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Resource Conservation and Recovery Act Industrial Site Environmental Restoration Site Characterization Plan

Area 23, Building 650 Leachfield

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Revision: 1

March 1997

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Environmental Restoration
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U.S. Department of Energy
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**RESOURCE CONSERVATION AND RECOVERY ACT
INDUSTRIAL SITE ENVIRONMENTAL RESTORATION
SITE CHARACTERIZATION PLAN**

AREA 23, BUILDING 650 LEACHFIELD

DOE Nevada Operations Office
Las Vegas, Nevada

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INDUSTRIAL SITE ENVIRONMENTAL RESTORATION
SITE CHARACTERIZATION PLAN**

AREA 23, BUILDING 650 LEACHFIELD

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Table of Contents

List of Figures	iii
List of Tables	iv
List of Plates	iv
List of Acronyms and Abbreviations	v
1.0 Introduction	1-1
1.1 Purpose	1-1
1.2 Scope	1-1
1.3 Data Quality Objectives	1-1
2.0 Facility Description	2-1
2.1 Waste Inventory	2-5
2.2 Non-Designed Release Information	2-6
2.3 Previous Characterization Plans and Activities	2-6
3.0 Objectives	3-1
3.1 Potential Contaminants of Concern	3-1
3.2 Preliminary Action Levels	3-2
3.3 Measurement Objectives	3-3
3.4 Conceptual Model	3-3
4.0 Sampling and Analysis Plan	4-1
4.1 Technical Approach	4-1
4.2 Site Preparation Activities	4-2
4.3 Drilling Activities	4-2
4.4 Sampling Activities	4-4
4.5 Sample Analysis	4-5

Table of Contents (Continued)

5.0 Waste Management Plan	5-1
5.1 Waste Minimization	5-1
5.2 Potential Waste Streams	5-1
5.3 Waste Determination	5-2
5.4 Waste Management	5-2
 6.0 Reporting	 6-1
 7.0 References	 7-1
 Appendix A - Data Quality Objectives Scoping Worksheets	 A-1
 Appendix B - Environmental Setting	 B-1
 Appendix C - Results of Previous Evaluations	 C-1
 Appendix D - Nevada Environmental Restoration Project Document Review Sheet - Nevada Division of Environmental Protection Comments and Responses	 D-1

List of Figures

Number	Title	Page
2-1	Location of the Nevada Test Site	2-2
2-2	Location of the Area 23, Building 650 Leachfield Facility	2-3
2-3	Area 23, Building 650 Leachfield Site Map	2-4
3-1	Characterization Study Areas, Area 23, Building 650 Leachfield	3-5
4-1	Planned Soil Boring Locations, Area 23, Building 650 Leachfield	4-3
A-1	Legend for the Decision Rule Diagrams	A-17
A-2	Decision Rules for Contaminant Identification and Action Level Exceedence ...	A-18
A-3	Decision Rules for Lateral Contaminant Migration Evaluation	A-19
A-4	Decision Rules for Vertical Contaminant Migration Evaluation	A-20
A-5	Decision Rules for Preliminary Shallow Perched Groundwater Evaluation	A-21
C-1	1992 Piping Excavation Sampling Trench and Sample Locations Area 23, Building 650 Leachfield Facility	C-3
C-2	1994 Preliminary Evaluation Trench and Sample Locations Area 23, Building 650 Leachfield Facility	C-4

List of Tables

<i>Number</i>	<i>Title</i>	<i>Page</i>
3-1	Chemical and Radiological Analytical Methods	3-3
4-1	Characterization Analytical Methods	4-6
C-1	Radionuclide Concentrations for Water Samples from the Building 650 Leachfield Distribution Box	C-1
C-2	1995 300-Minute Gamma Scan Analytical Results	C-6

List of Plates

Plate 1 - Waste Management Strategy Decision Process

Plate 2 - Characterization Decision Process, Area 23, Building 650 Leachfield

Plate 3 - Evaluation of Potential Decision Errors, Area 23, Building 650 Leachfield Facility

(All plates are located at the end of the document.)

List of Acronyms and Abbreviations

amsl	Above mean sea level
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BN	Bechtel Nevada
CERCLA	Comprehensive Environmental Resource Conservation and Liability Act
CFR	<i>Code of Federal Regulations</i>
cm	Centimeter(s)
COC	Contaminant(s) of concern
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DOT	U.S. Department of Transportation
DQO	Data Quality Objective(s)
EPA	U.S. Environmental Protection Agency
ft	Foot (feet)
gal	Gallon(s)
IDW	Investigation-derived waste
in.	Inch(es)
IT	IT Corporation
L	Liter(s)
LDR	Land Disposal Restriction
LLW	Low-level radioactive waste
m	Meter(s)
MEK	Methyl ethyl ketone
mg/kg	Milligram(s) per kilogram
mg/L	Milligram(s) per liter
NAC	Nevada Administrative Code
NDEP	Nevada Division of Environmental Protection
NTS	Nevada Test Site
NTSWAC	<i>Nevada Test Site Defense Waste Acceptance Criteria</i>
PAL	Preliminary action level(s)
PCBs	Polychlorinated biphenyl(s)
pCi/g	PicoCurie(s) per gram

List of Acronyms and Abbreviations (Continued)

POC	Performance Objective for Certification
ppm	Part(s) per million
PRG	Preliminary Remediation Goal(s)
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
RBCA	Risk-Based Corrective Action
RCRA	Resource Conservation and Recovery Act
REECo	Reynolds Electrical & Engineering Co., Inc.
SVOC	Semivolatile organic compound(s)
TC	Toxicity characteristic
TCLP	Toxicity characteristic leachate procedure
TPH	Total petroleum hydrocarbon(s)
TRU Pad	Transuranic Waste Storage Pad
TSCA	Toxic Substances Control Act
VOC	Volatile organic compound(s)
$\mu\text{Ci/g}$	MicroCurie(s) per gram
$\mu\text{Ci/mL}$	MicroCurie(s) per milliliter
$\mu\text{g/kg}$	Microgram(s) per kilogram

1.0 Introduction

1.1 Purpose

This plan presents the strategy for the characterization of Corrective Action Unit 94, Area 23, Building 650 Leachfield (referred to as 650 Leachfield) at the Nevada Test Site (NTS), which will be conducted for the U.S. Department of Energy Nevada Operations Office (DOE/NV) Environmental Restoration Division. The objectives of the planned activities are to:

- Obtain sufficient sample analytical data from which further assessment, remediation, and/or closure strategies may be developed for the site
- Obtain sufficient sample analytical data for management of investigation-derived waste (IDW)

All references to regulations in this plan are to the versions of the regulations that are current at the time of publication of this plan.

1.2 Scope

The scope of the characterization will include subsurface soil boring (i.e., drilling), *in situ* sampling of the soil within subsurface soil borings, and sample analysis for both site characterization and waste management purposes.

1.3 Data Quality Objectives

The plan for this project has been developed through the implementation of the Data Quality Objective (DQO) Process as described in the U.S. Environmental Protection Agency's (EPA) *Guidance for the Data Quality Objectives Process* (EPA, 1994) and implemented in *Data Quality Objectives for Superfund, Interim Final Guidance* (i.e., EPA, 1993a, 1993b). This plan represents the results of the DQO process, and the specifics of the DQO scoping process for the project are summarized in Appendix A of this Plan and maintained in project files. The approach to site characterization is an iterative process. As part of the Quality Assurance (QA) and Quality Control program for the project, the seven-stage DQO approach has been employed to ensure that the environmental data gathered for site characterization are adequate to support further characterization, remediation, and/or the development of a closure strategy for the site being evaluated. The DQO process allows conceptual models and resulting project decisions to

be refined as additional information or data needs are discovered or generated during the implementation of the site characterization.

The DQO process outlined by EPA (1993a and 1994) consists of seven steps that have been applied to design the initial sampling plan and will be re-evaluated as more information becomes available during the site investigation. These steps are:

- Problem Statement - stating the problem to be resolved and developing a conceptual model for the site (Section 3.1)
- Identification of Decisions - the principle study question(s) that must be answered by the characterization and the decision process (Appendix A)
- Decision Inputs - identification of inputs to the decision (i.e., data needs) (Appendix A)
- Study Boundaries - definition of the characteristic, spatial, and temporal study boundaries (Appendix A)
- Decision Rules - development of decision rules (i.e., logic statements) (Appendix A)
- Decision Error Limits - development of limits on decision errors (i.e., uncertainty constraints) (Appendix A)
- Optimize the Design for Obtaining Data - develop a sampling and analysis plan that satisfies the needs identified in Steps 1 through 6 (Section 4.0)

The DQOs for the characterization were also developed to adhere to the precision, accuracy, representativeness, comparability, and completeness parameters, as discussed in the *Resource Conservation and Recovery Act (RCRA) Industrial Sites Quality Assurance Project Plan (QAPP)* (DOE, 1996a).

2.0 Facility Description

The 650 Leachfield is located in Area 23 at the NTS, a U.S. Department of Energy (DOE) research and development facility in Nye County, Nevada. The NTS is approximately 88 kilometers (55 miles) northwest of Las Vegas, the major population center in the area (Figure 2-1). Area 23 is in the southern part of the NTS. Regional and local topography, soil types, stratigraphy, surface water features, and groundwater which might affect the migration of contaminants at the site are discussed in Appendix B.

The 650 Leachfield is located southeast of Building 650 in the southwest portion of Mercury, Nevada (Figure 2-2). According to information provided by Reynolds Electrical & Engineering Company, Inc. (REECo), Building 650 Leachfield is a land disposal unit that was in operation from 1965 to October 1992, with an estimated annual discharge rate of less than 984 liters (L) (260 gallons [gal]) (REECo, 1993). Known discharge volumes are available for the period from June 1984 through December 1985 (142 L or 37.5 gal) and for calendar year 1986 (95 L or 25 gal). No RCRA-regulated hazardous waste or hazardous waste constituents were discharged to the leachfield after 1987 (REECo, 1993). An unknown volume of dilute mineral acids (pH 5 or greater) were discharged to the leachfield until October 1992 (REECo, 1993). The Building 650 Leachfield received discharges from designated sinks, floor drains, and emergency decontamination showers in Building 650.

The main leachfield discharge pipe originates at the north end of Building 650 and extends south along the east side of the building (Figure 2-3). The pipeline terminates near the southeast corner of Building 650 at a concrete distribution box measuring 0.9 x 0.9 x 2 meters (m) (3 x 3 x 7 feet [ft]) (REECo, 1993). The distribution box is connected to four 15-m (50-ft) long infiltration pipes consisting of solid piping with open spaces at the pipe joints spaced across a 9-m (30-ft) wide field (Figure 2-3) (REECo, 1989). The pipes are approximately 2 m to 2.4 m (6 ft to 8 ft) below the ground surface (REECo, 1989). These pipes provided for the distribution of discharged effluent over a large area so that the liquid slowly percolated into the underlying soil which comprised the Building 650 Leachfield. The surface soil at the leachfield is a very coarse gravel to cobble mixed with a very fine-grained matrix. The ground surface in the vicinity of the leachfield was recontoured sometime between 1986 and 1988 when an ambulance port was constructed south of Building 650 (REECo, 1989).

RCRA 650LF
Section: 2.0
Revision: 1
Date: 03/18/97

Area 23
Building 650
Leachfield

SCALE

0 8 16 Miles
0 12 24 Kilometers

Figure 2-2
Location of the Area 23, Building 650 Leachfield Facility

RCRA 650LF
Section: 2.0
Revision: 1
Date: 03/18/97

Gravel

Modified from REEC Co, 1993

SCALE

0 50 100 Feet

LEGEND

- Piping leading to the leachfield
- - - Leachfield open drain piping
- ... Site boundary

Figure 2-3
Area 23, Building 650 Leachfield Site Map

Building 650 at the NTS houses the Radiochemistry Laboratory used for bioassay and environmental sample analyses in support of the NTS radiological environmental monitoring program (REECo, 1989). Water and soil samples and air filters were processed regularly. Human excreta samples were also analyzed as part of the NTS bioassay program for monitoring internal exposures to various radionuclides. Analytical procedures performed include chemical separations for various actinides, gross alpha and beta counting, gamma, beta, and alpha spectrometry, and liquid scintillation. Building 650 formerly housed the Industrial Hygiene Laboratory used from 1965 to late 1986 or early 1987. Standard industrial hygiene analyses were performed as well as film development. RCRA-regulated cleaning agents and solvents were discharged to the leachfield until 1987 (REECo, 1988 and 1993) after which process knowledge, administrative controls, and employee training precluded the discharge of RCRA-regulated materials to the leachfield (REECo, 1988). Non-RCRA-regulated discharges continued through October 1992 when the piping to the leachfield was sealed.

2.1 Waste Inventory

RCRA-regulated discharges to the leachfield were discontinued in 1987; however, radioactive waste discharges to the leachfield had been discontinued in 1979 (REECo, 1988). After these dates, and prior to the sealing of the pipes leading to the leachfield, process knowledge, administrative controls, and employee training were used to preclude the discharge of radioactive or hazardous waste to the leachfield (REECo, 1988). Hazardous chemicals used in the analytical processes or contained in samples that were discharged to the leachfield prior to 1987 included hydrochloric acid, nitric acid, silver nitrate, dioctyl phthalate, methyl ethyl ketone (MEK), ethylene diamine, toluene, xylene, acetone, hexane, benzene, carbon tetrachloride, carbon disulfide; isocyanates and formaldehyde; Kodak film developing chemicals; detergents; polychlorinated biphenyls (PCB); other chemicals that may have been used for radionuclide separation or to produce liquid scintillation cocktails; chlorinated solvents, acids, caustics, and RCRA-regulated metals (e.g., lead, chromium, cadmium, silver, and mercury); and radionuclides (e.g., beryllium, magnesium, bismuth, boron, lead, and manganese) (REECo, 1985 and 1989). The radionuclides contained in samples analyzed in Building 650 (i.e., tritium, carbon-14, iodine-131, cesium-137, plutonium-239, strontium-89/90, and other mixed fission products) were usually in the microcurie per sample range (REECo, 1989). Additional information on waste inventory will be gathered as site investigations proceed.

2.2 Non-Designed Release Information

In October 1992, a hole measuring 15 x 20 x 8 centimeters (cm) (6 x 8 x 3 inches [in.]) was discovered in the concrete floor of the distribution box for the Building 650 Leachfield (REECo, 1993). During periods of heavy flow, water was leaking from the hole into the surrounding soil. After the discovery of the hole, the flow to the distribution box was diverted to a sanitary sewer. During the sewer tie-in activities, no odors, soil discoloration, or unusual amounts of soil moisture were noted in the excavated areas around the piping leading to the leachfield (see Appendix C, Section C.1.3, for additional information). REECo personnel collected soil samples from potentially contaminated areas below the distribution box in 1992 and 1995 and submitted the samples for laboratory analysis. In 1992, the sample was analyzed for gamma-emitting radionuclides only. The 1995 samples were analyzed for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), toxicity characteristic (TC) metals, pH, tritium, gamma scan, and plutonium. The 1992 sample was reported to contain low levels of cesium-137 and cobalt-60 (see Appendix C, Section C.1.3). The only contaminants of concern (COCs) detected in the 1995 samples were the radionuclides americium-241, cesium-137, and cobalt-60 (see Appendix C, Section C.1.6). No other COCs were identified in the samples. There have been no other known nondesigned releases from the Building 650 Leachfield.

2.3 Previous Characterization Plans and Activities

To date, at least one draft and one final characterization plan have been produced for the 650 Leachfield by the DOE and IT Corporation (IT) (DOE, 1993; IT, 1994). In addition, closure plans which also addressed characterization of the site, were produced in 1988 and 1989 (IT, 1988; DOE, 1989). Each subsequent plan was written to address comments on previous plans and changing characterization methods, strategies, and philosophies. None of the previous characterization plans was approved by both the DOE and the Nevada Division of Environmental Protection (NDEP); consequently, no site characterization work resulting in the complete characterization of the site was performed under the guidance of the plans. This plan incorporates, and in some cases refines, process knowledge presented in the earlier plans. The current plan is intended to supersede all previous characterization plans, and it contains some significant changes in the approach to characterization planning and implementation.

Previous investigation activities at the 650 Leachfield have included the following:

- Distribution box liquid waste sampling in 1988 and 1990
- Soil sample collected from below the distribution box in 1992
- Piping excavation sampling in 1992
- Leachfield preliminary evaluation in 1994
- Distribution box and discharge line operational closure in 1994
- Geophysical evaluation in 1994
- Distribution box preliminary evaluation in 1995

The results of these evaluations are discussed in further detail in Appendix C of this plan.

3.0 Objectives

3.1 Potential Contaminants of Concern

The potential COCs for the site have been identified through the review of site history documentation and preliminary investigation results. The potential presence of COCs within the soils of the site are a result of releases from the following known or potential contaminant sources:

- Discharge into the leachfield system from designated sinks, floor drains, and emergency decontamination showers within the Building 650 Radiochemistry and former Industrial Hygiene Laboratories between 1965 and October 1992.
- Leakage from the leachfield system distribution box.
- Leakage from the lines leading from Building 650 to the leachfield distribution box.

The final list of potential COCs for the site was designated during the implementation of the DQO scoping process for the characterization. The following constituents have been designated as the current COCs for the site:

- Corrosives - hydrochloric and nitric acids (likely neutralized by the native soils)
- VOCs - acetone, benzene, carbon tetrachloride, MEK, toluene, xylene
- RCRA metals
- SVOCs - dioctyl phthalate
- Radionuclides - tritium, carbon-14, cobalt-60, iodine-131, cesium-137, plutonium-239, strontium-89, strontium-90, other mixed fission products
- PCBs
- Total petroleum hydrocarbons (TPH)

Based on the lack of fluid inputs into the leachfield in recent years, free liquids are not expected on the site. Furthermore, the alkaline content of the native soil is likely to have neutralized any acidic liquids released to the leachfield. Due to these factors, the only RCRA characteristic

(i.e., ignitability, corrosivity, reactivity, toxicity) that has been identified as a concern on the site is the toxicity characteristic for VOCs and metals.

3.2 Preliminary Action Levels

For the purpose of defining the extent of contamination at the site, preliminary action levels (PALs) or screening levels have been designated for the project through the DQO process. Although non-detect levels are expected for most parameters at relatively shallow depths, the following levels can be used in the event of attenuating contamination that does not appear to be rapidly approaching non-detect.

- RCRA-listed hazardous wastes: concentrations above EPA Region 9, 1996 Residential Soil Preliminary Remediation Goals (PRGs) for initial site screening and concentrations above risk-based levels (which may be different from the PRGs) for final analysis of characterization sampling results. (Note that the use of the residential PRGs is based on the NDEP's input to the DQO process for the characterization as discussed in Appendix A.)
- RCRA toxicity characteristic hazardous wastes: RCRA toxicity characteristic values from the *Code of Federal Regulations* (CFR) Title 40 Part 261.24 (ESI, 1996). (If additional COCs are identified for which toxicity characteristic leachate procedure [TCLP] analyses have not been conducted [e.g., SVOCs], then the 20 times rule will be used as a PAL.)
- PCB constituents: concentrations above EPA Region 9, 1996 Residential Soil Preliminary Remediation Goals for initial site screening and concentrations above risk-based levels (which may be different from the PRGs) for final analysis of characterization sampling results. (Note that the use of the residential PRGs is based on the NDEP's input to the DQO process for the characterization as discussed in Appendix A.)
- TPH constituents: total concentrations above 100 milligrams per kilogram (mg/kg) per *Nevada Administrative Code* (NAC) 445A(NAC, 1996).
- Radionuclide constituents: presence of man-made radionuclides above background for initial field screening, followed by application of NTS Performance Objective for Certification of Nonradioactive Hazardous Waste (POC) (BN, 1996) screening levels for evaluation of waste that will be shipped off of the NTS, and finally either the presence of man-made radionuclides above background or risk-based analysis using RESRAD (Yu et al., 1993) (or another acceptable model) for final characterization results (based on the outcome of discussions currently taking place between the DOE and the NDEP).

3.3 Measurement Objectives

All chemical and radiological analyses will be conducted using the standard analytical methods identified in Table 3-1. The detection limits for all the COCs identified in Section 3.1 will be substantially below (i.e., less than 50 percent) the specified preliminary action levels.

Table 3-1
Chemical and Radiological Analytical Methods

Analytical Parameter	Analytical Methods ^a
Total petroleum hydrocarbons - full range	EPA 8015 Modified
Total volatile organic compounds	EPA 8240
Toxicity Characteristic VOCs	EPA 1311/8240
Total semi-volatile organic compounds	EPA 8270
TC metals	EPA 1311/6010 EPA 1311/7470
Polychlorinated Biphenyls	EPA 8080A
Gamma scan	HASL-300, 4.5.2.3 ^b /EPA 901.1
Gross alpha-beta	SM 7110 ^c /EPA 900.0
Plutonium-239/240	NAS-NS-3058 ^d
Strontium-89/90	Sr-7500 ^e
Tritium	EERF H.01 ^f
Free liquids paint filter test	EPA 9095

^aSW-846 (EPA, 1992) unless otherwise noted

^bEnvironmental Measurements Laboratory Procedure Manual, HASL-300 (DOE, 1992)

^cStandard Methods for the Evaluation of Water and Waste Water (APHA, 1992)

^dNational Academy of Science, Nuclear Series (Coleman, 1965)

^eAlpha Inc., 1960

^fEastern Environmental Radiation Facility (EPA, 1987)

3.4 Conceptual Model

The conceptual model for the Building 650 Leachfield was developed to be used as a basis for the site characterization plan. The conceptual model was developed during the DQO scoping process through the review of archival investigations of the site, process knowledge, and the results of preliminary field investigations. The model takes into account the known or assumed

source of the problem and the constituents of potential concern (see Section 3.1) in order to suggest the following potential migration pathways for the COCs.

- Infiltration and concentration of contaminants into the soil directly below the leachfield distribution box with infiltration limited to less than 50 feet of vertical and 10 feet of lateral migration
- Minor infiltration into the soil around the upper portion of the leachfield limited to less than 50 feet of vertical and 10 feet of lateral migration
- No significant infiltration into the soil around the piping leading to the distribution box or the lower portions of the leachfield

To facilitate the evaluation of the conceptual model, the site has been divided into four initial study areas (see Figure 3-1) based on the designed function of the different portions of the leachfield system and the varying potential for contamination in the different areas of the site. It should be noted that the configuration of the study areas will not necessarily be reflected in the configuration of contaminant zones identified on the site through the characterization process. The study areas for the site and the hypothesized potential for contamination of each area are assigned as follows:

- Study Area 1 - Soil directly below and immediately surrounding the distribution box which is likely to have been impacted by unplanned releases from the distribution box (potential for man-made radionuclide contamination above background, RCRA-listed waste, characteristic waste, metals, PCB contamination, and TPH contamination above NDEP action level of 100 parts per million [ppm])
- Study Area 2 - Soil directly below and immediately surrounding the leachfield piping that has the potential to have been impacted by designed releases from the leachfield piping (decreasing potential with distance from the distribution box for man-made radionuclide contamination above background, RCRA-listed waste, characteristic waste, metals, PCB contamination, and TPH contamination above NDEP action level of 100 ppm)
- Study Area 3 - Soil directly below and immediately surrounding the piping leading from Building 650 to the leachfield distribution box (slight potential for man-made radionuclide contamination above background, RCRA-listed waste, characteristic waste, metals, PCB contamination, and TPH contamination above NDEP action level of 100 ppm)

RCRA 650LF
 Section: 3.0
 Revision: 1
 Date: 03/18/97

Gravel

Building 650

4" line disconnected
 and plugged 11/1992

4" line main
 leachfield line

Distribution box

Leachfield location

Ambulance
 Shelter

Modified from REEC Co, 1993

LEGEND

- Piping leading to the leachfield
- Leachfield open drain piping
- Study Areas

Figure 3-1

Characterization Study Areas, Area 23, Building 650 Leachfield

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- Study Area 4 - Soil below and around Areas 1, 2, and 3 that has not been impacted by planned or unplanned releases from the leachfield system. (Uncontaminated or contamination below applicable regulatory action levels.) Even though this Study Area is basically equivalent to the "rest of the world", it is defined for the purposes of this plan because specific samples are necessary from the area. Samples from this study are used to constrain the bottom of encountered contamination (as identified by two "clean" sample intervals below a zone of contamination) and the lateral extent of contamination (as identified by a step-out boring that does not encounter indications of contamination). These samples are considered to have been taken in Study Area 4. Furthermore, project support areas, such as designated waste staging and equipment decontamination areas are to be located within Study Area 4 (i.e., outside of the currently designated Study Areas 1, 2, and 3).

The sampling objectives will confirm, evaluate, and potentially modify or refute the conceptual model presented. They have been used to develop a sampling methodology to ensure that data-collection activities provide data that are meaningful, valid, and defensible and which lead to development of a closure strategy. This approach identifies areas of concern (i.e., areas which violate the conceptual model) early in the characterization and then targets those areas for additional investigation, as needed.

4.0 Sampling and Analysis Plan

Data will be collected during the field investigation to confirm or refute the conceptual model for the site, to assess the migration of COCs, and to determine if COCs are present in concentrations exceeding the PALs established for the site. Samples will also be collected in order to obtain site-specific geotechnical information applicable to the evaluation of remediation and/or closure options. Sampling will be conducted to allow for definition of migration pathways consistent with the DQOs and to provide adequate data to support or develop a closure strategy. The characterization activities (i.e., sampling, decontamination, etc.) will be conducted in accordance with approved sampling instructions and operating procedures and the *RCRA Industrial Sites QAPP* (DOE, 1996a).

4.1 Technical Approach

Based on the results of the DQO process, the technical approach to the completion of characterization activities at the Building 650 Leachfield will involve the following steps:

- Subsurface environmental samples will be collected and analyzed to determine concentrations of suspected COCs in the potentially affected environment. The field sampling and analytical programs have been designed to meet the DQOs for site characterization.
- Analytical data will be used to determine if the conceptual model for the site is valid or if additional characterization is required to support an alternative model. The data will also be used to propose a plan to achieve closure of the site and to evaluate the regulatory status of waste generated during the field activities.

The field investigative program shall be conducted to allow for either the modification or termination of the characterization activities when it is determined that sufficient data exist to support or refute the conceptual model. Based on the conceptual model, the characterization is planned for one phase of investigation to consist of subsurface soil sampling to an approximate maximum depth of 15.2 m (50 ft) below ground surface within and around the 650 Leachfield and associated piping via hollow-stem auger drilling techniques.

If the conceptual model is proven to be incorrect (e.g., contamination is deeper or more wide spread than projected) during the planned activities, two contingencies have been developed in order to adjust the scope of the characterization, consistent with an alternate conceptual model

that might support wider or deeper contaminant migration. The alternate model assumes that infiltration was greater and contaminants have migrated to a deeper extent and/or greater lateral extent than indicated in the primary conceptual model. The contingencies are as follows:

- If the contamination is deeper than anticipated, the contingency is having the ability to drill deeper (i.e., approximately 30.5 m [100 ft] below ground surface [bgs]) than the conceptual model indicates if regulated contamination is present.
- If the contamination covers a larger area or is more complexly distributed, the contingency is having the ability to include more extensive subsurface soil sampling both inside and outside of the area of the 650 Leachfield via drilling techniques.

Contingent investigations may be carried out as part of the current or subsequent characterization phases and will be based on the results of the first phase of the investigation.

This sampling and analysis plan will be executed as described in the following sections. Unexpected site conditions may require modification of the methods described in this section as well as the conceptual model for the site and/or the DQOs for the characterization. The following sections detail the technical approach and activities that will be conducted for the characterization.

4.2 Site Preparation Activities

Site preparation activities will include the demarcation of work areas and the designation and fencing of a waste accumulation area in which drums containing investigative-derived waste will be maintained pending analysis of their contents. Site preparation may also entail cutting access holes in the pavement at drilling locations within the parking area and screening for subsurface utilities (using the air knife) at each drilling location.

4.3 Drilling Activities

Drilling activities will be conducted using a hollow-stem auger drill rig capable of boring to depths of approximately 30 m (100 ft). However, it is anticipated that drilling will only be necessary to depths of 15 m (50 ft) or less. Currently, ten boring locations are planned in the vicinity of the leachfield and distribution box, and two boring locations are planned along the piping leading to the distribution box (see Figure 4-1). Additional borings may be drilled based on field indications of contaminant migration trends. The initial boring locations are based on the strategy agreed to during the DQO scoping for the project and on the results of the

RCRA 650LF
Section: 4.0
Revision: 1
Date: 03/18/97

Figure 4-1
Planned Soil Boring Locations, Area 23, Building 650 Leachfield

preliminary sampling conducted at the site (see Appendix C). Industry-standard methods for determining the locations for step-out borings will be used if lateral migration of subsurface contaminants is suspected or observed. Step-out borings will either be placed in configurations that are based on known contaminant trends or in geometric configurations (e.g., a triangular pattern originating from the center of the study area, drilling location, or contaminant zone) if contaminant migration trends have not been established.

4.4 Sampling Activities

Sampling activities will focus on further characterizing COCs, evaluating COC concentrations, and defining contaminant extent to confirm or refute the conceptual model for the site. The sampling activities will also be used to determine waste types for appropriate waste minimization options and management requirements. All samples will be field-surveyed for radiation hazards. Selected samples (based on the results of on-site screening indicating the presence or absence of contamination as appropriate) will be sent to an approved off-site laboratory to be analyzed for more complete characterization. The analytical methods to be used and the sample volume requirements are discussed in this section.

The first samples from each boring will be collected from two consecutive intervals directly below the leachfield component (e.g., piping, distribution box, etc. at approximately 6 to 10 feet bgs) being investigated and in 1.5-m (5-ft) intervals thereafter to a depth of approximately 15 m (50 ft based on the current conceptual model). If, or when, drilling is conducted below 15 m (50 ft), the sampling interval will be increased to 3 m (10 ft). Before terminating a boring, at least two unimpacted samples (as identified through on-site screening) will be collected from approximately 1.5 and 3.1 m (5 and 10 ft) below any encountered contaminant zones. When possible, at least three samples for laboratory analysis will be collected from encountered contaminant zones (i.e., one sample each from the top and bottom and the area of highest suspected contamination within the zone). If the encountered contamination is less than two sampling intervals thick, then fewer samples of the contaminated zone will be obtained for laboratory analysis.

All collected samples will be screened on site using standard field screening techniques such as radionuclide/radiation detector, flame-ionization detector, photoionization detector, and/or colorimetric screening. It is anticipated that approximately 30 to 50 samples may be obtained from within the area of the leachfield based on the current conceptual model. An additional 6 to 10 samples could result from drilling at two planned drilling locations in the vicinity of the piping leading to the distribution box. Samples to be analyzed by the off-site laboratory will be selected based on the results of field screening and planned sampling intervals. The actual number of samples analyzed will depend on decisions made in the field. Additional (or fewer) characterization samples may be sent for off-site analysis based on field screening results, field indications of potential changes in contaminant characteristics (i.e., contaminant type, concentration, mobility, etc.), and the results of sample analysis when they become available.

During the characterization activities, the boundaries between the various study areas defined in the conceptual model (e.g., particularly between Area 4 and the other study areas) will be determined initially through visual indications of impact followed by on-site screening of samples. If off-site analysis of samples indicate the presence of contamination not attributed to the current study area, then the conceptual model may be changed appropriately to account for such differences that might affect later characterization or site closure activities.

4.5 Sample Analysis

Table 4-1 lists the analytical methods that will be applied to samples. The analytical methods have been chosen based on the results of the preliminary investigations, process knowledge of the past use of the leachfield, and any additional regulatory and DOE guidance or requirements. In addition, the NDEP has specified a "full suite" analysis to be run on at least one sample in each boring to confirm the absence of a wide variety of analytes. In the case of this site, the full suite consists of the same analyses being conducted for the characterization sampling so that no additional analyses will be conducted for the suite. Based on the results of preliminary sampling and review of process knowledge information, it is expected that the contamination associated with the Building 650 Leachfield consists primarily of radionuclides and potentially RCRA-regulated chemicals. Radioactive or mixed contamination are possible and will be investigated during both the site and waste characterization sampling. Sample collection and analysis for waste management purposes are discussed in Sections 5.3 and 5.4 of this plan.

Table 4-1
Characterization Analytical Methods

Analytical Parameter	SC ^a	WC ^b	FS ^c	Analytical Methods ^d
Chemical and Radiological Analyses				
Total petroleum hydrocarbons - full range	X	X	X	EPA 8015 Modified
Total volatile organic compounds	X	X	X	EPA 8240
Toxicity Characteristic VOCs	X	X	X	EPA 1311/8240
Total semi-volatile organic compounds	X	X	X	EPA 8270
TC metals	X	X	X	EPA 1311/6010 EPA 1311/7470
Polychlorinated Biphenyls	X	X	X	EPA 8080A
Gamma scan	X	X	X	HASL-300, 4.5.2.3 ^e /EPA 901.1
Gross alpha-beta	X	X	X	SM 7110 ^f /EPA 900.0
Plutonium-239/240	X	X	X	NAS-NS-3058 ^g *
Strontium-89/90	X	X	X	Sr-7500 ^h *
Tritium	X	X	X	EERF H.01 ⁱ *
Free liquids paint filter test		X		EPA 9095
Hydrologic Analyses				
Initial moisture content	X			ASTM ^j D 2216-92/D 4643-93
Dry bulk density	X			ASTM D 2937-94/MOSA ^k Chapter 13
Calculated porosity	X			MOSA Chapter 18
Saturated hydraulic conductivity	X			ASTM D 2434-68(94)
Unsaturated hydraulic conductivity	X			SSSAJ ^l , 1980
Particle size distribution	X			ASTM D 422-63(90)
Atterberg Limits	X			ASTM D 4318-93
Moisture retention characteristics	X			MOSA Chapter 26 ASTM D 2325-68(94)/MOSA Chapter 26 SSSAJ, 1984 MOSA Chapter 24 SSSAJ, 1982 ASTM D 3252 MOSA Chapter 23
Geotechnical Analyses				
Shrink/swell	X			ASTM D 4943-89
Specific gravity	X			ASTM D 854-92

Note: Analyses performed on groundwater, if encountered, will depend on the results of the soil sampling

*The listed method or an equivalent, approved method may be used.

^aRequired Site Characterization analysis

^bRequired Waste Characterization analysis

^cRequired Full Suite analysis

^dSW-846 (EPA, 1992) unless otherwise noted

^eEnvironmental Measurements Laboratory Procedure Manual, HASL-300 (DOE, 1992)

^fStandard Methods for the Evaluation of Water and Waste Water (APHA, 1992)

^gNational Academy of Science, Nuclear Series (Coleman, 1965)

^hEastern Environmental Radiation Facility (EPA, 1987)

ⁱAlpha Inc., 1960

^jAmerican Society for Testing and Materials

^kMethods of Soil Analysis (American Society of Agronomy) (Klute, 1986)

^lSoil Science Society of America Journal

Three samples for physical parameter analysis (see Figure 4-1) will be collected from the bottom of three of the boreholes (one in the vicinity of the distribution box and two at the distal end of the leachfield) below any field-detected contamination. These samples will be collected and analyzed in order to evaluate the physical characteristics of the underlying soil with respect to how these characteristics might affect the migration of contaminants and the future remediation or closure options for the site.

5.0 Waste Management Plan

The requirements for managing of the wastes derived from the characterization will be determined based on regulatory requirements, field screening, and the results of off-site laboratory analysis of site characterization samples. Administrative controls (i.e., decontamination procedures and characterization strategies) will minimize the hazardous and/or mixed waste generated during site investigation activities. Hazardous, low-level radioactive (LLW) and/or mixed waste, if generated, will be managed and disposed of in accordance with the *Nevada Test Site Defense Waste Acceptance Criteria* (NTSWAC) (DOE, 1996b), DOE Orders (DOE, 1988a and 1988b), and U.S. Department of Transportation (DOT) and RCRA regulations as agreed to with the NDEP and interpreted as presented in the following sections. Decontamination activities will be performed in accordance with approved procedures as specified in the project field sampling instructions and will be designed according to the COCs present at the site. Requirements for LLW and mixed waste analysis will be presented in a separate plan that will address the specific requirements of NTSWAC:

5.1 Waste Minimization

The characterization activities have been designed to minimize the amount of IDW produced through the segregation of different waste streams and the production of as little waste as possible. The only waste produced will be drill cuttings (soil), used personal protective equipment, and decontamination waste. Initial site preparation activities have been planned to remove no soil from the unit.

5.2 Potential Waste Streams

Based on preliminary sampling results and process knowledge, LLW and/or mixed wastes are anticipated. It is also possible that hazardous wastes will be produced from the 650 Leachfield although they are not expected to exceed the Land Disposal Restriction (LDR) levels for listed hazardous wastes.

Wastes generated during the characterization of the Building 650 Leachfield may include, but are not limited to, the following:

- Decontamination rinsate

- Contaminated sample management equipment (e.g., plastic, paper, aluminum foil, and sample containers)
- Personal protective equipment
- Samples returned from the laboratory
- Contaminated and uncontaminated soil (e.g., cuttings generated from drilling operations)

Samples may be returned from the laboratory for disposal by the generator if the samples are found to exceed established radioactive contaminant limits above which the laboratory can not dispose of the sample material. These limits affect only radioactive and/or mixed waste samples and are expected to result in the return of some samples from the Building 650 Leachfield characterization activities. Any returned mixed waste samples that exceed the LDR levels will be transferred to the Area 5 Transuranic Waste Storage Pad (TRU Pad) pending determination of treatment and/or dispositioning requirements. The samples will be properly stored pending disposal according to the requirements of NTSWAC (DOE, 1996b).

5.3 Waste Determination

Solid materials other than soil waste are waste only by the virtue of contact with contaminated media. The same is true of decontamination rinsate. Therefore, sampling and analysis of the investigation derived waste, separate from site characterization analyses, will not be required. The status of IDW (i.e., TPH, RCRA-hazardous, LLW, and/or mixed waste) will be determined through the application of statistical analyses of site and/or waste characterization sample data as described in Chapter 9 of SW-846 (EPA, 1992) for determining the RCRA status of waste and the requirements of NTSWAC and Bechtel Nevada's (BN) *Nevada Test Site Performance Objective for Certification of Nonradioactive Hazardous Waste* (BN, 1996) for determining the radioactive status of the waste that will be shipped off the NTS. Issues regarding the NTSWAC evaluation and status of the IDW will be discussed in greater detail in the NTSWAC waste management plan to be prepared for the site.

5.4 Waste Management

The data generated as a result of contaminant characterization will be used to assign the appropriate waste type (i.e., hazardous, mixed waste, low-level waste, TPH, Toxic Substances Control Act [TSCA] Waste [i.e., PCBs], or nonregulated) to the IDW. Plate 1 presents a waste management decision process flow chart for characterization activities. The object of the flow

chart is to guide the management of IDW. In order to answer the questions in this flow chart, the appropriate waste data must be obtained with respect to the contaminants encountered during sample analysis. From the data generated as a result of contaminant characterization, it should be possible to assign the appropriate waste type (i.e., hazardous, mixed, LLW, TPH, or unregulated) to the IDW.

Suspected hazardous wastes will be managed in accordance with RCRA and State of Nevada hazardous waste management regulations, interpreted as follows. Suspected hazardous wastes will be placed in DOT-compliant drums which will be locked or fitted with tamper-indicating devices. The containers shall be compatible with the waste in accordance with the requirements of 40 CFR 265.172. Containers shall be handled and inspected in accordance with the requirements of 40 CFR 265.173 and 174, respectively. Incompatible wastes shall be managed in accordance with 40 CFR 265.177 based on process knowledge (i.e., they shall not be placed in the same container, and they shall be separated so that in the event of a spill, leak, or release, suspected incompatible wastes shall not contact one another) (CFR references from ESI, 1996).

Wastes shall be characterized in accordance with the requirements of 40 CFR 262.11. Characterization will be based on laboratory results, process knowledge, or a combination thereof. Wastes pending characterization will be marked with "Hazardous Waste Awaiting Analysis" labels until its regulatory status can be determined through the receipt and evaluation of laboratory results. Once a waste determination has been made, the waste containers shall be relabeled to reflect the correct regulatory status. Waste shall be traceable to its source and/or samples considered analogous to the waste (such as waste drill core associated with a sample). Traceability shall be maintained by numbering containers and keeping appropriate records which trace waste to samples, areas, or products. After receipt of analytical results, RCRA-regulated hazardous wastes will be labeled and marked in accordance with the requirements of Title 40 CFR 262.32, and State of Nevada requirements such as writing the EPA Waste Code on the hazardous waste label. If the waste is not RCRA-regulated hazardous waste, the label will be removed, and the waste will be managed as radioactive or sanitary waste (CFR references from ESI, 1996).

RCRA-regulated hazardous wastes will be accumulated at the site of generation in accordance with Title 40 CFR 262.34. More than 55 gallons of IDW will be generated during the characterization activities on the site. Because of the volume of waste anticipated, if a waste

determination cannot be made within 90 days, a request for an extension (i.e., to continue to maintain the waste on site) will be made to NDEP. This request will be made prior to 90 days after the accumulation start date as specified in 40 CFR 262.34. The waste will be transported to the permitted hazardous waste storage pad in Area 5 of the Nevada Test Site. The waste will ultimately be shipped to an off-site permitted treatment, storage, and disposal facility by an appropriately licensed and permitted hazardous waste hauler. A Uniform Hazardous Waste Manifest shall be completed prior to shipping hazardous waste off site in accordance with the requirements of 40 CFR 262.20, 262.21, 262.22, and 262.23. A copy of the manifest shall be provided to the State of Nevada in accordance with state regulatory requirements (CFR references from ESI, 1996).

Waste that is TSCA-regulated (e.g., PCB contaminated) only, will be staged on site until receipt of laboratory analytical results. Once the analytical results have been received, the waste will be moved to the permitted storage facility in Area 6 of the NTS and shipped off site to a permitted and approved disposal facility within 270 days. RCRA and radioactive waste management requirements shall take precedence over TSCA waste management requirements, which are less stringent.

If low level waste is generated, it will be managed in accordance with the Nevada Test Site Waste Acceptance Criteria (DOE, 1996b). If mixed waste is generated, it shall be managed in accordance with RCRA and State of Nevada regulations, as well as DOE requirements for radioactive waste, interpreted as follows. Where there is conflict in regulations or requirements, the most stringent shall apply. For example, the 90-day accumulation time limit and weekly inspections per RCRA regulations will be applied to mixed waste even though it is not required for radioactive waste. Conversely, while RCRA does not require traceability through the use of waste tracking tags, the waste acceptance program for LLW does; therefore, waste tracking tags shall be used for nonliquid waste. In general, mixed waste shall be managed in the same manner as hazardous waste. Suspected mixed waste will be managed in accordance with applicable regulations, and requirements and will be marked with "Hazardous Waste Awaiting Analysis" labels pending characterization and confirmation of its regulatory status. However, mixed waste shall be transported to the Nevada Test Site 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 Area 5 Radioactive Waste Management Site under interim status. Mixed waste not meeting land disposal restrictions will require development of a

treatment plan under the requirements of the Mutual Consent Order between DOE and the State of Nevada (NDEP, 1995).

If mixed waste is produced, the appropriate waste data must also be obtained or developed in accordance with the TRU Pad waste acceptance criteria. The number of samples necessary to

satisfy the various mixed waste management requirements (i.e., RCRA, NTSWAC [DOE, 1996b]) will depend on the number of containers of IDW produced, the volume of IDW produced, and/or the variability in the analytical values for the IDW produced.

As discussed in Section 5.3, sampling and analysis of the investigation-derived waste (other than soil cuttings), separate from site characterization analyses, will not be required. However, in order to address contractor-specific waste management requirements, a composite sample of the decontamination rinsates produced during the characterization activities shall be collected and analyzed for the waste management parameters discussed in Section 4.5. Administrative controls will be used to ensure that no additional contaminants are added to the waste.

Soil waste will be segregated according to the conceptual model study area and/or soil boring from which it is removed and containerized (see Section 3.4). The anticipated volume of waste-contaminated soil to be generated during the characterization is approximately 13 cubic meters (17 cubic yards) or approximately 63 55-gallon drums. In the event that mixed waste exceeding LDR levels is generated, it will be stored at the TRU Pad in appropriate containers after having met the appropriate waste acceptance criteria. Low-level waste or mixed waste that does not exceed LDR levels, if generated, will be disposed of at the NTS under the NTSWAC Requirements (DOE, 1996b). Hazardous, nonradioactive waste will be shipped off site to a permitted treatment, storage, disposal, or recycling facility.

6.0 Reporting

Upon completion of the field activities and receipt of the sample analytical and data validation results (as applicable), a report of findings will be produced. The report will, at a minimum, include the following:

- Drawings of the site, including appropriate site boundaries, sampling locations, estimated boundaries of contamination, and other relevant features
- Brief discussions of the characterization methods used, including soil sampling methods, materials, and logs
- Information about the presence and concentrations of constituents of concern
- Tables summarizing laboratory analytical results and field screening data, where appropriate
- A discussion about the adequacy of the characterization of the site
- A discussion about the quality control data obtained for the characterization
- Recommendations for further assessment, remediation, or closure of the site

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Appendix A
Data Quality Objectives Scoping Worksheets

DATA QUALITY OBJECTIVES WORKSHEETS FOR THE AREA 23 BUILDING 650 LEACHFIELD CHARACTERIZATION EFFORT

Results of Scoping Meeting Conducted on October 16, 1996, and subsequent informal conversations with the NDEP. **All bold text has been taken from the EPA (1993b) document *Data Quality Objectives Process for Superfund Workbook*.**

I. STATE THE PROBLEM.

A. Identify the members of the Scoping Team:

1. Scoping Team

DOE/NV

Janet Appenzeller-Wing
Sabine Curtis
Lori Arent

NDEP

Jon Taylor
Harry van Drielen

IT Corp.

Kenneth Beach
Edward Thomas
Randy Dubiskas
Don Cox
Syl Hersh
Cheryl Prince

Bechtel

Steve Nacht
Jerry Bonn
Allison Urbon

2. Core Decision Team

Janet Appenzeller-Wing
Sabine Curtis
Kenneth Beach
Randy Dubiskas
Edward Thomas
Syl Hersh

3. Primary Decision Makers

Janet Appenzeller-Wing
Sabine Curtis
Kenneth Beach
Randy Dubiskas

B. Develop/Refine the Conceptual Model:

1. List sources of historic data associated with previous data collection activities

- a. 1985 REECO Standard Procedures for the Industrial Hygiene Laboratory
- b. 1993 REECO sampling results from facility piping
- c. 1994 IT Corporation preliminary sampling results
- d. 1995 BN preliminary sampling results
- e. Process knowledge from various sources to be presented in the characterization plan (e.g., previous draft and final closure and characterization plans)

2. List known or suspected sources of contamination

- a. Discharge into the leachfield system from designated sinks, floor drains, and emergency decontamination showers within the Building 650 Radiochemistry and former Industrial Hygiene Laboratories between 1965 and October 1992
- b. Leakage from the leachfield system distribution box
- c. Leakage from the lines leading from Building 650 to the leachfield distribution box

3. List types of contaminants and affected media

- a. Caustics--hydrochloric and nitric acids--likely neutralized
- b. VOCs--toluene, xylene, acetone, MEK, benzene, carbon tetrachloride, etc.--subsurface soil
- c. RCRA metals--subsurface soil
- d. SVOCs--dioctyl phthalate, etc.--subsurface soil
- e. Radionuclides - tritium, carbon-14, iodine-131, cesium-137, plutonium-239, strontium-89, strontium-90, other mixed fission products--subsurface soil
- f. PCBs--subsurface soil
- g. TPH--subsurface soil

4. List known or potential routes of migration

- a. Primary Model
 - (1) Infiltration and concentration of contaminants into the soil directly below the leachfield distribution box
 - (2) Minor infiltration into the soil around the upper portion of the leachfield
 - (3) No significant infiltration into the soil around the piping leading to the distribution box or the lower portions of the leachfield
 - (4) Infiltration limited to less than 50 feet of vertical and 10 feet of lateral migration
- b. Alternate Model
Infiltration greater than 50 feet of vertical and/or 10 feet of lateral migration

5. List known human and environmental receptors

- a. On-site personnel--minimum potential/exposure
- b. Plants and animals--minimum potential/exposure
- c. Future land use impacts

C. Define the exposure pathway(s):

1. Define the exposure pathway(s)

- a. Entrance into the controlled area and excavation of soil
- b. No exposure potential related to groundwater contamination which is estimated to be at least 240 m (790 ft) below the site

2. Define the current and future land use

- a. Current--unimproved or paved surface, subsurface currently not in use. Surrounding land use includes a helicopter landing pad; however, no fueling equipment or storage tanks are associated. The Building 650 laboratory sinks and drains are currently connected to the sanitary sewer system so that wastes from the laboratory are no longer released to the leachfield.
- b. Future--likely to be similar or no use

3. Define applicable or relevant and appropriate or preliminary remediation goals (PRGs)

EPA Region 9, 1996, PRGs for hazardous, metallic, and PCB constituents, NDEP action levels for TPH, and NTS Performance Objective Criteria for radionuclide constituents will be used to designate screening levels in order to establish stop points for the characterization activities. Any potential remediation and/or closure activities to be conducted on the site will be conducted using NDEP-mandated risk-based evaluation methods for hazardous and TPH constituents (e.g., Risk-Based Corrective Action [RBCA] Guidance) and risk-based analysis using RESRAD (or other acceptable model) for radionuclides in order to support one of the following options:

- a. Closure in place--most likely if contaminants are radionuclides only, and vertical or lateral migration makes excavation impractical. Also most likely for contamination originating from the piping leading to the leachfield distribution box due to the presence of active utilities in the vicinity.
- b. Partial remediation (e.g., chemical components) and closure in place--possible if some contaminants are readily remediated (e.g., VOCs) while others are not (e.g., radionuclides), and/or vertical or lateral migration makes complete excavation impractical.

- c. Remediation (e.g., chemical and radioactive components) and clean closure - likely if contaminants are readily remediated *in situ* (e.g., VOCs, hydrocarbons, etc.) or can be excavated and removed from the site due to limited depth and lateral extent.

4. Develop the exposure scenario

- a. Excavation of contaminated material
- b. Migration of contaminants into groundwater--unlikely to occur and resulting impacts would probably be very minor. The nearest production well (Army Well 1) is located approximately 3.5 miles from the site.

D. Specify the available resources:

1. Specify monetary budget for the field investigation

To be determined based on budgetary constraints; however, allocations should be sufficient to address site.

2. Define relevant time constraints

- a. Characterization to be started in middle FY 1997 and completed in late FY 1997
- b. Closure to be completed in FY 1998

E. Summarize the contamination problem; combine the relevant background information into a concise description of the problem to be resolved:

Radioactive, RCRA-regulated hazardous, Toxic Substances Control Act (TSCA)-regulated, and NDEP-regulated hydrocarbon wastes have been discharged to the Building 650 Leachfield system (i.e., piping, distribution box, and leachfield). The extent to which these materials have impacted surrounding and underlying soil and/or groundwater is currently not known, but must be determined in order to close the site under RCRA, TSCA, DOE, and NDEP requirements.

II. IDENTIFY THE DECISION.

A. Select the appropriate decision for the current phase of the site assessment process:

- 1. Contaminant Identification--Determine whether regulated contaminants are present. (Yes or No answer)
- 2. Action level exceedence--If regulated contaminants are present, determine whether contamination exceeds EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, NTS POC radionuclide screening levels, and NDEP TPH action

levels applicable to the site or the current study area under investigation.
(Yes or No answer)

3. Contaminant migration--If regulated contaminant exceed screening levels, determine whether regulated contaminant concentrations exceed the spatial boundaries proposed in the conceptual model for the site? (Yes or No answer)

B. Identify alternative action that may be taken based on the findings of the field investigation; select the actions that will be taken based on the outcome of the field investigation that corresponds with the selected decision:

1. Contaminant Identification
 - a. (No answer) Recommend that the site or the current study area is not contaminated and further assessment (at this location) is not necessary.
 - b. (Yes answer) Recommend that the current study area is contaminated and further assessment (at this location) may be warranted (i.e., determine if action levels have been exceeded).
2. Action Level Exceedence
 - a. (No answer) Recommend that the site or the current study area is not contaminated above applicable screening levels and further assessment (at this location) is not necessary.
 - b. (Yes answer) Recommend that the current study area is contaminated above applicable screening levels and further assessment (at this location) may be warranted (i.e., determine if the conceptual model is correct).
3. Contaminant Migration
 - a. (No answer) Recommend that the regulated contaminant concentrations do not exceed the proposed spatial boundaries and the conceptual model does not need to be modified.
 - b. (Yes answer) Recommend that the regulated contaminant concentrations exceed the proposed spatial boundary and the model must then be modified and further assessment is required to evaluate the new model.

C. Identify relationships among decisions:

1. Prioritize decisions
 - a. Contaminant Identification
 - b. Action Level Exceedence
 - c. Contaminant Migration
 - (1) Vertical migration
 - (2) Lateral migration--subsurface
 - (3) Shallow perched groundwater contamination

2. Determine the logical sequence of actions

Presented in flow chart form (see Plate 2, and Figures A-1 through A-5) based on the sequence presented in IIA, B, and C.

III. IDENTIFY THE INPUTS TO THE DECISION.

A. Identify the information inputs needed to resolve the decision:

1. Prepare a list of all of the data needed to resolve the decision

a. Characterization

Man-made radionuclides (gamma scan, strontium 89/90, isotopic Pu, tritium, gross alpha/beta)

RCRA VOCs/TC VOCs, SVOCs, TC metals

TPH - full range

PCBs

Contaminant distributions (i.e., boundaries)

b. Waste Management

NVO-325 analyses/process knowledge package (i.e., all planned characterization analyses plus free liquids)

Contaminant distributions (i.e., volume)

c. Engineering

Soil physical characteristics (hydrological and geotechnical)

2. Indicate how to generate the necessary data (e.g., sampling modeling, etc.)

a. Sampling and analysis

b. Contaminant distribution modeling

c. Review of historic information on waste inventory, contaminant types, soil characteristics, nearby well records, groundwater maps, etc.

B. Identify sources for each environmental input and list those inputs that are obtained through environmental measurements; identify existing sources of information that can support the decision:

1. Preliminary sampling results from 1992, 1993, 1994 and 1995 (REECo, IT Corp., and BN)

2. Historic distribution box sampling results, during facility operation in 1988 and 1990 (REECo)

C. Determine the basis for establishing contaminant-specific action level(s); list the possible basis for establishing the action level (e.g., regulatory threshold, risk or exposure assessment, technological limits, reference based, standards, etc.):

1. Hazardous and TSCA waste

- a. Characterization--Non-detect levels are expected for most parameters at relatively shallow depths; however, the following levels can be used in the event of attenuating contamination that does not appear to be rapidly approaching non-detect. EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, and NDEP TPH action levels applicable to the site or the current study area will be used to screen the site for contamination; however, current RCRA standards apply (i.e., presence above the detection limit for listed wastes and TC levels in 40 CFR 261.24 for TC wastes), and development of site-specific clean-up levels may be required prior to remediation and/or closure of the site.
- b. Waste management
 - (1) Listed wastes--presence above detection limits for designation (i.e., as hazardous waste) and concentrations above the LDR levels for disposal
 - (2) Characteristic wastes--concentrations above the TC levels for designation and disposal

2. Radionuclides

- a. Characterization--presence of man-made radionuclides above background for initial field screening, followed by application of NTS POC screening levels for evaluation of waste that will be shipped off the NTS, and finally either the presence of man-made radionuclides above background on risk-based analysis using RESRAD (or another acceptable model) for final characterization results (based on the outcome of discussions currently taking place between the DOE and the NDEP)
- b. Waste management--concentrations above the POC

3. TPH (characterization and/or waste management)--Concentrations above 100 ppm in soil by EPA Test Method 8015 Modified per NAC 459.9973, NAC 445A, and the NDEP *Soil and Groundwater Remediation Policy of 1992*

4. General--Establishment of risk-based levels through the implementation of RCRA, CERCLA, and/or ASTM risk assessment techniques, as necessary and/or appropriate

D. Identify potential sampling approaches and appropriate analytical methods:

1. Sampling

- a. Subsurface drilling (i.e., less than 50 feet bgs) and sampling below and around the distribution box, leachfield, and piping with locations based on the results of preliminary investigations
- b. Subsurface drilling (i.e., greater than 50 feet bgs) and sampling (if necessary based on the results of [a]) below and around the distribution box, leachfield, and piping with locations based on the results of (a) (if applicable)

2. Analytical

Drilling and sampling to be conducted in early- to mid-1997. Parameters selected based on the process knowledge, the results of preliminary investigations, and requirements specified by the NDEP for "full suite" analysis.

Total VOCs - EPA 8240

TC VOCs - EPA 1311/8240

Total SVOCs - EPA 8270

TC metals

Total petroleum hydrocarbons - gasoline, diesel, and oil fractions

PCBs

Gamma spectroscopy (preliminary sampling results indicated the presence of Co-60, Cs-137, Am-241, Tl-208)

Strontium 89/90

Isotopic plutonium

Tritium

Gross alpha/beta

Free liquids paint filter test (to be run for NTSWAC waste management requirements)

Off-site, fixed-base laboratory used for soil engineering analysis (will provide data applicable to remedial/closure option evaluation)

Initial moisture content

Dry bulk density

Calculated porosity

Saturated/unsaturated hydraulic conductivity

Particle size distribution

Moisture retention characteristics

IV. DEFINE THE BOUNDARIES OF THE STUDY.

A. Define the geographic areas of the field investigation:

- 1. Define the domain or geographic area within which all decisions must apply (in some cases this may be defined by the Operable Unit)**
 - a. Study Area 1--Soil directly below and immediately surrounding the distribution box which is likely to have been impacted by unplanned releases from the distribution box
 - b. Study Area 2--Soil directly below and immediately surrounding the leachfield piping that has the potential to have been impacted by designed releases from the leachfield piping
 - c. Study Area 3--Soil directly below and immediately surrounding the piping leading from Building 650 to the leachfield distribution box
 - d. Study Area 4--Soil below and around Areas 1, 2, and 3 that has not been impacted by planned or unplanned releases from the leachfield system
- 2. Specify the characteristics that define the population of interest**
 - a. Study Area 1--Potential for man-made radionuclide contamination above background, RCRA-listed waste, characteristic waste, metals, PCB contamination, and TPH contamination above NDEP action level of 100 ppm
 - b. Study Area 2--Decreasing potential with distance from the distribution box for man-made radionuclide contamination above background, RCRA-listed waste, characteristic waste, metals, PCB contamination, TPH contamination above NDEP action level of 100 ppm
 - c. Study Area 3--Slight potential for man-made radionuclide contamination above background, RCRA-listed waste, characteristic waste, metals, PCB contamination, and TPH contamination above NDEP action level of 100 ppm
 - d. Study Area 4--Uncontaminated or contamination below applicable regulatory action levels
- 3. When appropriate, divide the population into strata that have relatively homogeneous characteristics**
 - a. Study Area 1--Contaminated, highest priority, greatest activity
 - b. Study Area 2--Potentially contaminated, already partially characterized, higher priority nearer to the distribution box
 - c. Study Area 3--Potentially contaminated, already partially characterized, low priority
 - d. Study Area 4--Uncontaminated, lowest priority, lowest activity, sampled only as necessary to define the boundaries of the other study areas

4. Define the scale of decision making

The scale of decision making will be based on the study areas into which the site has been divided. Decisions shall be made in order to provide data to support or refute the characteristic and spatial study boundaries for each of the study areas identified above and in the conceptual model.

B. Define the temporal boundaries of the decision:

1. Determine the time frame to which the study data apply

- a. Process knowledge to include all available validated (i.e., source of information can be traced and verified) documentation regardless of age of information
- b. Begin--1994 preliminary evaluation by IT Corp. and 1995 preliminary evaluation by REEC/BN
- c. End--Completion of all planned characterization activities
- d. Extend--May be extended to include additional characterization activities not currently planned depending on the amount of time necessary to implement and complete

2. Determine when to collect data

Characterization activities will be conducted only during favorable weather conditions (i.e., no rain, no significant wind); however, engineering controls may be used to improve conditions.

C. Identify any practical constraints on data collection:

1. Seasonal
2. Meteorological
3. BN personnel
4. Health and safety

V. DEVELOP A DECISION RULE; DEFINE A LOGICAL BASIS FOR CHOOSING AMONG ALTERNATIVE ACTIONS.

A. Specify the parameter that characterizes the population of interest:

Individual sample results for identified contaminants and mean concentrations of identified contaminants (i.e., RCRA, TSCA, TPH, radiological), where applicable

B. Specify the action level or preliminary action level for the decision:

1. On-site (if an on-site laboratory or screening methods are used)
 - a. Radiation levels above background
 - b. RCRA contamination above detection limits or total concentrations of TC components above 20 times the TC limits if TCLP analyses are not conducted
 - c. TPH above 100 ppm
2. Off-site
 - a. Presence of man-made radionuclides above background for initial field screening, followed by application of NTS POC screening levels for evaluation of waste to be shipped off the NTS, and finally either the presence of man-made radionuclides above background on risk-based analysis using RESRAD (or another acceptable model) for final characterization results (based on the outcome of discussions currently taking place between the DOE and the NDEP)
 - b. RCRA-listed contaminant concentrations above detection limits but below the EPA Region 9 PRGs for initial site screening and characterization and above risk-based levels (which may be different) for final analysis of contamination
 - c. TPH concentrations above the TPH limits per the NAC 445A and NDEP *Soil and Groundwater Remediation Policy of 1992*

C. Develop the decision rule; Combine the outputs of the previous DQO steps into "if ... then ..." decision rules that include the parameters of interest, the action levels, and the alternative actions:

Presented in flow chart form (Figures A-1 through A-5)

VI. SPECIFY ACCEPTABLE LIMITS ON DECISION ERRORS; SPECIFY DECISION ERROR LIMITS BASED ON THE CONSIDERATION OF THE CONSEQUENCES OF MAKING AN INCORRECT DECISION.

A. Determine the upper and lower bounds for the parameter of interest using relevant historical site data:

1. Radionuclides
 - a. Cs-137 @ ND--1.23 picoCuries per gram (pCi/g)
 - b. Co-60 @ ND--1.33 pCi/g
 - c. Tl-208 @ ND--0.37 pCi/g
 - d. Am-241 @ ND--20.5 pCi/g

- e. Pu-239 @ ND--0.0022 pCi/g
 - f. Gross alpha @ 2.36--70.8 pCi/g
 - g. Gross beta @ 3.73--19.9 pCi/g
- 2. VOCs--none detected in preliminary investigations
 - 3. SVOCs--none detected in preliminary investigations
 - 4. Metals
 - a. Barium @ 28--73 mg/kg (TC @ 0.19 - 0.30 milligrams per Liter [mg/L])
 - b. Cadmium @ ND--0.8 mg/kg (TC not detected)
 - c. Chromium @ 3--16 mg/kg (TC not detected)
 - d. Mercury @ ND--5.2 mg/kg (TC @ 0.00007 - 0.0001 mg/L)
 - 5. TPH @ ND--155 mg/kg (only previous results from EPA Method 418.1)
 - 6. PCBs--none analyzed to date

B. Define both types of decision errors and identify the potential consequences of each:

Present in flow chart form (Plate 3)

- 1. **Using the actions, action level, and decision rule(s), define both types of decision errors**
 - a. Contaminant Identification--Regulated contaminants **are/are** not present within the current study area(s).
 - b. Action Level Exceedence--If regulated contaminants are present, contamination **does/does** not exceed EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, NTS radionuclide background levels, and NDEP TPH action levels applicable to the site or the current study area under investigation.
 - c. Contaminant Migration--If regulated contaminants exceed applicable screening/action levels, the regulated contaminant concentrations **do/do not** exceed the spatial boundaries proposed in the conceptual model for the site.
- 2. **Establish the true state of nature for each decision error**
 - a. Contaminant Identification--Regulated contaminants are present within the current study areas.

- b. Contaminant characterization--The contamination exceeds EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, NTS radionuclide background levels, and NDEP TPH action levels applicable to the site or the current study area under investigation
 - c. Contaminant migration--Regulated contaminant concentrations exceed the spatial boundaries proposed in the conceptual model for the site.
- 3. Define the true state of nature for the more severe decision error as the baseline condition or the null hypothesis (H_0), and define the true state of nature for the less severe decision error as the alternative hypothesis (H_a)**
- a. Contaminant Identification
 - (1) H_0 --Regulated contaminants are present within the current study areas.
 - (2) H_a --Regulated contaminants are not present within the current study areas.
 - b. Action Level Exceedence
 - (1) H_0 --The contamination exceeds EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, NTS radionuclide background levels and NDEP TPH action levels applicable to the site or the current study area under investigation.
 - (2) H_a --The contamination does not exceed EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, NTS radionuclide background levels, and NDEP TPH action levels applicable to the site or the current study area under investigation.
 - c. Contaminant Migration
 - (1) H_0 --Regulated contaminant concentrations exceed the spatial boundaries proposed in the conceptual model for the site.
 - (2) H_a --Regulated contaminant concentration do not exceed the spatial boundaries proposed in the conceptual model for the site.
- 4. Assign the terms "false positive" and "false negative" to the proper decision errors**
- a. Contaminant Identification
 - (1) False positive--Regulated contaminants are not present within the current study areas.
 - (2) False negative--Regulated contaminants are present within the current study areas.
 - b. Action Level Exceedence
 - (1) False positive--The contamination does not exceed EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, NTS radionuclide background levels, and NDEP TPH action levels applicable to the site or the current study area under investigation.

- (2) False negative--The contamination exceeds EPA Region 9 PRGs, RCRA TC hazardous waste screening levels, NTS radionuclide background levels, and NDEP TPH action levels applicable to the site or the current study area under investigation.

c. Contaminant Migration

- (1) False positive--Regulated contaminant concentrations do not exceed the spatial boundaries proposed in the conceptual model for the site.
 (2) False negative--Regulated contaminant concentrations exceed the spatial boundaries proposed in the conceptual model for the site.

C. Specify a range of possible parameter values where the consequences of decision errors are relatively minor (the gray region); identify the range of points on the false negative side of the action level where the consequences of making a decision errors are relatively minor. This range establishes the gray region:

Established as the region from 80 to 100 percent of the action level

D. Assign probability values to points above and below the action level that reflect the acceptable probability for the occurrences of decision errors:

Where statistical analysis can be performed (e.g., gridded sampling results or analysis of biased contaminated sample groups), the probability values shall be established at a 90 percent confidence level above and below the grey area.

True Concentration	Correct Decision	Type of Error	Tolerable Probability of Incorrect Decision	Level of Confidence
< 80% action level	Not exceeded	False Negative	10%	90%
80 - 100% action level	Not exceeded	False Negative	Gray Region	Gray Region
> 100% action level	Does exceed	False Positive	10%	90%

E. Check for consistency; check the limits on decision errors to ensure that they accurately reflect the decision maker's concerns about the relative consequences for each type of decision error:

Limits meet current concerns by involved decision makers but will require formal approval during the internal and NDEP review process.

VII. OPTIMIZE THE DESIGN; OUTLINE A SAMPLING DESIGN, SPECIFYING THE OPERATIONAL DETAILS OF THE SAMPLING PLAN WHICH FALLS WITHIN THE PROJECTS CONSTRAINTS.

A. Review the DQO outputs and existing environmental data; compile outputs from previous steps of the DQO process:

1. Process inputs
2. Study boundaries
3. Decision rules
4. Limits on decision errors

B. Develop general sampling and analysis design alternatives:

1. Develop a preliminary estimate of variability

Insufficient data is available to adequately estimate the variability for the likely constituents of concern.

2. Develop a sampling strategy for the site that specifies all of the previously defined data quality objectives

- a. Subsurface drilling (i.e., less than 50 feet bgs) and sampling below and around the distribution box, leachfield, and piping with locations based on the results of preliminary investigations
- b. Subsurface drilling (i.e., greater than 50 feet bgs) and sampling (if necessary based on the results of [a]) below and around the distribution box, leachfield, and piping with locations based on the results of (a) (if applicable)

C. For each design alternative, verify that the DQOs are satisfied:

Subsurface sampling techniques may require reliance on single-sample decisions rather than statistical analysis but have no practical alternatives.

D. Select the most resource-effective design that satisfies all of the DQOs:

1. Subsurface drilling (i.e., up to 50 feet bgs) and sampling with locations based on the results of preliminary sampling activities. A total of at least 12 borings are planned, four in the vicinity of the distribution box (one center [if possible, otherwise directly adjacent] and three within approximately 5-10 feet), four in the vicinity of the first piping "perforation" in the leachfield, two in the vicinity of the end of the leachfield piping (see Figure 4-1), and two in the vicinity of the piping leading from Building 650 to the leachfield distribution box (i.e., borings spaced along the run of the piping). The borings will be drilled to at least 10 feet below the maximum depth of

contamination to an estimated total depth of 50 feet bgs, as determined through field screening and/or rush turn-around analysis of samples.

If the contamination is found to be deeper than anticipated, the boring depths will be extended appropriately. Samples for chemical and radiological analysis will be obtained from approximate 5-foot intervals for the first 50 feet, after which the sampling interval will be increased to approximately 10 feet. Samples for off-site analysis will be selected based on the results of on-site screening and will be included between three and five samples per boring with at least two samples from below any field-detected contamination. Hydrologic/geotechnical samples will be obtained from at least three of the borings below detected contamination. These samples will be held pending the results of the chemical and radiological analysis in order to confirm that contamination is present and may be closed in place, and that the samples have been obtained from unimpacted soil.

2. Deeper (i.e., 50 to 100 feet bgs) subsurface drilling and sampling with locations based on the results of the shallower drilling

E. Document the operational details and theoretical assumptions of the selected design in the sampling and analysis plan:

Documentation will be contained in the "Sampling and Analysis Plan" section of the *Site Characterization Plan*.

Figure A-1
Legend of the Decision Rule Diagrams

Figure
Decision Rules For Contamination
and Action Levels

Contamination
Exceedence

Does the contamination
exceed the RCRA or
TSCA action levels or
do the concentrations
exceed the COCs
action levels?

NO

The contamination is not RCRA or
TSCA regulated (i.e., hazardous).

Likely path for
the 650 Leachfield

YES

Do TPH concentrations
exceed the NDEP action
level of 100 ppm?

NO

The contamination is TPH.

The contamination is not TPH or
RCRA hazardous.

YES

Do
man-made radionuclide
concentrations exceed
action levels?

NO

The contamination is radioactive
and TPH (i.e., low-level waste
contamination).

The contamination is TPH.

YES

Do
man-made radionuclide
concentrations exceed
action levels?

NO

The contamination is radioactive
(i.e., low-level waste
contamination).

The contamination is not
radioactive, TPH, or RCRA
hazardous waste
(i.e., uncontaminated).

2
Dominant Identification
Exceedence

Figure A-3
Decision Rules for Lateral Contaminant Migration Evaluation

Figure A-4
Decision Rules for Vertical Contaminant Migration Evaluation

Figure A-5
Decision Rules for Preliminary Shallow Perched Groundwater Evaluation

Appendix B
Environmental Setting

B.1.0 Environmental Setting

B.1.1 Topography

The NTS lies in the Great Basin section of the Basin and Range physiographic province that encompasses Nevada, Arizona, and western Utah. The Basin and Range province was formed by east-west tectonic extension that stretched the original crust over 100 percent. Large north-south striking normal faults accommodated the extension, resulting in long, thin, parallel, north-south-oriented mountain ranges separated by down-dropped basins. The ranges are steep-sided and are relatively constant in elevation and width. The basins are broad and flat.

On the NTS, the higher elevations are on Pahute Mesa, approximately 2,200 m (7,230 ft) above mean sea level (amsl), and Rainier Mesa, approximately 2,340 m (7,690 ft) amsl. The lowest elevations are in Frenchman Flat and Jackass Flat, both at approximately 900 m (3,000 ft) amsl. The NTS can be generally described as ranging from about 900 to 1,370 m (3,000 to 4,500 ft) amsl in the valleys to the south and east and rising to 1,700 to 2,100 m (5,600 to 6,900 ft) amsl in the high country toward the northern and western boundaries (ERDA, 1977). Yucca Flat lies more than 1,200 m (4,000 ft) amsl. The Building 650 Leachfield is approximately 1,000 m (3,300 ft) amsl.

There are three principal valleys within the NTS:

- Yucca Flat, a north-south elongated closed basin, with Yucca Lake, a dry lake (playa), at the southern end
- Frenchman Flat, an oval-shaped closed basin, with Frenchman Lake (playa) at the center
- Jackass Flat, a valley that drains off the NTS at its southwest corner

Pahute Mesa, Rainier Mesa, Timber Mountain, and Shoshone Mountain are prominent highland areas that dominate the NTS landscape (ERDA, 1977).

The Building 650 Leachfield is located in Mercury, Nevada, in the southeast corner of the NTS, on the northeast flank of the Armagosa Valley. Surface runoff from Mercury drains southwest into the Armagosa Valley.

B.1.2 Shallow Soils and Stratigraphy

At the Building 650 Leachfield, a 30-m (100-ft) thick layer of Quaternary alluvium derived from hills to the east (i.e., Mercury Ridge, North Ridge, and Spotted Range) is underlain by the Lower Paleozoic carbonate stratigraphic units which contain the Paleozoic lower carbonate aquifer (Winograd and Thordarson, 1975). Surface deposits in the area consist of alluvial silty sands with gravels and cobbles. The site-specific geotechnical and hydrogeologic characteristics of the alluvium at the Building 650 Leachfield are currently unknown.

B.1.3 Surface Water

The only perennial surface-water bodies on the NTS are several small springs and associated pools that occur on the flanks of ranges or the edges of topographic basins. The sources of spring recharge are perched, saturated zones in highland ranges (Winograd and Thordarson, 1975). Surface water in the vicinity of the Building 650 Leachfield is present only during intense storms which are most likely to occur during the summer months.

B.1.4 Groundwater

Beneath the Building 650 Leachfield, the water table and/or perched water zones lie in the Quaternary and Tertiary valley-fill aquifer or Tertiary tuff aquitard (Winograd and Thordarson, 1975). Groundwater is reported at approximately 460 m (1,500 ft) below land surface (Winograd and Thordarson, 1975). Flow in the Quaternary alluvium and underlying carbonate rocks would be primarily vertical beneath the site except for local, small-scale heterogeneities, such as clay or silt lenses or fractures, that may cause increased lateral and/or vertical flow.

A water supply well (Army Well 1), located approximately 5.6 kilometers (3.5 miles) southwest of the Building 650 Leachfield, was installed in 1962 and penetrates a perched water zone at approximately 240 m (790 ft) below the land surface (O'Hagan, 1992). It is not known whether a perched water zone is present beneath the Building 650 Leachfield. The perched water zone may indicate that the hills to the east of Mercury contain perched or semiperched groundwater at altitudes hundreds of feet above the groundwater table. Also, because of the extremely low transmissibility of the aquitards near the Building 650 Leachfield and their structurally high position near the margins of Mercury Valley, the existence of a perched or semiperched water zone in the vicinity of the Building 650 Leachfield is likely. However, if the elevation of the

perched water at the Army Well 1 location is any indication, the perched zone would still lie a significant distance below the Building 650 Leachfield.

Winograd and Thordarson (1975) postulate that perched and semiperched groundwater in the Quaternary and Tertiary aquifers and aquitards leaves Mercury Valley by downward leakage into the underlying carbonate aquifers. Groundwater movement may take place either through structurally controlled sinks or by vertical drainage throughout the entire basin. The magnitude of such leakages is up to 70 acre-ft per year.

Appendix C
Results of Previous Evaluations

C.1.0 Results of Previous Evaluations

Samples of both soil and distribution box water have been obtained from the Building 650 Leachfield and associated piping areas on at least five occasions in the past. A geophysical evaluation has also been conducted. The following sections discuss the results of these evaluations.

C.1.1 Distribution Box Liquid Evaluations

In 1988 and 1990 a total of six grab samples were taken from the distribution box by REECo (REECo, 1993). The samples were analyzed for gross beta, gamma, and/or tritium. The results of the sampling are summarized in Table C-1.

Table C-1
Radionuclide Concentrations for Water Samples
from the Building 650 Leachfield Distribution Box

Sample Date	Tritium ($\mu\text{Ci/mL}^a$)	Gross Beta ($\mu\text{Ci/mL}$)	Gamma Scan ($\mu\text{Ci/mL}$)
3/23/88	6.990E-07	6.840E-09	ND ^b
4/15/88	7.450E-07	1.420E-08	Co-60 7.510E-08 Rh-106 1.340E-07
5/11/88	1.130E-06	2.260E-05	ND
4/25/90	9.130E-08	1.764E-06	ND
8/17/90	1.566E-07	1.487E-08	ND
9/12/90	1.432E-07	2.102E-08	ND
12/5/90	ND	NA ^c	ND

^a MicroCuries per milliliter

^b Non-detected above laboratory detection/reporting limits

^c Not analyzed

C.1.2 1992 Soil Sample from Below the Distribution Box

On October 15, 1992, REECo collected a soil sample from below the distribution box by inserting an aluminum tube through the hole in the bottom of the box and approximately 10 to 15 centimeters (4 to 6 in.) into the underlying soil. The sample was analyzed at the Building 650 laboratory for gamma emitters. Analysis indicated the presence of cesium-137 at

3.30E-06 $\mu\text{Ci/g}$ (microCuries per gram) (3.30 picoCuries per gram) and cobalt-60 at 1.44E-04 $\mu\text{Ci/g}$ (144 pCi/g).

C.1.3 1992 Piping Excavation Sampling

In October 1992, REECo excavated three trenches east of Building 650 (see REECo, 1993): one at each drain line (referred to as the north and south trenches) and one along the main leachfield line at the sewer manhole between the drain lines (referred to as the middle trench) (see Figure C-1). Soil samples were obtained from adjacent to the drain lines at three locations in the trenches. The samples from the south and middle trenches were analyzed for VOCs, SVOCs, TC metals, pH, tritium, gamma scan, and plutonium while the sample from the north trench was only analyzed for SVOCs. The only constituents identified were methylene chloride and acetone at laboratory contamination levels, TC barium at background levels, plutonium-239 at 2.20E-09 $\mu\text{Ci/g}$ (2.20E-03 pCi/g) in the middle trench sample, and cesium-137 at 1.66E-07 $\mu\text{Ci/g}$ (0.166 pCi/g) in the south trench sample.

C.1.4 1994 Preliminary Evaluation

In August and September 1994, IT conducted a preliminary evaluation of the Building 650 Leachfield (see IT, 1995). The evaluation involved the excavation of two trenches across and along the two central leachfield drain pipes near the distal end of the leachfield. The trenches were excavated to a depth of approximately 12 feet below ground surface and samples were collected from the trench profiles (see Figure C-2 for the approximate locations of the trenches). A total of four soil samples, one background sample, and one field duplicate sample were collected and analyzed for VOCs using EPA Test Method 8240, SVOCs using EPA Test Method 8270, TPH using EPA Test Method 418.1, TC metals using EPA Test Methods 6010 and 7000, and radiological parameters using Standard Method 7110 (gross alpha and gross beta) and HASL 300, 4.5.2.3 (gamma spec).

Sample LCH00007, taken from the bottom of the west end of Trench 1, was reported to contain 155 milligrams/kilogram (mg/kg) of TPH. However, the TPH result was obtained using EPA Test Method 418.1 which is only used for gross screening for hydrocarbon compounds and cannot be used to substantiate the presence or absence of hydrocarbon contamination to the NDEP. It is likely that the results of an analysis using EPA Test Method 8015 Modified rather than Method 418.1 for TPH would have yielded lower results for the same sample. Sample LCH00008, taken from 8 to 10 feet depth on the east end of Trench 1, was reported to contain 5 micrograms per kilogram ($\mu\text{g/kg}$) of methylene chloride, a regulated hazardous waste. The

Figure C-1
1992 Piping Excavation Sampling Trench and Sample Locations
Area 23, Building 650 Leachfield Facility

RCRA 650LF
 Section: Appendix C
 Revision: 1
 Date: 03/18/97

Area 23
 Building 650
 Leachfield

SCALE

Source: IT, 1995

LEGEND

- Contour interval equals 1 foot
- Drainage ditch
- Distribution pipe
- Discharge pipe
- Approximate trench location

Figure C-2
1994 Preliminary Evaluation Trench and Sample Locations
Area 23, Building 650 Leachfield Facility

methylene chloride is likely to be a laboratory contaminant based on its very low concentration, the detection limit for methylene chloride (i.e., 5 µg/kg), and its lack of presence in any of the other samples.

The analytical results did not appear to indicate the presence of man-made or man-added radionuclides in the samples analyzed.

C.1.5 1994 Distribution Box and Laboratory 126 Discharge Line Operational Closure

In March and May 1994, closure activities were conducted by REECo on the Building 650 Leachfield distribution box and the Laboratory 126 discharge line leading to the distribution box (REECo, 1994). The closure activities included plugging the discharge line into the distribution box with rapid setting cement, hand excavation of the laboratory discharge line, sampling of soil at two locations along the line, and rerouting the line to the sanitary sewer. A total of four soil samples were obtained: two below a deteriorated pipe junction and two below the intersection of the laboratory discharge line and the main leachfield line (see Figure C-3). A background soil sample was also collected in the vicinity of the helicopter pad, approximately 183 m (600 ft) southeast of the project site. The soil samples were analyzed for VOCs, SVOCs, TC metals, PCBs, pH, gamma scan, isotopic plutonium, and tritium. The results of the soil analyses indicated no chemical or radioactive COCs in the soil below the piping.

C.1.6 1994 Geophysical Evaluation

In October and November 1994, a geophysical investigation was conducted at the Building 650 Leachfield (IT, 1996) with the following objectives:

- Determine if leachate migration away from the leachfield has occurred.
- Approximate the lateral boundaries and vertical extent of any plume present in the shallow subsurface.
- Locate shallow conductive zones in the vicinity of the ponds potentially representing perched leachate.

To accomplish these objectives, electromagnetic induction surveys were conducted at various transmitter/receiver intercoil spacings and system configurations, which provided for a qualitative interpretation of changing physical conditions with depth beneath the surface.

Interpretation of the results of the survey suggested that there was no obvious subsurface fluid/leachate migration away from the leachfield. However, surface conditions and subsurface utilities in the area of the leachfield (i.e., buildings) may have skewed some of the data values (particularly those nearest the leachfield), resulting in an inaccurate interpretation of subsurface conditions. Subsurface investigation and sampling will be necessary to confirm the results of the geophysical evaluation.

C.1.7 1995 Preliminary Evaluation

In February 1995, REECo used a GeoProbe sampling device to collect three samples from below the leachfield distribution box. The GeoProbe apparatus used a hydraulic ram to drive a small-diameter core barrel through the hole in the bottom of the distribution box and into the underlying soil. Samples were collected from approximately 56 cm (22 in.), 112 cm (44 in.), and 168 cm (66 in.) below the base of the distribution box. The samples were analyzed for total and TC metals, gamma scan (20 and 300 minutes), tritium oxide, and gross alpha/beta. The small sample volumes did not allow for additional analyses. The 300-minute gamma scan results indicated the presence of americium-241, cobalt-60, and cesium-137 in the soil to a depth of at least 168 cm (66 in.). No other constituents of concern were identified. Table C-2 summarizes the analytical data which have not been published in a final report of findings to date.

Table C-2
1995 300-Minute Gamma Scan Analytical Results

Sample Number	Americium-241 (pCi/g^a)	Cobalt-60 (pCi/g)	Cesium-137 (pCi/g)
650-DB-22	ND	0.699	1.23
650-DB-22-44	20.2	1.33	0.718
650-DB-44-66	1.97	1.18	0.944

^aPicoCuries per gram

Appendix D
Nevada Environmental Restoration Project
Document Review Sheet
Nevada Division of Environmental Protection
Comments and Responses

NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

1. Document Title/Number Area 23 Building 650 Leachfield Characterization Plan 2. Document Date January 1997
3. Revision Number Revision 1 4. Originator/Organization IT Corporation
5. Responsible DOE/NV ERP Subproject Mgr. Janet Appenzeller-Wing, DOE/NV 6. Date Comments Due March 14, 1997
7. Review Criteria Review for Technical Content and Level of Detail
8. Reviewer/Organization/Phone No. Mr. Jon Taylor, NDEP 9. Reviewer's Signature N/A

10. Comment Number/ Location	11. Type ^a	12. Comment	13. Comment Response	14. Accept
1.		As discharge to the leachfield has been sourced as the Building 650 Laboratories, contamination confirmed in either the distribution box or the Leachfield may also be contained in the discharge lines above the distribution box. Given this, sampling results from previous investigation must also meet the Data Quality Objectives (DQOs) defined in the document, as well. Specifically, <u>all</u> data used in support of the Sites' characterization, inclusive of data acquired from previous investigations must undergo the same scrutiny and validation procedure as that proposed to be acquired for the current investigation.	The results of previous preliminary evaluations conducted at the 650 Leachfield were discussed during the DQO process without any objection made to their use as part of the characterization of the site. The data was collected under standard QA/QC protocols and has been deemed reliable under this condition. Samples were collected at specific locations along the pipelines where leakage and contamination was most likely to occur (i.e., pipe joints and cracks) and no indications of contamination were detected. The two borings planned for the portions of the piping near the distribution box will be used to augment and confirm the results of these previous samplings. If contamination is not present in these borings, it should be reasonable to conclude that the piping has been sufficiently characterized and Study Area 3 may be considered uncontaminated and thus part of Study Area 4. Since leaks from piping are typically very localized (e.g., from a joint in the piping) if contamination is encountered in the borings, additional investigation should still only be necessary up to the point where the previous investigations were conducted on the north side of the whole-body counter.	

^a Comment Types: M = Mandatory, S = Suggested.

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NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

Document Title/Number Area 23 Building 650 Leachfield Characterization Plan

Revision Number Rev. 1

Reviewer/Organization Mr. Jon Taylor - NDEP

10. Comment Number/ Location	11. Type ^a	12. Comment	13. Comment Response	14. Accept
2.		In Section 3.4 Conceptual Model, four (4) study areas have been identified for sampling activities. Study areas 1, 2 and 3 refer to areas of likely contamination, however, Study Area Four (4) refers to unimpacted (assumed) soils. It is unclear whether the samples taken from these areas will be used to show either, the edge of contamination or used as background samples for future use. The NDEP requests some clarification on how and in what form samples from these areas will be used.	<p>Study Area 4 is basically the equivalent of the "rest of the world." It is defined since there are specific samples to be taken from this Area in order to delineate the edges of the contamination. For example, as stated in the plan, at least two clean samples will be taken from the bottom of each boring prior to completing the boring. This will be done in order to ensure that the base of the contamination has been identified with the assumption that no separated contaminant plumes exist at greater depths. Furthermore, some step-out borings are planned (i.e., around the distribution box) and others may be deemed necessary based on field indications of contamination. When a step-out boring has been drilled and results in no indications of contamination in the field or through laboratory sample analysis, this boring is will be used to define the edge of the contamination (i.e., the boundary between Study Area 4 and one of the other Study Areas). Although no samples are being taken specifically for the purpose of evaluating background values, samples from Zone 4 could be considered background samples.</p> <p>The text in the document will be changed in order to clarify the use of Study Area 4 based on the above information.</p>	

^a Comment Types: M = Mandatory, S = Suggested.

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NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

Document Title/Number Area 23 Building 650 Leachfield Characterization Plan

Revision Number Rev. 1

Reviewer/Organization Mr. Jon Taylor - NDEP

10. Comment Number/ Location	11. Type ^a	12. Comment	13. Comment Response	14. Accept
3.		<p>In Section 4.4 Sampling Activities, it is proposed the first sampling effort begin at the five (5) foot depth with the next at (approximately) the ten (10) foot depth. The combination of the leach lines at six (6) to eight (8) feet below ground surface (bgs) and the "... very coarse gravel to cobble mixed with very fine grained matrix ..." (Draft RCRA Site Characterization Plan, Area 23 Building 650 Leachfield, May 1993), the initial five (5) foot depth would appear to be above the leach lines (and perhaps of limited use), with the ten (10) foot depth being more representative of the contamination from the leach lines.</p> <p>The Conceptual Model (Section 3.4 Conceptual Model) has assumed most of the contamination to be contained at relatively shallow depths and limited in extent. As the Corrective Action Investigation Plan (CAIP) attempts to identify the nature and extent of contamination based upon available information, full examination of the most likely pathways, must, of necessity, bear the greatest scrutiny. Therefore, the NDEP would expect a closer sampling interval in the most likely contaminated areas for the Site to be more appropriate.</p>	<p>Per this comment and conversations with NDEP personnel, the sampling strategy will be changed as follows. The five foot sample interval will be eliminated. The first sample from each boring will be obtained at a level equivalent to the approximate depth of the bottom of the leachfield component (e.g., leach lines, distribution box, or upper pipelines) being investigated. The first sample will be followed immediately by a consecutive sample starting at the bottom of the first sample interval. After the first two samples, samples will be obtained from five-foot intervals to a depth of approximately 50 feet bgs. If it is necessary to drill deeper than 50 feet, the sampling interval will be increased to 10 feet below 50 feet bgs.</p>	

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NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

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Revision Number Rev. 1

Reviewer/Organization Mr. Jon Taylor - NDEP

10. Comment Number/ Location	11. Type ^a	12. Comment	13. Comment Response	14. Accept
4.		Section 6.0 Reporting, in light of the fact that Sites' components (Upper Pipelines, Distribution Box and Leachfield) have not had, to any considerable extent, substantive administrative controls (periodic inspections and/or maintenance), the DOE/NVO should include as a portion of the Site Characterization Report an evaluation of the potential for contamination to have migrated beyond the scope of the investigation.	<p>The sampling strategy has been planned using industry standard sampling intervals (i.e., 5-foot intervals) for drilling activities and the requirement to obtain at least two "clean" samples from the base of each boring prior to discontinuing drilling in the boring. Should off-site sample analysis indicate the presence of contamination at the bottom of a boring that was not detected in the field, then additional drilling may be deemed necessary upon receipt and review of this data.</p> <p>Samples from the base of three of the borings to be drilled will also be analyzed for hydrologic parameters in order to assess the potential for the migration of liquids from the leachfield past the vertical extent of the investigation. However, these samples are considered valid only to support the conclusion that the vertical extent of contamination has been identified through the receipt of at least two "clean" samples from the boring. Since the hydrologic samples and data tend to be problematic (as seen on other sites to date) it is not considered valid to use this data to refute the conclusion that the base of the contamination has been identified.</p> <p>Furthermore, as discussed and agreed to during the DQO scoping process, there is no process knowledge currently available to suggest that migration of contamination on the site is likely beyond 50 feet bgs (it is more likely that the total vertical migration is far less than 50 feet).</p>	

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NEVADA ENVIRONMENTAL RESTORATION PROJECT DOCUMENT REVIEW SHEET

Document Title/Number Area 23 Building 650 Leachfield Characterization Plan

Revision Number Rev. 1

Reviewer/Organization Mr. Jon Taylor - NDEP

10. Comment Number/ Location	11. Type ^a	12. Comment	13. Comment Response	14. Accept
5.		The NDEP requests a map depicting the location of the Waste Management Area for the Area 23 Bldg. 650 investigation. In addition, Section 5.4 Waste Management, fourth paragraph states "If more than 55-gallons of waste are generated ...", while paragraph nine (9) refers to the volume of waste soil generated to be approximately 17 m ³ (approximately 82 barrels of waste). If the DOE/NVO is proposing to store over the 55-gallon limit, as referenced in 40 CFR § 262.34, then it should be formally incorporated into the CAIP and concurred on by the NDEP in order to avoid misconstruing Waste Management activities at the Site.	<p>The designation of the location of the waste staging area is considered part of the active site management issues that are defined during the first stages of the field activity on a site. Furthermore, its location may be subject to change during that time. Because of this, the location is not typically included in the site characterization plan. The requirements for the proper management of the waste area are contained in the plan and include the proper management and staging of the waste. The location of such support areas (e.g., waste staging, equipment decontamination, etc.) are currently in the process of being selected since the first stages of the field effort are beginning. The NDEP's desire to see where these support areas will be placed is understood and a map showing their location will be forwarded under separate cover from the characterization plan once the locations have been selected.</p> <p>For clarity, the second sentence of the fourth paragraph will be changed to read: "More than 55 gallons of IDW will be generated during the characterization activities on the site. Because of the volume of waste anticipated, if a waste determination cannot be made within 90 days, a request for an extension (i.e., to continue to maintain the waste on site) will be made to NDEP."</p> <p>It should be noted that a mistake was made in the presentation of the anticipated volume of waste to be generated. The correct volume should have been approximately 13 cubic meters (17 cubic yards) or approximately 63 drums.</p>	

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D-5

Plates

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