is not to exceed 20 ft laterally or vertically.
CAS 18-03-01, Sewage Lagoon	For lagoons, sumps, and ponds: Locations for Decision II samples are not to exceed 20 ft from feature, and for step-out locations not to exceed 20 ft from feature and 100 ft in the arroyo or washout. For piping, distribution boxes, cleanouts, and manholes: Decision II samples will be collected at Decision I locations laterally and vertically where the FSRs are below FSLs not to exceed 20 ft from feature. For Decision II step-out samples, the boundary is not to exceed 20 ft laterally or vertically.
CAS 18-99-09, Sewer Line (Exposed)	For piping, distribution boxes, cleanouts, and manholes: Decision II samples will be collected at Decision I locations laterally and vertically where the FSRs are below FSLs not to exceed 20 ft from feature. For Decision II step-out samples, the boundary is not to exceed 20 ft laterally or vertically.
CAS 20-19-02, Photochemical Drain	The systematic grid sampling to determine the location of the hot spot, an area of 396 by 528 ft has been identified for Decision I(a). Locations for Decision I(b) and II samples are not to exceed 20 ft vertically and 100 ft laterally from the gridded area of concern.

The population parameter for Decision I/I(b) data collected from biased sample locations is the maximum observed concentration of each COPC within the target population. For radiological surveys, the maximum observed activity of each COPC is considered the population parameter. If radiological sampling and analysis is performed to support the radiological survey results, the maximum observed activity of each COPC identified in the sample will be the population parameter. Radiological sampling and analysis will supersede radiological survey results.

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

A.1.6.2 Choose an Action Level

Action levels are defined as the PALs, that are specified in Section A.1.4.2.

A.1.6.3 Decision Rule

These decision rules have been developed to combine the decision statement, parameter of interest, scale of decision making, and action level into a statement that describes the conditions that would lead to a specific regulatory response action.

For CAS 20-19-02 there was a Decision I(a) statement derived to address and define the location of the surface release. If there is total Ag detected in Area 20 Camp, then nature [Decision I(b)] of the surface discharge will be determined. If there are no total Ag results of the systematic grid-based sampling above PALs, then the stakeholders will reconvene and decide the next course of action for CAS 20-19-02.

As discussed in Section A.1.3.2, based on the results of the Decision I(a) sampling at CAS 20-19-02, the location of the photochemical drain was not identified. The stakeholders (i.e, SNJV, NNSA, NDEP) agreed that a no further action strategy would be set for CAS 20-19-02 and Decision I(b) would not be resolved.

If the concentration of any COPC in a target population exceeds the corresponding PAL in a Decision I/I(b) or Decision II sample, then that COPC is identified as a COC. If all COPC concentrations are less than the corresponding PALs, then the decision will be no further action.

If the observed population parameter of any COC in a Decision II sample exceeds the PALs, then samples will be collected to define the extent of contamination. 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 vertical directions.

If contamination is inconsistent with the CSM or extends beyond the identified spatial 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 extent.

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

The sampling approach for the investigation relies on biased sampling locations (judgemental data collection) for all CASs except CAS 20-19-02 Decision I(a) samples. For Decision I(a) samples at CAS 20-19-02, a systematic grid-based sampling method has been developed. Only validated analytical results (quantitative data) will be used to determine if COCs are present (Decision I/I[b]) or the extent of a COC (Decision II), unless otherwise stated. The baseline condition (i.e., null hypothesis) and alternative condition for Decision I(a) for CAS 20-19-02 are:

- Baseline condition – The location of the surface release cannot be identified.
- Alternative condition – The location of the surface release can be identified.

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

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

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

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

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

A.1.7.1 False Negative (Rejection) Decision Error

The false negative (rejection of the null hypothesis or alpha error) decision error would mean:

- Deciding that the location of the surface discharge is not present when it actually is (Decision I[a])

- Deciding that a COC is not present when it actually is (Decision I/I[b])

- Deciding that the extent of a COC has been defined when it actually has not (Decision II)

In all cases, this would result in an increased risk to human health and environment.

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

- Having a high degree of confidence that the systematic grid-based sampling method has been developed with an adequate confidence interval (95 percent) and hot spot size to determine the location of the surface discharge.
- Having a high degree of confidence that Decision I(a) analyses selected for total Ag will be sufficient to detect the surface discharge.

For Decision I/I(b), a false negative decision error (where the consequences are more severe) is controlled by meeting the following criteria:

- Having a high degree of confidence that the Decision I/I(b) sample locations selected will identify COCs (above PALs) if present at the CAS.
- Having a high degree of confidence that Decision I/I(b) analyses selected will be sufficient to detect COCs present in the sampled media (results above PALs) to ensure an accurate quantification of the COCs.

For Decision II, the false negative decision error is reduced by:

- Having a high degree of confidence that the Decision II sample locations selected will identify the extent of COCs.
- Having a high degree of confidence that Decision II analyses conducted will be sufficient to detect any COCs present in the samples.
- Having a high degree of confidence that the dataset is of sufficient quality and completeness.

To satisfy the first criterion for both decisions, Decision I/I(b) biased samples will be collected in areas most likely to be contaminated by COPCs. The Decision II samples will be collected in areas that potentially represent the lateral and vertical extent of COCs. The following characteristics are considered to accomplish the first criterion:

- Accurate knowledge of the source and location of release
- Understanding of the chemical nature and fate properties of the COPCs
- Physical properties of the media and migration/transport pathways
- Hydrologic drivers

These characteristics were considered during the development of the CSM. 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 for all samples used to define the nature and extent of contamination will be analyzed for the parameters listed in Section A.1.4.3.4. Analytical methods that are capable of producing quantitative data at concentrations equal to or below PALs will be used (unless stated otherwise in the CAIP).

To satisfy the third criterion for Decision II, 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 completeness DQI is that 80 percent of the COPC results are valid for every sample. The COPCs are defined as those contaminants that may realistically be present within a CAS (Section A.1.4.3.4). 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 protocols also protects against false positives.

A.1.7.2 False Positive Decision Error

The false positive (acceptance of the null hypothesis or beta) decision error would mean:

- Deciding that the location is present when it actually is not (Decision I[a])
- Deciding that a COC is present when it actually is not (Decision I/I[b])
- Accepting that the extent of a COC has not been defined when it really has (Decision II)

These errors result in increased costs for unnecessary characterization or corrective actions.

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

A.1.7.3 Quality Assurance/Quality Control

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 Site QAPP (NNSA/NV, 2002) and in accordance with established procedures. The required QC field samples include:

- Trip blanks (1 per sample cooler containing environmental VOC samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per source lot per sampling event)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples or 1 per CAS if less than 20 collected)
- Field blanks 1 per CAS or 1 per day or change in field conditions
- Matrix spike/matrix spike duplicate (minimum of 1 per matrix per 20 environmental samples) or 1 per CAS if less than 20 collected as required by the analytical method.

Additional QC samples may be submitted based on site-specific conditions.

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

This section presents an overview of the resource-effective strategy planned to obtain the data required to meet the project DQOs. As additional data or information is obtained such as that identified in Table A.1-7, this step will be reevaluated and refined, as necessary, to reduce uncertainty and increase the confidence that the nature and extent is accurately defined.

A.1.8.1 General Investigation Strategy

Intrusive soil and/or sludge sampling for field screening and laboratory analysis will be conducted at the CAU 151 CASs when media is available to sample. A judgemental or biased sampling design (a nonprobabilistic approach) has been developed for the general investigation strategy based on the *Work Plan for Leachfield Corrective Action Units: Nevada Test Site and Tonopah Test Range, Nevada* (DOE/NV, 1998a) for all of the CASs in CAU 151 with the exception of CAS 20-19-02. At

CAS 20-19-02 a systematic grid-based sampling method to identify a hot spot has been developed for Decision I(a) samples to identify the area of concern and then a judgemental or biased sampling design (a nonprobabilistic approach) will be used for Decision I/I(b) and II samples. The biased sampling approach for the remainder of the CASs will focus on specific sampling locations to support the decision statements presented in Section A.1.3 and the migration and release pathways identified in the CSMs. Chapter 7 of the EPA QA/G-4HW guidance document (EPA, 2000a) allows for judgmental (biased) sampling when chosen locations are based on expert knowledge.

The Decision I(a) locations for CAS 20-19-02, will be identified using a systematic grid-based sampling method for a hot spot plan. These samples are needed to identify the location and verify that the CAS (area with no biasing factors upon which to base the selection of a sampling location) does not pose an unacceptable risk to human health and the environment. A systematic grid-based sampling method has been developed using Visual Sample Plan software (PNNL, 2002) to determine the number and location of surface soil samples to be collected to adequately identify the location of CAS 20-19-02, Photochemical Drain.

The Decision I/I(b) locations for biased sampling will be determined based on biasing factors listed in Section A.1.4.1, the CSM, and the target populations as detailed in Section A.1.5. The selected biased locations may be modified during the CAI, but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.4.1.

Decision II biased sampling locations at each CAS are based on Decision I/I(b) locations. If biasing factors indicate COCs extend beyond the proposed Decision II biased sample locations, further incremental step-out locations will be selected and samples may be collected without support of analytical results. In the event that step-out locations from different components or elements in a CAS approach each other, then the area will be considered as one area and samples would be collected only in an outward direction.

If there is no residue present and the system has not been breached, then there will be no samples collected from the location. Additionally, breaching systems may be necessary to completely evaluate the integrity of the site. In this case, samples will be collected to ensure that the breach has not released any constituents into the environment.

A.1.8.2 Detailed Investigation Strategy

The following sections discuss the approach for obtaining the information necessary to resolve the DQOs based on the CSM. The strategy may be further revised based on upcoming field inspections, geophysical surveys, and radiological surveys. Target populations to be sampled are detailed in Section A.1.5.1. The proposed sampling locations for Decision I/I(b) are illustrated for each CAS in Figure A.1-14 through Figure A.1-22.

A.1.8.2.1 Piping

Piping is common in all the CASs with the exception of CASs 02-03-01 and CAS 20-19-02. Sampling activities at CASs with piping will consist of video-mole survey of abandoned piping adjacent to a feature in the CAS to identify breaches or residual material. Site conditions and conditions of the piping may not allow 100 percent video survey. If the video survey identifies breaches and/or conditions that may have provided a means for effluent to reach the surrounding soils, then Decision I samples may be collected at those locations for laboratory analysis. If no breaches or residual material is identified during the survey, then Decision I sampling adjacent to and within the buried portions of the pipelines will not be necessary.

A.1.8.2.2 Manholes, Cleanouts, and Distribution Boxes

Corrective Action Site 12-03-01 has a covered distribution box that directed effluent to the lagoons, and CASs 12-47-01 and 18-03-01 has manhole/cleanouts along the piping that head into the sewage lagoons. Decision I activities at these CASs will consist of excavating (as appropriate) to locate the distribution box, manhole, and/or cleanout for collecting Decision I samples for laboratory analysis of residual contents in the feature (if present). Decision I soil samples will be collected beneath the inlet and outlet piping of the features if breaches are suspected and the soil horizon underlying the base of the box. Residual material, including soil, sludge, or water, in these features will be sampled, if present. Only the inactive features will be sampled and accessed for the purposes of this investigation. If a feature is broken or breached in a way that a release may have occurred, then samples will be collected from below the feature to ensure that a release has not occurred that may impact the environment. Decision II samples vertically from the base will be collected based on FSL exceedances and at additional locations encompassing the features.

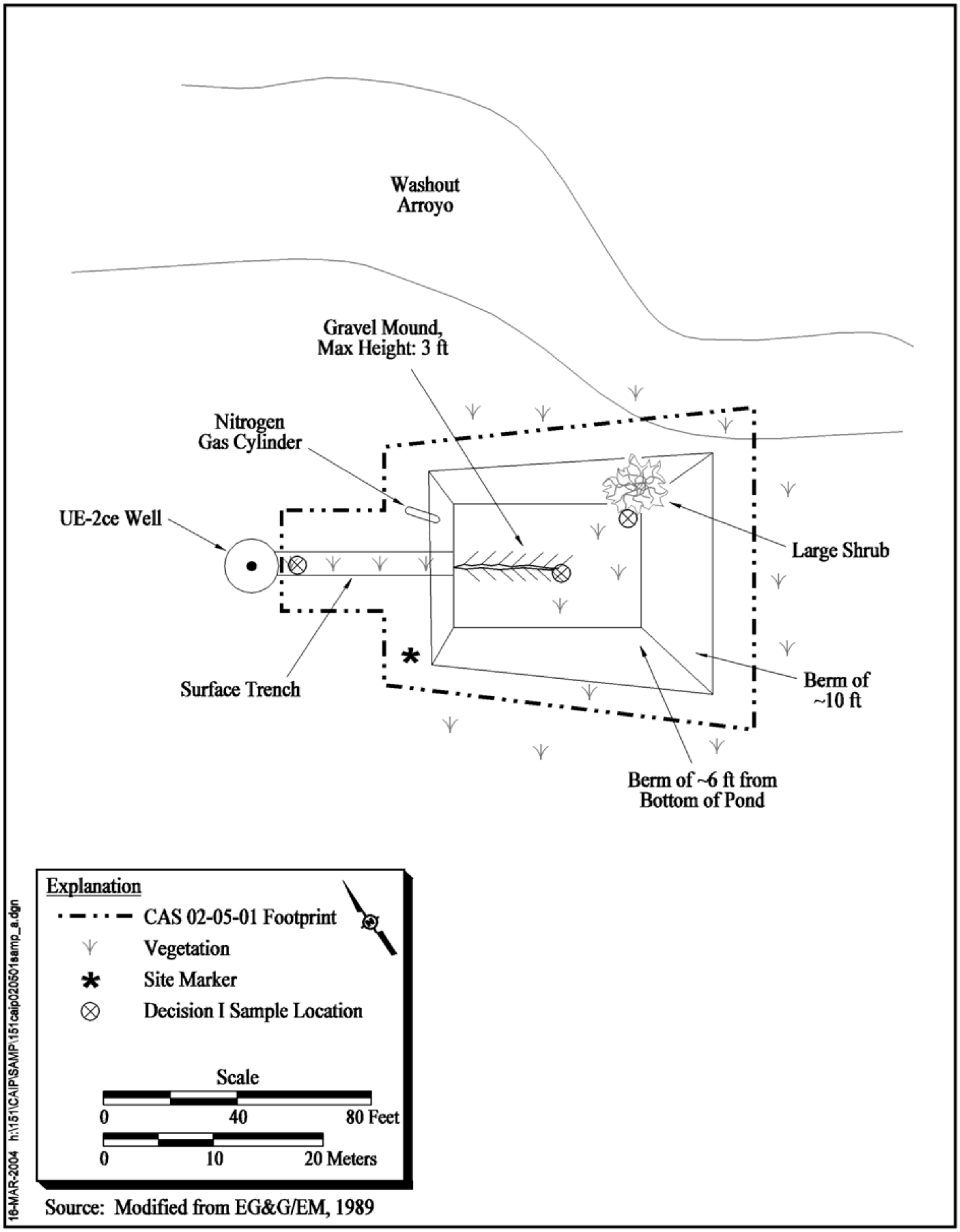


Figure A.1-14
CAU 151, CAS 02-05-01 Sample Locations

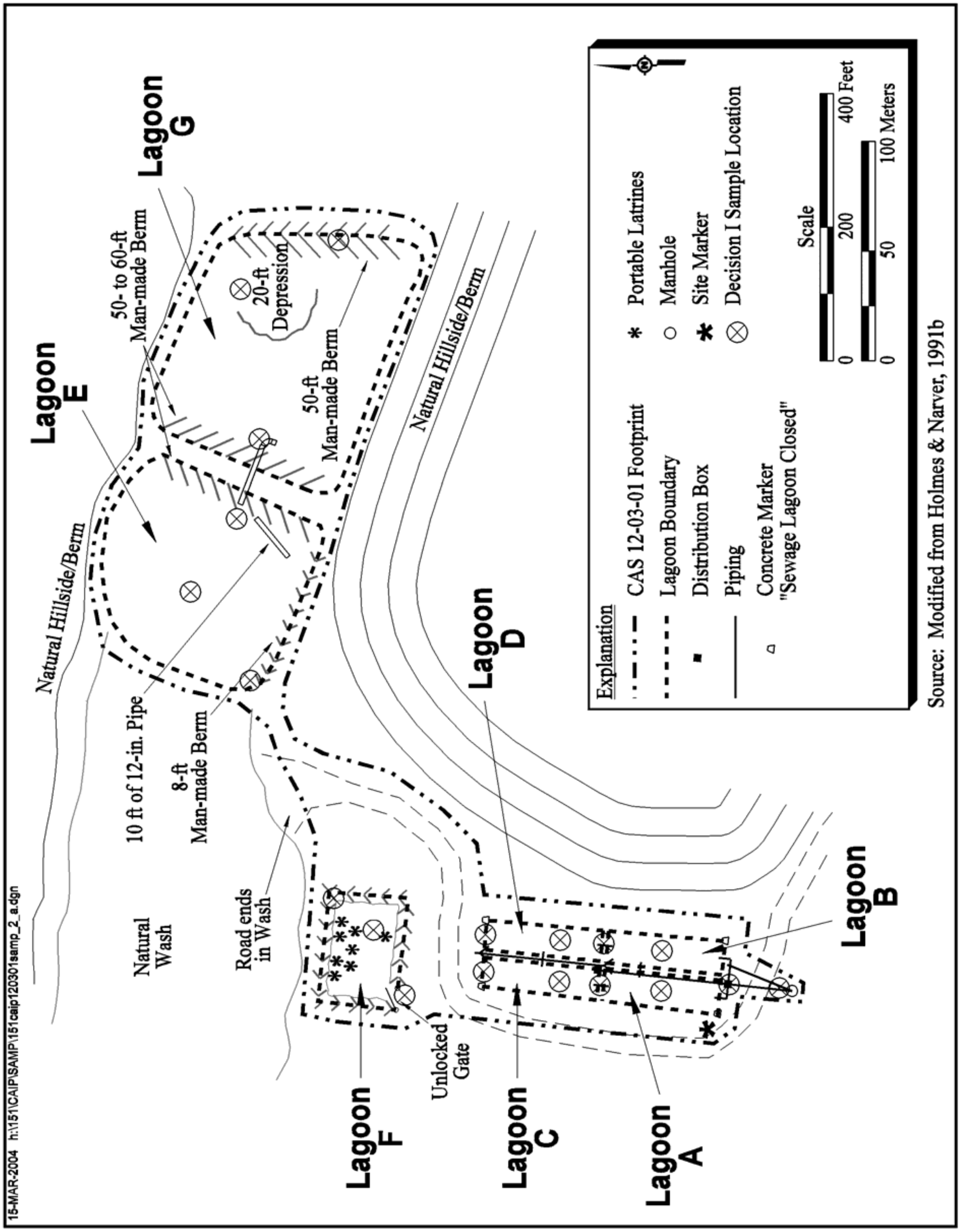
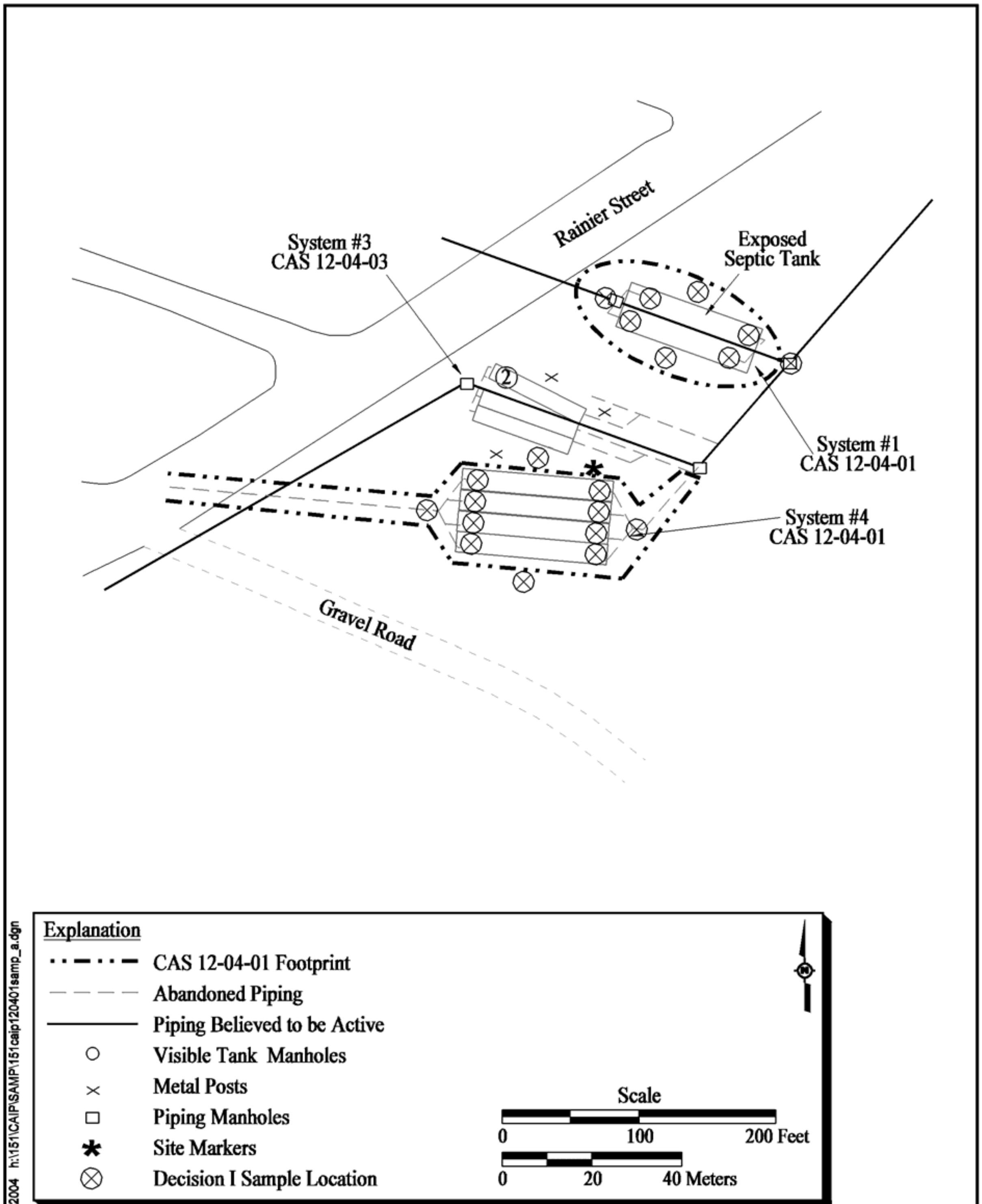


Figure A.1-15
CAU 151, CAS 12-03-01 Sample Locations



Source: Modified from Shaw, 2002; REECo, 1967a, and 1995

Figure A.1-16
CAU 151, CAS 12-04-01 Sample Locations

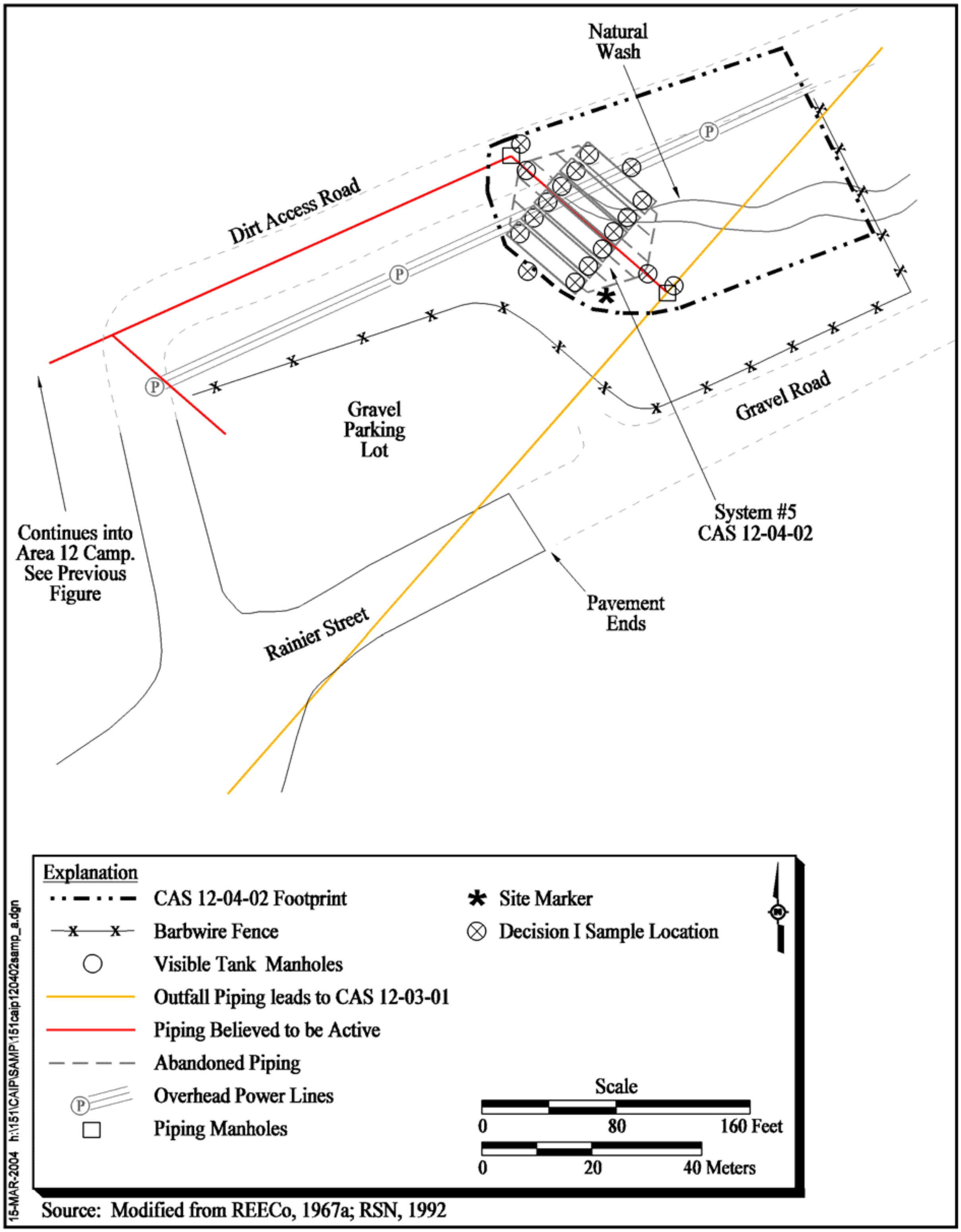


Figure A.1-17
CAU 151, CAS 12-04-02 Sample Locations

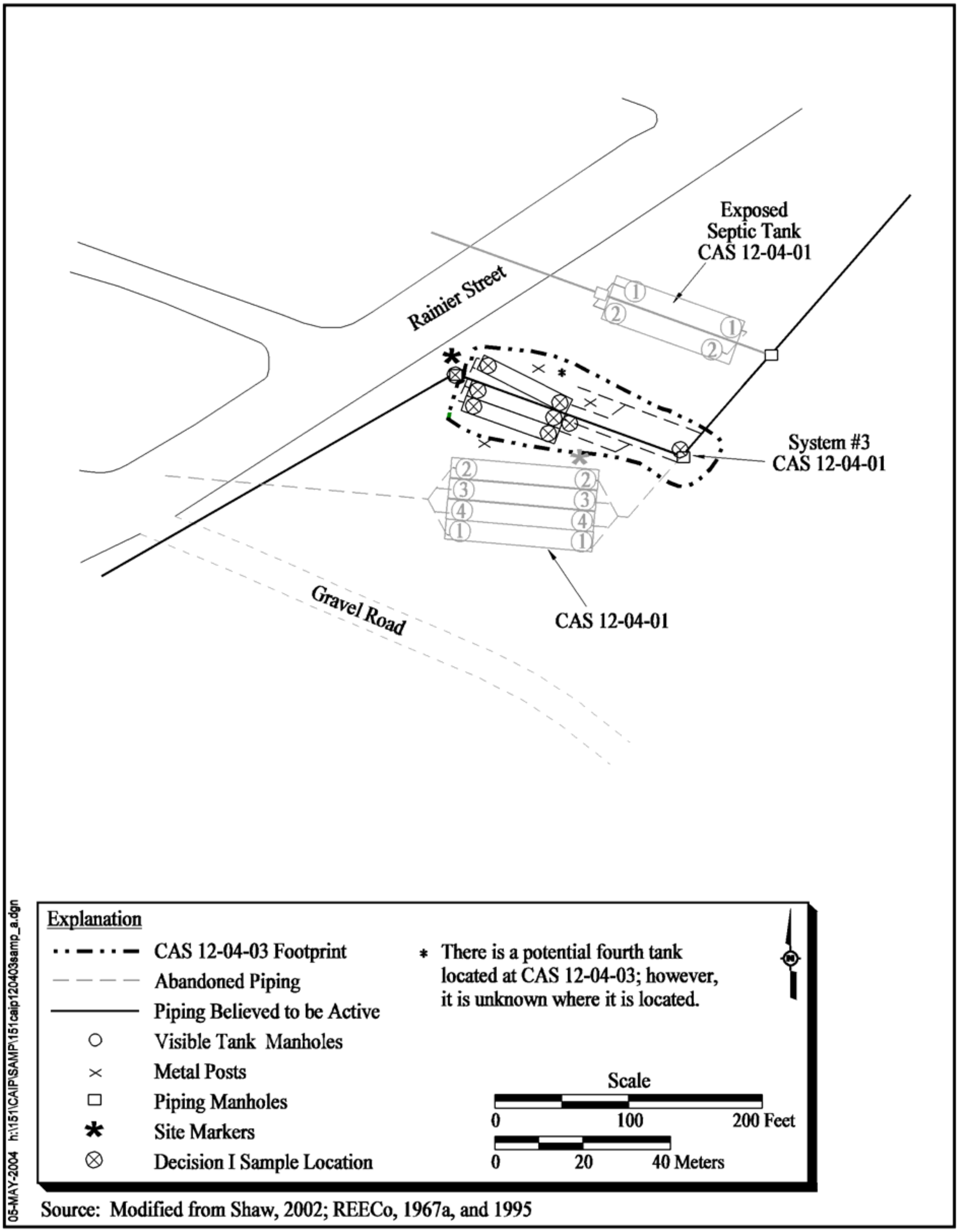


Figure A.1-18
CAU 151, CAS 12-04-03 Sample Locations

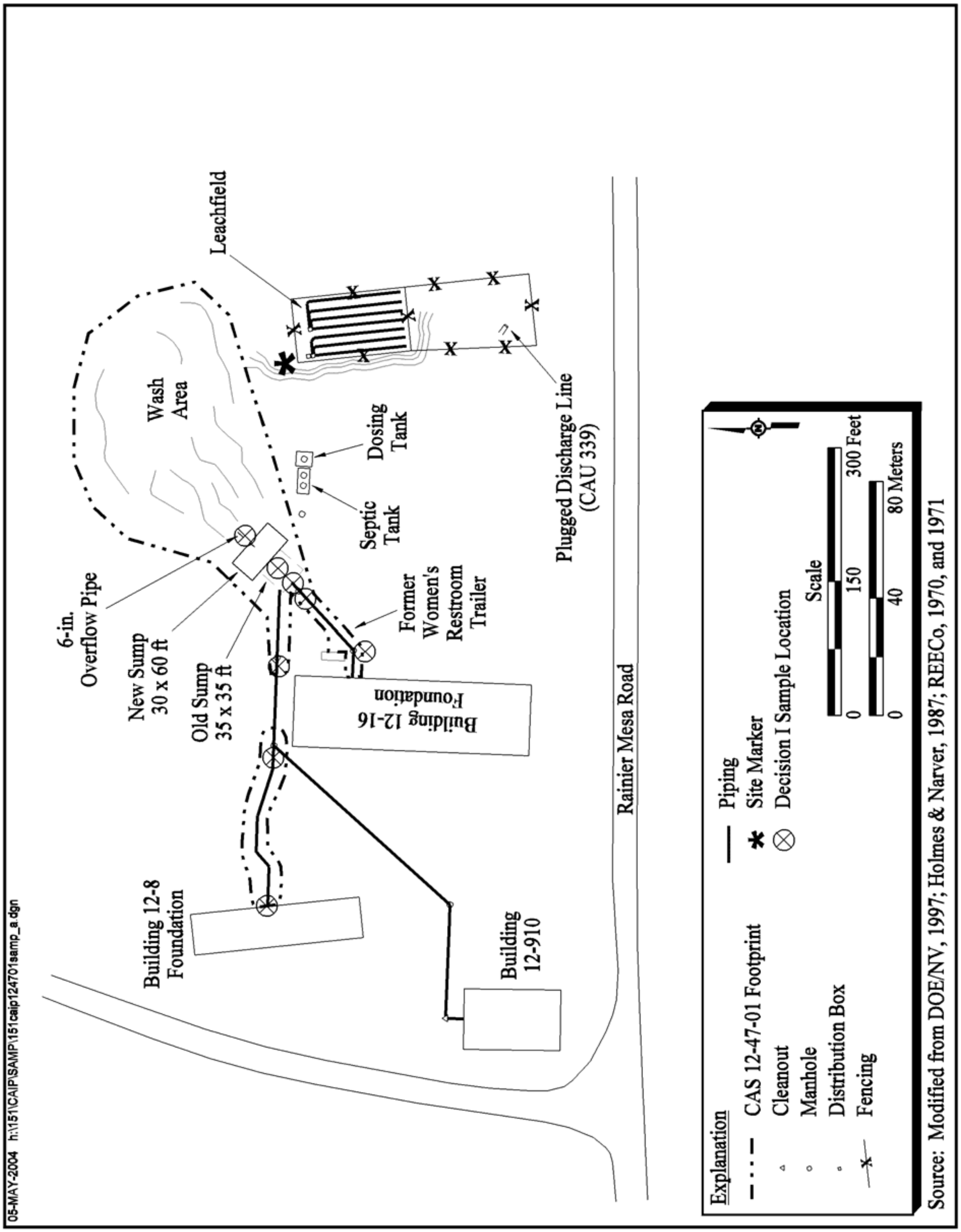


Figure A.1-19
CAU 151, CAS 12-47-01 Sample Locations

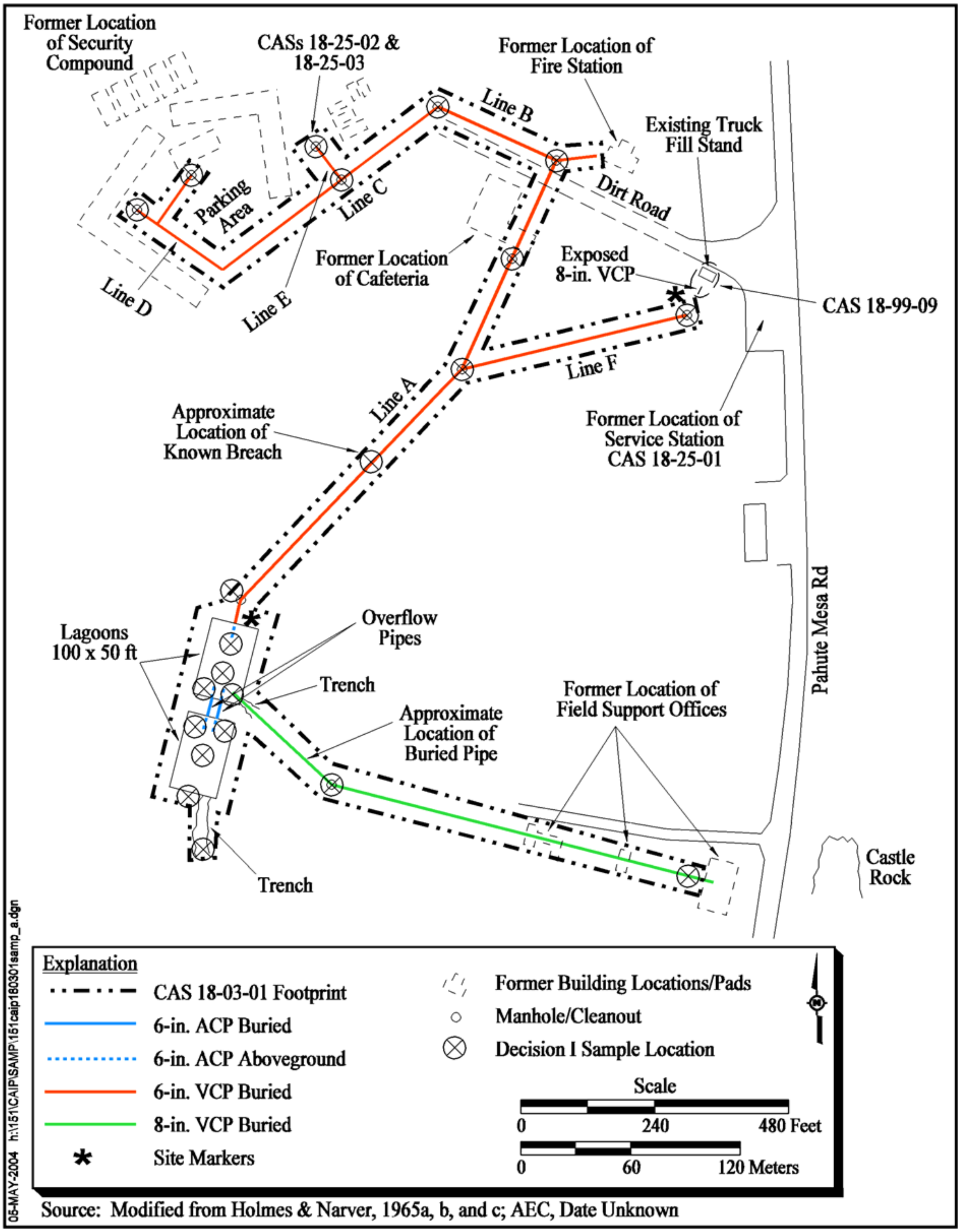


Figure A.1-20
CAU 151, CAS 18-03-01 Sample Locations

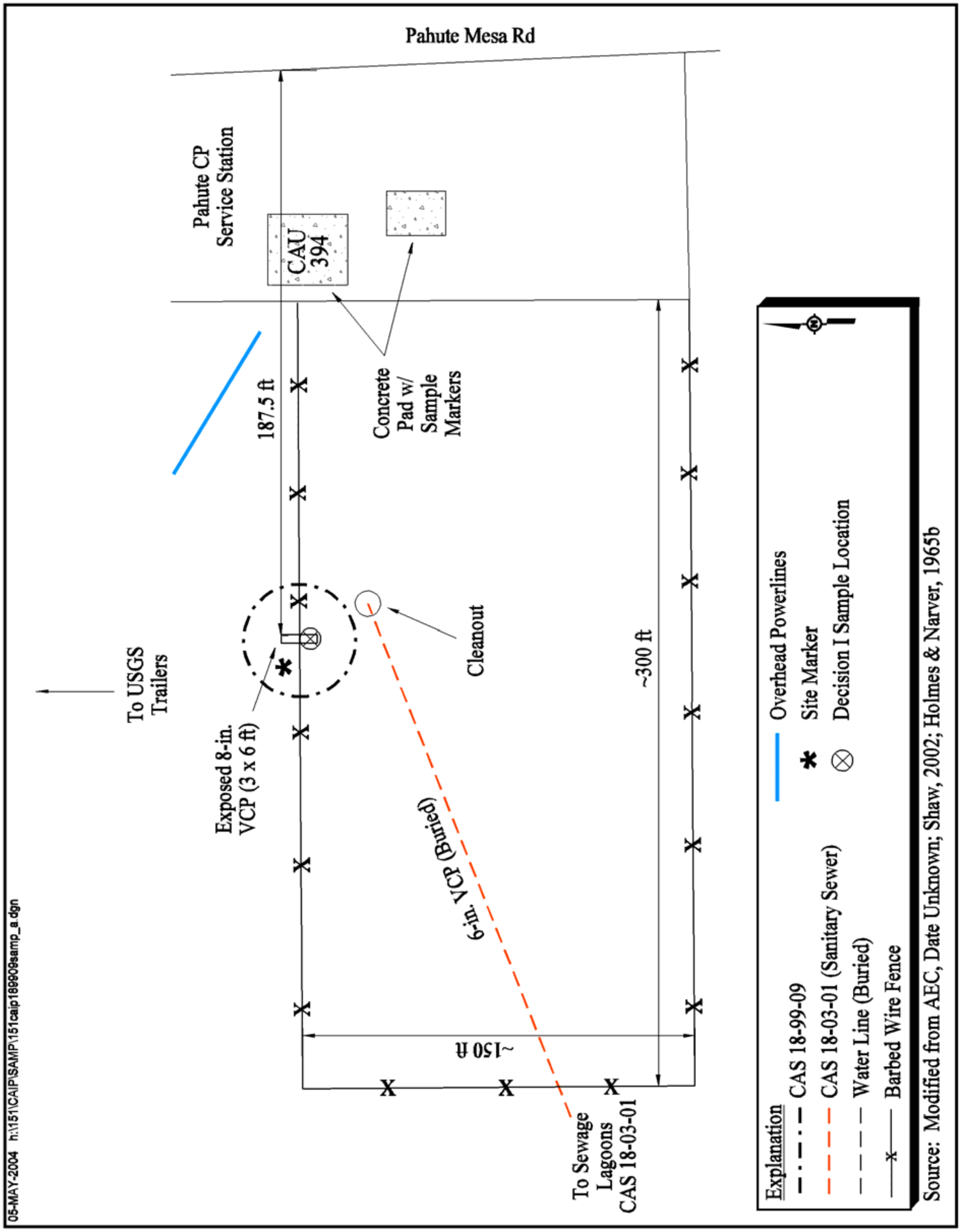


Figure A.1-21
CAU 151, CAS 18-99-09 Sample Locations

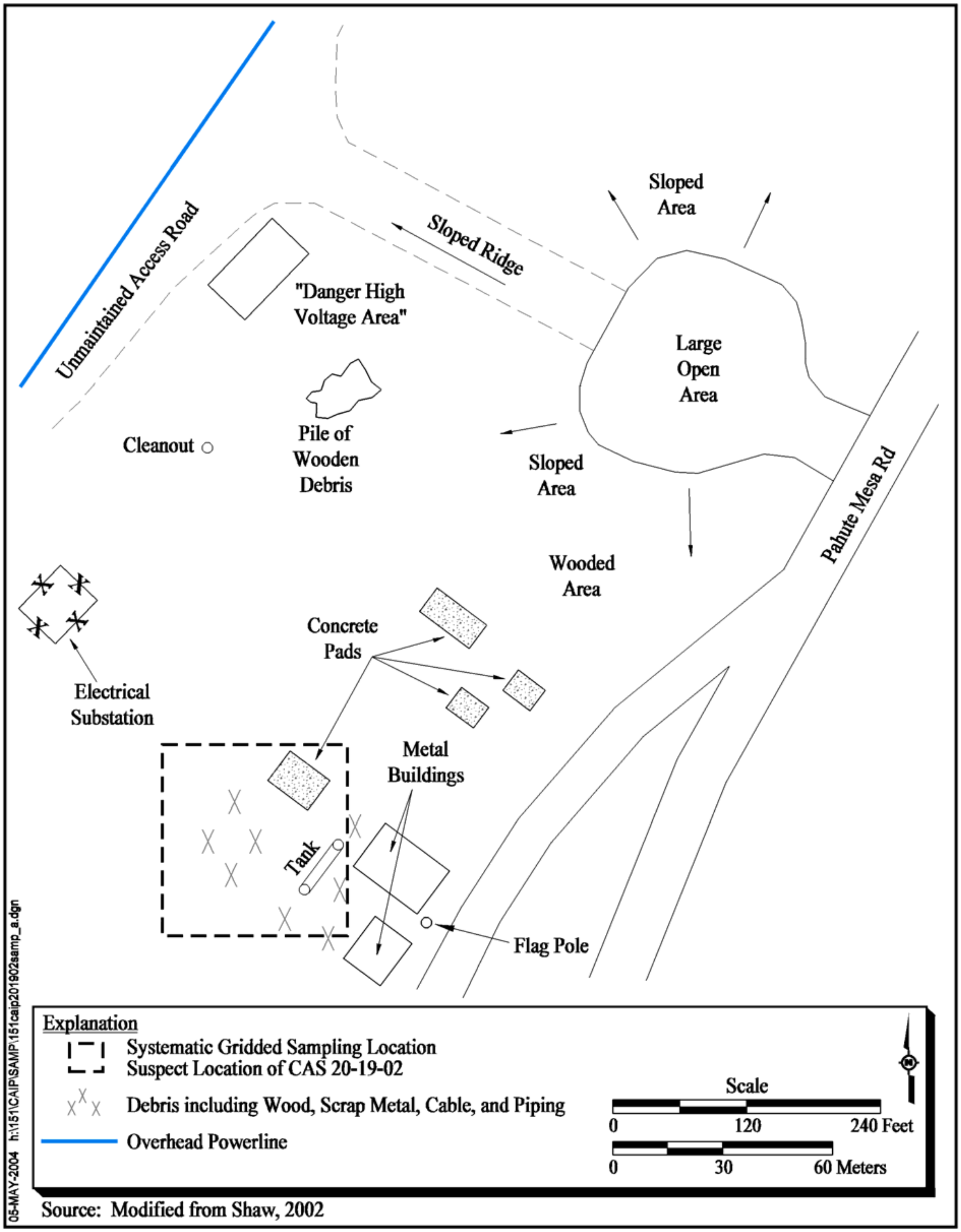


Figure A.1-22
CAU 151, CAS 20-19-02 Sample Locations

A.1.8.2.3 Septic Systems

Each of the CASs 12-04-01, 12-04-02, and 12-04-03 has at least three septic tanks. The tank configurations are similar for each site. Intrusive verification activities at CAS 12-04-03 may be necessary to locate one of the tanks because investigations are inconclusive whether or not there are three or four tanks. Activities at CASs 12-04-01, 12-04-02, and 12-04-03 include visual inspection of the inside of the septic tank and collecting Decision I samples for laboratory analysis from the tank residual if present. If sampling of residual material is necessary, samples of multi-phased liquid, sludge, and solids will be collected in their distinct phases using the appropriate methods. Decision I soil samples will be collected beneath the inlet and outlet end pipes, in the soil horizon underlying the base of the septic tanks, and in areas of potential overflow. Decision II samples in the area encompassing the tanks will be collected to define the lateral and vertical extent of the contamination.

A.1.8.2.4 Lagoons/Sumps/Ponds

Corrective Action Sites 02-05-01, 12-03-01, 12-47-01, and 18-03-01 each have a lagoon or lagoon-like (i.e., sump) component. Decision I activities at these CASs will consist of locating the distribution pipe or discharge area for each lagoon and collecting Decision I samples of lagoon sediments and soil beneath the lagoon at the native soil interface at the proximal, midpoint and distal ends. In the case of CAS 02-03-01, the discharge point is an open trench area. This will also be sampled at the proximal end beneath the well head. Decision II samples will be collected vertically at Decision I locations if FSLs are exceeded and until FSRs are less than FSLs and at locations encompassing the CAS. Decision II samples will also be collected at the perimeter locations of the lagoons.

For sites within CASs 12-03-01 and 12-47-01, the lagoons/sumps have been filled in. A similar strategy will be used to approach these sites; however, sample locations will need to be excavated to the native soil interface and collected. By trenching across the lagoons the interfaces with fill, clay, and native soil should be apparent. Any staining or odors identified will be chased to have the nature and extent defined during the investigation. Decision II samples will be required at any anomalous locations within the lagoons.

A.1.8.2.5 Surface Discharge

Corrective Action Site 20-19-02 is a surface discharge. Because the physical location of the surface discharge has not been precisely identified, for Decision I(a), a systematic grid-based sampling event has been proposed to determine the location of the surface discharge. If the systematic grid-based samples identify a location of the surface discharge, Decision I(b) activities at this CAS will consist of defining the contaminants of the location as defined in Table A.1-3. Decision II samples will be collected vertically and horizontally to define the boundaries of the discharge. Decision II samples will be collected vertically at Decision I(b) locations if FSLs are exceeded and until FSRs are less than FSLs and at locations encompassing the CAS.

Due to the uncertainty of the exact location Trailer 992 drained the wastes in Area 20, a comprehensive sampling effort will be conducted at the Area 20 Camp to locate CAS 20-19-02. This strategy was developed for an area of approximately 396 by 528 ft in the Area 20 Camp based on interview information and process knowledge about the possible location of the site and the buildings around the location. Assuming a hot spot size of at least 15-ft radius exists in this area, the VSP software calculates that we would need to collect surface soil samples from 270 locations to be 95 percent confident that we would identify the surface discharge for CAS 20-19-02 based on a Singer and Wickman algorithm (Gilbert, 1987; PNNL, 2002).

The strategy for sample collection at this CAS is to hand auger, excavate, or use other appropriate methods to define the discharge location for Decision I(a) and be submitted for total Ag to the laboratory for analysis. Decision I(b) and II samples may need the use of a backhoe to determine the depth of the CAS.

A.1.9 References

ASTM, see American Society for Testing and Materials.

American Aerial Surveys, Inc. Date Unknown a. Aerial photograph 002 showing Area 17 Camp. Nellis Air Force Base, NV: Remote Sensing Laboratory Photo Library.

American Aerial Surveys, Inc. Date Unknown b. Aerial photograph U2CE Pre-Test 2 showing the Nash test site. Covina, CA.

American Aerial Surveys, Inc. Date unknown c. Oblique photograph U2CE Post-Test 1 showing the U-2ce crater and U-2ce post-test hole. Covina, CA.

American Society for Testing and Materials. 2000. *Standard Test Method for Strontium-90 in Water*, D5811-2000. Philadelphia, PA.

American Society for Testing and Materials. 2002a. *Standard Test Method for Isotopic Uranium in Water by Radiochemistry*, D3972-2002. Philadelphia, PA.

American Society for Testing and Materials. 2002b. *Standard Test Method for Plutonium in Water*, D3865-02. Philadelphia, PA.

American Society for Testing and Materials. 2002c. *Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectroscopy*, C1000-2000. Philadelphia, PA.

Bingham, F.E., Reynolds Electrical & Engineering Co., Inc. 1992. Letter to J.D. Stewart (DOE/NV) entitled, "Survey of Nevada Test Site (NTS) Abandoned Septic Tank Systems - Tiger Team Finding SW/CF-3," 2 January. Las Vegas, NV.

Bordelois, B., IT Corporation. 1998. Memorandum to R. Jackson and R. Bull (IT Corporation) entitled, "CAU 234, CAS 02-05-01 Sampling Report," 20 March. Las Vegas, NV.

DOE, see U.S. Department of Energy.

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

DRI, see Desert Research Institute.

Desert Research Institute. 1988. *CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas*, Volume I. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV: Water Resources Center.

EG&G/EM, see EG&G Energy Measurements.

EPA, see U.S. Environmental Protection Agency.

EG&G Energy Measurements. 1985. *An Aerial Radiological Survey of Areas 18 and 20 Nevada Test Site*. November. Las Vegas, NV.

EG&G Energy Measurements. 1989. Aerial Photograph 6613-106 showing the UE-2ce pond and trench, 23 September. Nellis Air Force Base, NV: Remote Sensing Laboratory Photo Library.

Fiore, J.N., U.S. Department of Energy, Nevada Operations Office. 1992. Letter to J.D. Stewart (NTSO) entitled, "Environmental Compliance Inventory Forms," February. Las Vegas, NV.

Gilbert, R. 1987. *Statistical Methods for Environmental Pollution Monitoring*. John Wiley and Sons. New York.

Haworth, O.L., Reynolds Electrical & Engineering Co., Inc. 1989. Letter to R.F. Friedricks (DOE/NV) entitled, "Sewage Lagoon Analysis Results and Proposed Monitoring Program," 5 April. Las Vegas, NV.

Holmes & Narver, see Holmes & Narver, Inc.

Holmes & Narver, Inc. 1965a. Engineering drawing 019-082-M10.1 entitled, "Nevada Test Site Pahute Mesa C.P. Sewage Dist. System Plans & Profiles," 1 February. Las Vegas, NV.

Holmes & Narver, Inc. 1965b. Engineering drawing 019-082-M5.5 entitled, "Nevada Test Site Pahute Mesa C.P. Water & Sewage Dist. System General Arrangement," 2 February. Las Vegas, NV.

Holmes & Narver, Inc. 1965c. Engineering drawing 019-082-M7.1 entitled, "Nevada Test Site Pahute Mesa C.P. Water & Sewage Distribution System Piping Details," 1 February. Las Vegas, NV.

Holmes & Narver, Inc. 1972. Aerial Photograph 73-002 showing an overall view of Area 12 Camp, 29 June. Nellis Air Force Base, NV: Remote Sensing Laboratory Photo Library.

Holmes & Narver, Inc. 1979. Engineering drawing 13S entitled, "Area 12 Camp Utilities Sewer," 1 April. Las Vegas, NV.

Holmes & Narver, Inc. 1987. Engineering drawing JS-012-910-C1.1 entitled, "Crafts Bldg. 12-910 Plot Plan," June. Las Vegas, NV.

Holmes & Narver, Inc. 1991. Engineering drawing JS-012-078-T12, entitled "Sewage Lagoons Title Sheet," 11 February. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 1998. *"Radiological Survey,"* 16 September. Las Vegas, NV.

LLNL, see Lawrence Livermore National Laboratory.

Lawrence Livermore National Laboratory. 2003. *Hydrologic Resource Management Program and Underground Test Area Project FY 2001-2002 Progress Report*, August. Prepared by Eaton, G.F., A.B. Kersting, and T.P. Rose. Livermore, CA.

Maddox, J., EG&G Energy Measurements. 1991. Memorandum to distribution entitled, "EG&G/EM Trailer 992 at Area 20 -Nevada Test Site (NTS)," 2 July. Las Vegas, NV.

Mattes, J.J., Reynolds Electrical & Engineering Co., Inc. 1990. Memorandum entitled, "Sewage Lagoon RCRA Sampling Results," 4 January. Las Vegas, NV.

Moeller, A., Bechtel Nevada. 2003. Record of Telecon with C. Jallo (SAIC) regarding CAS 20-19-02, 26 February. Las Vegas, NV.

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

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

NCRP, see National Council on Radiological Protection and Measurement.

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

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

Nevada Administrative Code. 2003. NAC 445A, "Water Controls." Carson City, NV.

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

Nicosia, W.C., Shaw Environmental, Inc. 2003. Memorandum to M. England (SAIC) entitled, "Radiological Land Area Surveys of Various Locations at the Nevada Test Site for Preliminary Assessments," 3 March. Las Vegas, NV.

PNNL, see Pacific Northwest National Laboratory.

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

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

RSN, see Raytheon Services Nevada.

Rarrick, H., Retired Sandia National Laboratories. 2003. Record of Telecon with S. Mittleman (SAIC) regarding Area 12 Camp, 28 March. Las Vegas, NV.

Raytheon Services Nevada. 1992a. Engineering drawing JS-090-094-C135 entitled, "Nevada Test Site -- LLNL -- Area 2 Planning and Power Distribution Map." Las Vegas, NV.

Raytheon Services Nevada. 1992b. Engineering drawing JS-012-002-C92 entitled, "Area 12 Camp Site Plan Map," 29 December. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1967a. Engineering drawing RE-12-M21 entitled, "Modifications to Sewage Treatment System Stabilization Ponds," 31 August. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1967b. Engineering drawing RE-12-M22 entitled, "Modifications to Sewage Treatment System," 31 August. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1967c. Engineering drawing RE- 12-M23 entitled, "Modifications to Sewage Treatment System," 31 August. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1970. Engineering drawing 12-SP-C1 entitled, "Area 12 Utilities Sewage Pond & Line Extension Plot Plan & Topography," Sheet 1 of 1, 15 December. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1971. Engineering drawing 12-16-E9 entitled, "Building 16 Womens Restroom Trailer Plans, Detail & Notes," Sheet 1 of 1, 7 June. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1992a. Engineering drawing 12-SD-C1.1 entitled, "Fleet Operations Sewage Disposal System Plan, Profile & Section," Sheet 1 of 1, 27 May. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1992b. *Work Plan Phase 1 Preliminary Characterization of Abandoned Septic Tank Systems*. Las Vegas, NV.

Reynolds Electrical & Engineering Co., Inc. 1995. *Preliminary Characterization of Abandoned Septic Tank Systems,* Vols. 1 and 2. Las Vegas, NV.

SAIC, see Science Applications International Corporation.

Shaw, see Shaw Environmental, Inc.

SNJV, see Stoller Navarro Joint Venture.

Science Applications International Corporation. 2003. *Surface Geophysical Survey Final Report Corrective Action Unit 151 Nevada Test Site*. Prepared for Shaw Environmental, Inc. Harrisburg, PA.

Shaw Environmental, Inc. 2002. Site sketch from the CAU 151 Project Files. Las Vegas, NV.

Shaw Environmental, Inc. 2003a. Digital Photographs for CAU 151, CAS 18-03-01. Las Vegas, NV.

Shaw Environmental, Inc. 2003b. *Results of Geophysical Survey Selected FFACO Sites, Nevada Test Site*. Las Vegas, NV.

Stoller-Navarro Joint Venture. 2004. *Results of the Geophysical Surveys at CASs 12-03-04 and 18-99-09, Nevada Test Site*. Las Vegas, NV.

Templeton, W., Bechtel Nevada. 2004. Record of telecon with J. Dale (SNJV) regarding CAS 20-19-02, 18 February. Las Vegas, NV.

Trump, D.E., Reynolds Electrical & Engineering Co., Inc. 1992. Memorandum to D. Peck (REECo) entitled, "Request for Updated Information on Sampling Results," 2 November. Las Vegas, NV.

U.S. Atomic Energy Commission. Date Unknown. Engineering drawing entitled, "Pahute Mesa Control Point Master Plan." Las Vegas, NV.

U.S. Atomic Energy Commission. 1969. Engineering drawing entitled, "Area 12 Camp Facility Plan," March. Las Vegas, NV.

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

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

U.S. Department of Energy. 1988a. *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada*, DOE/EH/OEV-15-P. Washington, DC: Environment, Safety, and Health Office of Environmental Audit.

U.S. Department of Energy. 1988b. *Environmental Survey Sampling and Analysis Plan*. Washington, DC: Environment, Safety, and Health Office of Environmental Audit.

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

U.S. Department of Energy, Nevada Operations Office. Date unknown. *Environmental Baseline Information for the Nevada Test Site, Hydrology*. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1986. *Radionuclide Migration Program Strategy Document,* NVO-298. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1990. *Environmental Survey Action Plan*. Las Vegas, NV.

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

U.S. Department of Energy, Nevada Operations Office. 1997. *Closure Report for CAU 339: Area 12 Fleet Operations Steam Cleaning Discharge Area Nevada Test Site,* DOE/NV–11718-167. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998a. *Work Plan for Leachfield Corrective Action Units: Nevada Test Site and Tonopah Test Range, Nevada,* DOE/NV--514. Las Vegas, NV.

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

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

U.S. Environmental Protection Agency. 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA 600/4-80-032 (NTIS/PB80-224744; CD ROM; NEPIS/http://www.epa.gov/cincl). Washington, DC.

U.S. Environmental Protection Agency. 1996. *Test Method for Evacuating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, CD-ROM PB97-501928GEI. Washington, DC.

U.S. Environmental Protection Agency. 2000a. *Data Quality Objectives Process for Hazardous Waste Site Investigations,* EPA QA/G-4HW, EPA/600/R-00/007. Washington, DC.

U.S. Environmental Protection Agency. 2000b. *Guidance on Choosing a Sampling Design for Environmental Data Collection*, EPA QA/G-5S. Washington, DC.

U.S. Environmental Protection Agency. 2002a. *Guidance for Quality Assurance Project Plans,* EPA QA/G-5, EPA/240/R-02/009. Washington, DC.

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

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 for CAU 151 will be identified in the FFACO Biweekly Activity Report prior to the start of field activities.

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

Appendix A.3

NDEP Comment Responses

JUN.21.2004 2:39PM DOE NVOO ERD NO.062 P.2/3

ALLEN BIAGGI, *Administrator*

Administration
Water Pollution Control
Air Quality
(702) 486-2850

STATE OF NEVADA
KENNY C. GUINN
Governor

R. MICHAEL TURNIPSEED, *Director*

Federal Facilities
Corrective Actions
Waste Management
Facsimile 486-2863

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
(Las Vegas Office)
1771 E. Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119-0837

June 6, 2004

ACTION	
INFO	ERD ESHD TD WMD MGR
NSO/MGR	✓
AMEM	✓
AMNS	
AMSO	
AMSSP	✓

Ms. Monica L. Sanchez
Acting Director, Environmental Restoration Division
Nevada Nuclear Security Administration
Nevada Site Office
P. O. Box 98518
Las Vegas, NV 89193-8518

RE: Review of the draft Corrective Action Investigation Plan for the Corrective Action Unit 151, Septic Systems and Discharge Area, Nevada Test Site, Nevada

Dear Ms. Sanchez:

The Nevada Division of Environmental Protection staff, Bureau of Federal Facilities (NDEP) has received and reviewed the draft Corrective Action Investigation Plan (CAIP) for the Corrective Action Unit 151, Septic Systems and Discharge Area provided by the Nevada Nuclear Security Administration/Nevada Site Office. NDEP has no comments related to the draft CAIP.

Address any questions regarding this matter to either Greg Raab at (702) 486-2867, or me at (702) 486-2874.

Sincerely,

Don Elle

Don Elle, Ph.D.
Supervisor, Las Vegas
Bureau of Federal Facilities

Library Distribution List

	Copies
U.S. Department of Energy National Nuclear Security Administration Nevada Site Office Technical Library P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (Uncontrolled)
U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831-0062	1 (Uncontrolled, electronic copy)
Southern Nevada Public Reading Facility c/o Nuclear Testing Archive P.O. Box 98521, M/S 400 Las Vegas, NV 89193-8521	1 (Controlled) 1 (Uncontrolled)
Manager, Northern Nevada FFACO Public Reading Facility c/o Nevada State Library & Archives Carson City, NV 89701-4285	1 (Uncontrolled)