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

Area 6 Steam Cleaning Effluent Ponds

February 1996

Environmental Restoration Division

U.S. Department of Energy
Nevada Operations Office
RESOURCE CONSERVATION AND RECOVERY ACT
INDUSTRIAL SITE ENVIRONMENTAL RESTORATION
SITE CHARACTERIZATION PLAN

AREA 6 STEAM CLEANING EFFLUENT PONDS

DOE Nevada Operations Office
Las Vegas, Nevada

February 1996
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RESOURCE CONSERVATION AND RECOVERY ACT
INDUSTRIAL SITE ENVIRONMENTAL RESTORATION
SITE CHARACTERIZATION PLAN

AREA 6 STEAM CLEANING EFFLUENT PONDS

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Nevada Environmental Restoration Project

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<th>Description</th>
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<tr>
<td>amsl</td>
<td>Above mean sea level</td>
</tr>
<tr>
<td>APHA</td>
<td>American Public Health Association</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>bgs</td>
<td>Below ground surface</td>
</tr>
<tr>
<td>BLM</td>
<td>U.S. Department of Interior, Bureau of Land Management</td>
</tr>
<tr>
<td>BN</td>
<td>Bechtel Nevada</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>COC</td>
<td>Contaminant of Concern</td>
</tr>
<tr>
<td>CRDL</td>
<td>Contract-required detection limit</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>DOE/NV</td>
<td>U.S. Department of Energy, Nevada Operations Office</td>
</tr>
<tr>
<td>DOT</td>
<td>U.S. Department of Transportation</td>
</tr>
<tr>
<td>DQO</td>
<td>Data quality objective(s)</td>
</tr>
<tr>
<td>EM</td>
<td>Electromagnetic</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>ERD</td>
<td>Environmental Restoration Division</td>
</tr>
<tr>
<td>FID</td>
<td>Flame ionization detector</td>
</tr>
<tr>
<td>FOAV</td>
<td>Finding of alleged violation</td>
</tr>
<tr>
<td>ft</td>
<td>Foot (feet)</td>
</tr>
<tr>
<td>IDW</td>
<td>Investigation-derived waste</td>
</tr>
<tr>
<td>IT</td>
<td>IT Corporation</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram(s)</td>
</tr>
<tr>
<td>km</td>
<td>Kilometer(s)</td>
</tr>
<tr>
<td>LDR</td>
<td>Land disposal restriction</td>
</tr>
<tr>
<td>LLW</td>
<td>Low-level radioactive waste</td>
</tr>
<tr>
<td>m</td>
<td>Meter(s)</td>
</tr>
<tr>
<td>mi</td>
<td>Mile(s)</td>
</tr>
<tr>
<td>μg/kg</td>
<td>Micrograms per kilogram</td>
</tr>
<tr>
<td>mg/kg</td>
<td>Milligrams per kilogram</td>
</tr>
<tr>
<td>mg/l</td>
<td>Milligrams per liter</td>
</tr>
<tr>
<td>NAC</td>
<td>Nevada Administrative Code</td>
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<td>NDEP</td>
<td>Nevada Division of Environmental Protection</td>
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<td>Nevada Test Site</td>
</tr>
<tr>
<td>PARCC</td>
<td>Precision, accuracy, representativeness, comparability, and completeness</td>
</tr>
<tr>
<td>PID</td>
<td>Photoionization detector</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
</tr>
<tr>
<td>ppm</td>
<td>Parts per million</td>
</tr>
<tr>
<td>QA</td>
<td>Quality assurance</td>
</tr>
<tr>
<td>QC</td>
<td>Quality control</td>
</tr>
<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
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<tr>
<td>REECo</td>
<td>Reynolds Electrical &amp; Engineering Co., Inc.</td>
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<tr>
<td>SCEPs</td>
<td>Steam Cleaning Effluent Pond(s)</td>
</tr>
<tr>
<td>SOW</td>
<td>Sand-oil-water</td>
</tr>
<tr>
<td>SVOC</td>
<td>Semivolatile organic compound</td>
</tr>
<tr>
<td>TC</td>
<td>Toxicity characteristic</td>
</tr>
<tr>
<td>TPH</td>
<td>Total petroleum hydrocarbon(s)</td>
</tr>
<tr>
<td>TRU</td>
<td>Transuranic</td>
</tr>
<tr>
<td>TSCA</td>
<td>Toxic Substances Control Act</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile organic compound(s)</td>
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1.0 Introduction

1.1 Purpose
This plan presents the strategy for the characterization of the Area 6 South and North Steam Cleaning Effluent Ponds (SCEPs) at the Nevada Test Site (NTS) to be conducted for the U.S. Department of Energy, Nevada Operations Office (DOE/NV), Environmental Restoration Division (ERD). The purposes 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)

1.2 Scope
The scope of the characterization may include excavation, drilling, and sampling of soil in and around both ponds; sampling of the excavated material; in situ sampling of the soil at the bottom and on the sides of the excavations as well as within subsurface borings; and conducting sample analysis for both characterization and waste management purposes.
2.0 Facility Description

- The SCEPs facility is located in Area 6 at the NTS, a U.S. Department of Energy (DOE) research and development facility in Nye County, Nevada. The NTS is approximately 88 kilometers (km) (55 miles [mi]) northwest of Las Vegas, the major population center in the area (Figure 2-1), and Area 6 is in the southern part of Yucca Flat. Regional and local topography, soil types, stratigraphy, surface water features, and groundwater which might effect the migration of contaminants at the site are discussed in Appendix A.

2.1 Area 6 SCEPs Operational History

The SCEPs are evaporation basins formerly used for the disposal of untreated liquid effluent discharged from NTS Buildings 6-621, 6-623, and 6-800, a group of electrical maintenance and machine shops. The ponds are located northeast of the intersection of Road 6-05 and Mercury Road 6-01 (i.e., Mercury Highway) (see Figure 2-2 and Plate 1). The south pond was constructed in 1969 and became operational in 1970. It is irregular in shape (approximately 49 meters [m] [160 feet (ft)] long and 37 m [120 ft] wide) and is surrounded by a gravel berm. The depth of the south pond is 4 m (12 ft) from the top of the berm. The north pond was constructed in 1975 and became operational during the same year. It is rectangular (30 m [100 ft] wide, 40 m [130 ft] long, and 2.4 m [8 ft] deep), has a capacity of approximately 2,900 cubic meters (780,000 gallons), and is surrounded by a wire fence. Both ponds are unlined (DOE, 1988a). Plate 1 shows a plot plan of the Area 6 sewer and steam cleaning effluent system that discharged to the SCEPs.

Discharges to the SCEPs were discontinued in June 1993 when a closed-loop, recirculating system was installed at the Test Pad to service the source facilities. The recirculating system is used to fully contain the current steam cleaning effluent, and the Test Pad is presently used for steam cleaning operations in this area. Prior to the startup of steam cleaning operations, one drain at the Test Pad, drains from the steam cleaning pads at Buildings 6-623 and 6-800, and a sand/oil/water separator and discharge pipe at the Layout Pad were all plugged with cement. Neither the Layout Pad nor the Test Pad was used for steam cleaning when the discharge pipes were operational. The Resource Conservation and Recovery Act (RCRA) unit is currently defined as the discharge pipes extending from the edge of Buildings 6-623 and 6-800 to the SCEPs, associated sand-oil-water (SOW) separators, and surrounding impacted environmental media.
Figure 2-1
Location of the Nevada Test Site

2-2
Figure 2-2
Location of the Area 6 Steam Cleaning Effluent Ponds
Buildings 6-623 and 6-800 were used to steam clean heavy equipment (e.g., removal of oil and grease from tractors, front-end loaders, engine blocks prior to and after maintenance). All potential radioactively contaminated heavy equipment underwent radiological decontamination, conforming to NTS on-site release limits at the Area 6 Decontamination Facility (Building 6-605) prior to steam cleaning at Building 6-623 or 6-800. Steam cleaning effluent from the Area 6 Heavy Duty Machine Shop (Building 6-800) was piped to the south pond (6-LFP-4), and steam cleaning effluent from the Area 6 Machine and Welding Shop (Building 6-623) was piped to the north pond (6-LFP-3). No RCRA-regulated hazardous waste or hazardous waste constituents have been discharged to the ponds since 1988 (IT, 1992). In June 1993, a release of water from an evaporative cooler leak at Building 6-621, an electrical maintenance shop, was identified as discharging to the south SCEP. Prior to this time, it was not known that the drain in Building 6-621 was tied to the discharge pipe to the south SCEP. This drain was plugged in June 1993.

Between 1988 and 1993 when all discharges to the SCEPs ceased, process knowledge, administrative controls, and employee training were used to preclude the discharge of RCRA-regulated material to the SCEPs (IT, 1992). The volume of effluent annually discharged to the SCEPs was dependent on the number of weapons tests conducted each year, i.e., the quantity of equipment requiring steam cleaning (and the volume of effluent generated) was directly proportional to the number of weapons tests performed at the NTS.

2.2 Waste Inventory

Shop surveys initiated in 1978 by the Reynolds Electrical & Engineering Co., Inc. (REECo) Industrial Hygiene Department (REECo, 1991a) indicate that the following RCRA-regulated hazardous waste constituents were used in Buildings 6-623 and 6-800:

- Toluene
- Methylene chloride
- 1,1,1-Trichloroethane
- Xylenes
- Lead

A DOE environmental survey report (DOE, 1988b) indicated that corrosives and metal-containing liquids had been used in Buildings 6-623 and 6-800 in addition to these constituents. The report also noted that the South SCEP had an oily surface film of a reddish
color and an oily odor. The North SCEP may also have received effluent containing cutting oils, water-soluble oils, and various types of metals in solution.

2.3 Spill Information
The only documented event where liquid was released from the SCEPs through the overfilling of the pond and breaching of the berm occurred in the summer of 1991 when the North SCEP overflowed during heavy rains (Nevada Office of Emergency Management [formerly Nevada Division of Emergency Management] Case Number H910911D) (REECo, 1991b). A black stain delineated the extent of the spill at the east and west ends of the pond. Sampling and analysis were performed in conjunction with this spill event, and the release was reported to the Nevada Division of Environmental Protection (NDEP). It is possible that in addition to this event, effluent may have been spilled from the SCEPs on other occasions. A 1988 DOE environmental survey report noted that the water level of the south pond was near the top of the berm, which could have led to an overflow situation during high winds and/or thunderstorms (DOE, 1988b).

2.4 Previous Characterization Activities
To date, the characterization activities at the SCEPs have involved the following:

- Archival information has been gathered from available sources to help define a basic understanding of the processes that were conducted at the SCEPs and associated facilities as well as the waste management practices that led to the designation of this site as a potential, RCRA-regulated, waste management unit.

- Preliminary site investigations were conducted to obtain information useful in the design of the site characterization plan and development of conceptual models of potential contaminant migration at the sites in order to optimize the cost-effectiveness of the characterization activities.

- This characterization plan was drafted to guide the collection of field data for the site characterization effort. The data quality objectives (DQO) process (EPA, 1994) was employed to formulate a sound, logical sampling plan and to ensure that the field data collected during site characterization are adequate for determining further characterization and/or closure strategies for the site.

Preliminary evaluations of the SCEPs were conducted in 1988, 1994, and 1995. One of the 1994 sampling events was conducted in response to a NDEP Finding of Alleged Violation (FOAV) and Order (NDEP, 1994; REECo, 1994). The 1988 sampling event involved effluent and pond liquid sampling as well as pond sediment/soil sampling. However, because of apparent quality
control problems, the data from the 1988 sampling event were never published in a final form. The 1994 sampling of the South SCEP involved sampling of SOW separator liquids and sludges, pond liquids, and soil/sediment (REECo, 1994). The 1994 sampling of the North SCEP involved sampling of only the pond and berm soil/sediment; however, the 1995 sampling event involved the sampling of pond and berm soil/sediment in both ponds (IT, 1995).

The results of the 1994 (REECo, 1994) and 1995 (see Appendix B, Section B.1.6 for presentation of the 1995 sampling results) preliminary sampling of the South SCEP sediment, sludge, and soil indicated the presence of significant total petroleum hydrocarbons (TPH) contamination (up to 61,000 milligrams per kilogram [mg/kg]) as well as RCRA-listed volatile organic compounds (VOCs) at levels above and below the RCRA Land Disposal Restriction (LDR) levels. Contaminant types and concentrations in the South SCEP appeared to correspond to different physical locations (i.e., pond bottom sediment/sludge, sludge on the berm sides, or berm material) and/or material types (sediment, sludge, or native/berm soil). Based on the consistent and successive attenuation of contamination from samples taken at the ground surface to samples obtained from up to approximately 1.5 m (5 ft) below ground surface (bgs) from different locations within the pond and berms, the depth of regulated contamination in the South SCEP appeared likely to be limited to less than 1.5 m (5 ft) bgs throughout the pond interior. The depth and apparent differentiation of contamination influenced the development of the proposed conceptual model for the site which is presented in Section 3.1 of this report.

Preliminary sampling of the North SCEP in 1994 (IT, 1995) and 1995 (see Appendix B, Section B.1.6 for presentation of the 1995 sampling results) indicated the presence of TPH contamination at concentrations less than 700 mg/kg in the North SCEP sediments and underlying soils. No RCRA-regulated contaminants of concern (COCs) were identified in the North SCEP sediment or soils. Based on the sampling results, regulated contamination (i.e., TPH contamination above 100 parts per million [ppm]) in the North SCEP appeared to be limited to only a portion of the base of the pond extending out from the inlet pipe and was likely to extend to less than 0.8 m (2.5 ft) bgs.

No man-made radionuclide contamination was observed in either of the SCEPs. More detailed discussion of the sampling events and presentation of the 1995 sampling data are contained in Appendix B.
3.0 Objectives

3.1 Conceptual Model

The conceptual model for the site takes into account the source of the problem, the potential migration pathways, the potential receptors, the constituents of concern, and the drivers for the characterization and closure. The conceptual model for the SCEPs was developed from archival investigations of the site, process knowledge (DOE, 1988b; REECo, 1991a), and the results of preliminary field investigations discussed in Section 2.4 and Appendix B of this plan. The model was developed to be used as a basis for the site characterization plan and is described as follows:

Conceptual Model for the Area 6 Steam Cleaning Effluent Ponds

I. CONTAMINANT SOURCE

- Potentially hazardous and petroleum hydrocarbon wastes have been discharged/disposed above regulated levels in the Area 6 SCEPs from nearby steam-cleaning activities and various other liquid sources (i.e., cooling system discharges).

- The Area 6 SCEPs are unlined evaporation ponds constructed on native soils of generally low porosity and permeability.

II. MIGRATION PATHWAYS

- The primary pathway is modeled to be evaporation of most of the liquids and volatile contaminants discharged to the ponds.

- The secondary pathway is modeled to be vertical infiltration of remaining liquids and volatile and nonvolatile contaminants into underlying low-permeability soil and minor lateral infiltration into surrounding berm material and low-permeability soil.

- Deposition of contaminants in the surrounding soil to a vertical depth of 3.1 m (10 ft) bgs and a lateral depth of less than 3.1 m (10 ft) inward from the interior berm faces is expected in the South SCEP; whereas, a vertical depth of 0.6 m (2 ft) bgs with no lateral infiltration is expected in the North SCEP.

- Minor contamination of soil within approximately 3.1 m (10 ft) of SCEP piping and SOW separators is expected.
• Shallow perched groundwater is not expected to be present below the site at less than 30.5 m (100 ft) bgs and/or is not expected to be impacted by the COCs originating from the SCEPs.

• Figures 3-1 through 3-4 depict the conceptual model and alternate conceptual models.

III. POTENTIAL RECEPTORS

• Nearby NTS personnel are considered to have a minimal exposure and associated risk.

• Plants and animals (i.e., birds, small mammals, and reptiles) are considered to have a minimal exposure and associated risk.

• Future land use in close proximity to the site could be negatively impacted by the presence of contamination remaining at the site. However, impact is likely to be minimal since future use of the area is not likely to be different from its current use.

IV. CONTAMINANTS OF CONCERN

The COCs for the South and North SCEPs are separated into various groups based on defined study areas which are depicted in Figures 3-1 through 3-3.

• South SCEP COCs for each study area are as follows:
  - Study Area 1 - Contaminated sludge, sediment, and/or soil in the pond bottom includes RCRA-regulated VOCs and/or metals present (i.e., above detection limits) but below LDR levels, and TPH above NDEP action levels.
  - Study Area 2 - Contaminated sludge on the surface of the pond berms includes RCRA-regulated VOCs and/or metals present (i.e., above detection limits) and above LDR levels with TPH above NDEP action levels.
  - Study Area 3 - Contaminated soil below and around the pond surface includes TPH above NDEP action levels only.
  - Study Area 4 - Uncontaminated soil (or soil contaminated above detection limits, but below the applicable action level) may be found below and around the pond.

• North SCEP COCs for each study area are as follows:
  - Study Area 1 - Contaminated sediment and/or soil in the pond bottom includes TPH above NDEP action levels with no RCRA-regulated contamination.
- Study Area 2 - Uncontaminated soil (or soil contaminated above detection limits, but below the applicable action level) may be found below and around the pond.

- Piping and Soil-Oil-Water separators:
  - Contaminated soil includes RCRA-regulated VOCs and/or metals above LDRs in the vicinity of release points (i.e., pipe joints, cracks, etc.).
  - Contaminated soil includes TPH above NDEP action levels in the vicinity of release points (i.e., pipe joints, cracks, etc.).
  - Uncontaminated soil (or soil contaminated below applicable action levels) may be found in the vicinity of most of the piping/separator system.

V. CONTROLS ON THE CHARACTERIZATION

- Contaminant volumes to be removed control the characterization with respect to:
  - The amount of IDW generated as a result of characterization activities
  - The logistics and cost for managing of IDW
  - The most likely closure strategy for the site (i.e., clean closure)

- Contaminant/waste types control the characterization with respect to the facts that:
  - The majority of RCRA-regulated contamination is expected to be below LDRs.
  - Only minor amounts of the RCRA-regulated contamination are expected to be above LDRs.
  - The majority of the contamination is expected to be TPH only.
  - Most of the site area is expected to be uncontaminated or contaminated below applicable action levels.

- Regulatory requirements which control the characterization include the facts that:
  - The majority of the IDW generated during the characterization activities is expected to be uncontaminated or TPH only, which can be managed on site by staging during the characterization activities and placing back into the unit upon completion of the activities.
  - Lesser amounts of RCRA-regulated IDW shall be staged and containerized on site and shipped off site for disposal.
- Site closure is regulated under the *Code of Federal Regulations* (40 CFR 265.228) and Nevada Administrative Code (NAC) 459.9973.

- Elements of the Closure Strategy that control the characterization are as follows:
  - Clean-closure is desired for the site.
  - Closure is likely to involve excavation of shallow contaminants.
  - Closure will involve removal of associated piping and SOW separators.
  - Disposal of resulting wastes would be part of a clean closure for the site.
  - Site restoration would be conducted upon completion of the closure activities.

The sampling objectives will confirm, modify, evaluate, support, and/or refute the conceptual model and have been used to develop a sampling methodology which ensures that data-collection activities provide data that are meaningful, valid, and defensible and that 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.

### 3.2 Data Quality Objectives

The specific results of the DQO process are summarized and presented as Section 3.1, Appendix C, and Section 4.0 of this plan. The approach to site characterization at the SCEPs is an iterative process. As part of the Quality Assurance (QA) and Quality Control (QC) program for the project, a seven-stage approach, as described in *Guidance for the Data Quality Objectives Process* (EPA, 1994), 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 SCEPs. 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 (1994) consists of seven steps that are applied to design the initial sampling plan and are re-evaluated as more information becomes available during the site investigation. These steps are:

1. Problem Statement - stating the problem to be resolved (Sections 3.1 and C.1.1)
Figure 3-1
Map View of the Conceptual Model for the Area 6 South Steam Cleaning Effluent Pond
Figure 3-2
Map View of the Conceptual Model for the Area 6 North Steam Cleaning Effluent Pond
Figure 3-3
Cross Sectional View of Conceptual Models for the
Area 6 Steam Cleaning Effluent Ponds

LEGEND

1 Study area
Figure 3-4
Cross Sectional View of Alternate Conceptual Models for the Area 6 Steam Cleaning Effluent Ponds
2. Identification of Decisions - the principle study question(s) that must be answered by the characterization and the decision process (Section C.1.2)

3. Decision Inputs - identification of inputs to the decision (i.e., data needs) (Section C.1.3)

4. Study Boundaries - definition of the characteristic, spatial, and temporal study boundaries (Section C.1.4)

5. Decision Rules - development of decision rules (i.e., logic statements) (Section C.1.5)

6. Decision Error Limits - development of limits on decision errors (i.e., uncertainty constraints) (Section C.1.6)

7. Sampling and Analysis Plan - optimization of the design for obtaining data that satisfies the needs identified in Steps 1 through 6 (Section 4.0)

3.3 Technical Approach

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

- Surface and/or 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 and are presented in the "Sampling and Analysis Plan" found in Section 4.0 of this plan.

- Analytical data will be used to determine whether 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 will 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 a single phase of investigation which will consist of subsurface soil sampling to an approximate depth of 3.1 m (10 ft) bgs within and around the SCEPs via excavation techniques.

However, if the conceptual model is proven to be incorrect (i.e., contamination is deeper than projected) during the planned activities, two contingencies have been developed in order to adjust the scope of the characterization and are consistent with alternate conceptual models (see Figure 3-4). The alternate models assume that pond infiltration was more significant and
contaminants have migrated to a deeper extent than indicated in the primary conceptual model. The contingencies include:

- The ability to excavate deeper (i.e., approximately 6.1 to 9.1 m [20 to 30 ft] bgs) than the conceptual model indicates regulated contamination should be present (Alternate Model 1)

- A second characterization phase to include subsurface soil sampling outside and potentially inside of the SCEPs via drilling techniques (Alternate Model 2)

Contingent investigations will be based on the results of the Phase I investigations. Detailed discussion of the plans for sampling and analysis of the site are contained in Section 4.0 of this plan.
4.0 Sampling and Analysis Plan

Data will be collected during the field investigation to confirm or refute the conceptual model for the site and, thus, assess the migration of potential COCs and determine if COCs are present in concentrations exceeding levels protective of human health and the environment (i.e., regulatory action levels). Samples may also be collected in order to obtain site-specific geotechnical information applicable to the evaluation of 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 contractor-specific field sampling instructions and operating procedures and the RCRA Industrial Sites Quality Assurance Project Plan (DOE, 1994). For the purpose of the characterization, the site boundaries will be configured as shown on Plate 1.

The following sections detail the technical approach and activities that will be conducted for the characterization.

A decision-logic diagram to guide the SCEPs characterization was developed as part of the DQO process and is presented on Plate 2 of this document. 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.

4.1 Site Preparation Activities

Site access control for both SCEPs will consist of fencing (to be erected if it is not present) around the work area and barricades which will be placed around the excavation to prevent unauthorized entry during periods of inactivity at the site. These measures will remain in place as long as the excavation remains open.

4.1.1 South Steam Cleaning Effluent Pond

The south SCEP has a substantial berm surrounding the pond. An initial partial removal of the berm, to facilitate access to the pond by investigation equipment, is planned for the pond. A cut, approximate 6 m (20 ft) wide through the berm, will first be made on the southwest side of the pond (see Figure 4-1). Soils from each defined spatial study area encountered during this
Figure 4-1
Area 6 South Steam Cleaning Effluent Pond
Site Plan Showing Planned Excavations

Contour Interval = 0.5 Meters

Possible access cut

Excavate to 1.5±0.8 m (5±2.5 ft)
excavation will be sampled and stockpiled separately to facilitate characterization and waste minimization during the activities. Once access to the pond is gained, approximately 1.5 m (5 ft) of contaminated soil (i.e., Study Area 1) in the center of the pond will be removed to facilitate access to the far side of the pond and reduce the spread of contamination. Depending on the results of field sampling and the indications of field observations, one to three additional cuts through the berm may be made in order to facilitate further access. Figure 4-1 shows the planned and possible second access locations around the pond.

If necessary, a temporary berm, made up of either the removed berm material or unimpacted soil from an NTS source, may be erected around the excavation to prevent surface flow of water into the pond, or existing berm material may be pushed into the access cut(s) for the same purpose.

When access to the far side (i.e., the northeast side) of the pond is gained, the track hoe shall be used to trench into the berm from the interior of the pond out to the maximum reach of the excavation equipment. If it is necessary to excavate further into or through the berm, then excavation may be continued from the exterior of the pond. All efforts will be made to avoid the necessity of opening additional access cuts through the berm.

4.1.2 North Steam Cleaning Effluent Pond

The North SCEP is not bermed and will probably not require any significant removal of soil to facilitate access to the pond area.

4.2 Excavation Activities

The intention is only to trench and/or pothole the SCEPs and surrounding soil with potentially minor excavation of the associated piping directly adjacent to the SCEPS and not to excavate the SOW separators. Trench and pothole excavation will be conducted, as practical, using a back hoe and/or track hoe available on site and positioned within and around the ponds. The extent of the excavation around the ponds will include at least the first 1.5 ± 0.8 m (5 ± 2.5 ft) of sediment/soil below and around the current pond surfaces. This is the most likely area to be impacted by COCs. Contamination beyond the first 1.5 ± 0.8 m (5 ± 2.5 ft) will be evaluated through continued excavation based on the depth and stability of excavations, estimated cost/benefit of such modifications, and available project time and resources. The planned configuration of trenches to be excavated for the North and South SCEPs is presented in Figures 4-1 and 4-2.
Figure 4-2
Area 6 North Steam Cleaning Effluent Pond
Site Plan Showing Planned Excavations

4-4
Excavated soil will be segregated and placed either in roll-off bins (i.e., South SCEP Study Area 1 and 2 soil) or placed on, and covered with, 20-milliliter (ml) plastic sheeting within a soil berm. As discussed in Sections 5.1 and 5.6 of this plan, most of the excavated soil (except that from South SCEP Study Areas 1 and 2) will be placed back into the excavations during or upon completion of characterization activities.

The first excavation priority will generally be the evaluation of downward COC migration. Once the extent of downward migration has been determined, the constraints of the conceptual model have been exceeded, and/or the maximum reach of the excavation equipment has been achieved, lateral migration will be assessed. The extent of lateral excavation will be limited by indications of COC migration, project time, and project budget constraints.

During the evaluation of contaminant migration, the characteristics of contamination in the areas between the trenches will be represented by the results of surrounding sample locations (i.e., sample-bounded site areas). However, during Phase I excavation, samples will be no greater than approximately 30 to 38 m (100 to 125 ft) apart if this assumption is used. Thus, if two adjacent trenches become greater than 30 to 38 m (100 to 125 ft) apart, an additional trench will be excavated and sampled between the two in order to evaluate the area. Additional trenches may also be excavated based on field indications of contaminant migration trends.

4.3 Drilling Activities

If necessary, drilling activities will be conducted using a hollow-stem auger drill rig capable of boring to depths of approximately 30 m (100 ft). The initial boring locations will be based on the results of the Phase I activities (i.e., borings will be placed at locations where it was not possible to determine the vertical extent of contaminant migration using the excavation equipment). Industry-standard methods for determining of drilling locations for step-out borings will be used if lateral migration of deeper 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 (i.e., a triangular pattern originating from the center of the pond or contamination) if contaminant migration trends have not been established.

As discussed in the previous section on excavation activities, during the characterization of contaminant migration, the characteristics of contamination in the areas between the boring locations will be represented by the results of surrounding sample locations (i.e., sample-bounded site areas). However, if Phase II drilling is conducted, boring locations (i.e., sample locations)
will be no greater than approximately 30 to 38 m (100 to 125 ft) apart if this assumption is used. Thus, if adjacent borings become greater than 30 to 38 m (100 to 125 ft) apart, an additional boring will be drilled and sampled between the two in order to evaluate the area. Additional borings may also be drilled based on field indications of contaminant migration trends.

4.4 Sampling Activities
Sampling activities will focus on 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. As is routine for investigations on the NTS, all samples will be field-surveyed for radiation hazards. All samples will also be field-screened for VOCs using a photoionization detector (PID) or flame ionization detector (FID). An on-site mobile laboratory will be used to analyze samples for TPH during excavation activities. Selected samples will be sent to an off-site laboratory to be analyzed for more complete characterization. The analytical methods to be used are discussed in Section 4.5 of this plan.

The boundaries between the various study areas defined in the conceptual model will be determined initially through visual indications of impact followed by on-site analysis of samples for TPH content. For example, according to the conceptual model and based on preliminary sampling results, South SCEP Study Area 2 should have significantly higher TPH concentrations (i.e., order of magnitude) than Study Area 3 although this may vary a great deal. Visually, the Study Area 2 sludge should appear different from the underlying soil and/or berm material in both texture, and to some extent, color or discoloration. Contamination from the Study Area 2 sludges may have leached downward into the underlying material, but this effect has been considered negligible for the purpose of the current conceptual model. If off-site analysis of samples from Study Area 3 indicate the presence of contamination attributed to Study Area 2 (i.e., RCRA-regulated contaminants exceeding LDR levels), then the conceptual model may be changed appropriately to account for such differences as they might affect later characterization and/or site closure activities.

4.4.1 Phase I Excavation Sample Collection
Samples for COC analysis will be collected from the backhoe bucket. The backhoe will scoop up soil from an excavation and then the bucket will be placed on the ground adjacent to the excavation. Soil samples will be retrieved from the center of the bucket using a decontaminated, disposable or stainless steel scoop and/or a stainless steel sampling sleeve. A quantity of soil
will be collected for on-site and off-site analysis of each sample. The samples will be placed in the appropriate sample jars or sleeves and immediately sealed, labeled, and placed in iced coolers or a refrigerator. Samples will be collected to document contaminant types and concentrations and identify unimpacted areas.

Samples will be collected along each trench from approximate 1.5- to 3-m (5- to 10-ft) horizontal intervals within the boundaries of the exterior edge of the pond berm. If additional lateral excavation is necessary outside of the outer edge of the berm, samples will be collected from approximate 3- to 4.5-m (10- to 15-ft) horizontal intervals. Samples will be collected at vertical intervals within each trench at approximate 1.5- to 3-m (5- to 10-ft) intervals.

During the first characterization phase, all samples collected will be analyzed by the on-site laboratory for TPH content. Based on the on-site analysis of samples, at least 10 percent (or a minimum of 10 samples) of the TPH and/or visually impacted samples will be submitted for analysis by the off-site laboratory. If possible, 10 percent (or a minimum of 10 samples) of the TPH and visually unimpacted samples (if there are any) will be submitted to the off-site laboratory for analysis. Because only a small portion of the South SCEP Study Area 2 contamination is expected to be encountered during the excavation activities (due to the study area's configuration), it is likely that less than 10 samples will be obtained from this study area. All of these will be analyzed by both the on-site and off-site laboratories.

It is anticipated that approximately 170 samples may be obtained from the South SCEP and 25 from the North SCEP based on the current conceptual model. Of these samples, approximately 45 of the South SCEP samples and 20 of the North SCEP samples would be analyzed by both the on-site and off-site laboratories. Based on the maximum potential extension of the proposed study area boundaries (see Appendix C, Sections C.1.4.1 and C.1.4.2), the maximum number of samples that would be generated during the first characterization phase would be approximately 250 for the South SCEP and 35 for the North SCEP. Of these samples, approximately 55 from the South SCEP and 20 from the North SCEP would be analyzed by both the on-site and off-site laboratories. The actual number of samples taken will depend on decisions made in the field. Additional (or fewer) characterization samples may be collected for on-site and off-site analysis based on field indications of potential changes in contaminant characteristics (i.e., contaminant type, concentration, mobility, etc.).
4.4.2 Phase II Soil Boring Sample Collection

Samples will be collected from soil borings at approximate 1.5-m (5-ft) intervals with at least two unimpacted samples collected from below any encountered contaminant zones. When possible, at least three samples 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 a second characterization phase (i.e., drilling phase) is necessary, it is possible that an on-site laboratory will not be used (the decision will be based on the expected number of samples as determined by the results of the first characterization phase). In that case, samples will be field-screened for radiation, VOCs (i.e., headspace screening), and/or visual indications of contamination, and samples will be selected for off-site analysis based on positive screening results. If an on-site laboratory is used, samples will be selected for off-site analysis based on the results of that analysis as well as field-screening. At a minimum, one sample from below a contaminated interval, or from the bottom of each boring exhibiting no signs of contamination, will be submitted for off-site analysis. In addition, at least one sample from a contaminated interval will be submitted for off-site analysis with two additional samples (i.e., one each from the top and the bottom of the contaminated zone), if the samples are available (i.e., if the contaminated zone is greater than 1.5 m [5 ft] thick, which is enough to yield more than one contaminated sample interval). The total number of samples to be analyzed from the drilling activities will depend on the results of the first characterization phase sampling and the resulting number and location of soil borings.

4.5 Sample Analysis

Table 4-1 lists the analytical methods that will be applied to soil samples. The EPA 8015 Modified method for TPH is planned for use by the on-site laboratory only. All of the other analytical methods will be used by the off-site laboratory. The analytical methods have been chosen based on the results of the preliminary investigations, process knowledge of the past use of the SCEPs, and any additional regulatory and DOE guidance and/or requirements. It is expected that the contamination associated with the SCEPs is primarily hydrocarbon with potentially lesser amounts of RCRA-regulated VOCs and/or metals. Radioactive and/or mixed contamination are not expected, but will be investigated during the waste characterization sampling as indicated in Section 5.0 of the plan. Sample collection and analysis for waste management purposes are discussed in Sections 5.3 and 5.4 of this plan.
Samples for physical parameter analysis will be collected if the lateral and/or vertical extent of contamination at the site suggests that an *in situ* remediation program would be preferable to an excavation/clean closure strategy which would represent a significant change in the conceptual model and characterization constraints and goals for the site. This change would be likely to occur only if it is necessary to continue the characterization into the contingent, second characterization phase drilling activities where the method of sampling (i.e., *in situ* split-spoon sampling) is better suited to the collection of samples for physical parameter analysis. However, field judgements may also result in the collection and analysis or archiving of physical parameter samples during the excavation activities, depending on the indications of contaminant extent.

### Table 4-1
**Characterization Analytical Methods**

<table>
<thead>
<tr>
<th>Media</th>
<th>Analytical Parameter</th>
<th>Analytical Methoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>Total Petroleum Hydrocarbons (TPH)</td>
<td>EPA 8015 Modified</td>
</tr>
<tr>
<td></td>
<td>Total Volatile Organic Compounds (VOCs)</td>
<td>EPA 8240</td>
</tr>
<tr>
<td></td>
<td>Toxicity Characteristic (TC) VOCs</td>
<td>EPA 1311/8240</td>
</tr>
<tr>
<td></td>
<td>TC Metals: (Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver)</td>
<td>EPA 1311/6010</td>
</tr>
<tr>
<td></td>
<td>TC Metals: Mercury</td>
<td>EPA 1311/7470</td>
</tr>
<tr>
<td></td>
<td>Initial Moisture Content, Dry Bulk Density, Calculated Porosity, Saturated Hydraulic Conductivity, Moisture Characteristics, Unsaturated Hydraulic Conductivity, Particle Size Distribution[b]</td>
<td>Various ASTMc Standard Methods</td>
</tr>
<tr>
<td>Groundwater</td>
<td>TPH</td>
<td>EPA 8015 Modified</td>
</tr>
<tr>
<td></td>
<td>Total VOCs</td>
<td>EPA 8240</td>
</tr>
<tr>
<td></td>
<td>Total Metals: (Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver)</td>
<td>EPA 6010 and/or 7060, 7421, 7740</td>
</tr>
<tr>
<td></td>
<td>Total Metals: Mercury</td>
<td>EPA 7470</td>
</tr>
</tbody>
</table>

*aSW-846 (U.S. Environmental Protection Agency [EPA], 1988) unless otherwise noted*
b*Physical parameters will be analyzed only if deemed necessary. The analyzed parameters will be based on assessed need.*
c*American Society for Testing and Materials (ASTM)*
5.0 Waste Management Plan

The requirements for managing the wastes derived from the characterization will be determined based on regulatory requirements, field observations, and the results of on-site and off-site laboratory analysis of site characterization samples. Administrative controls (i.e., decontamination procedures and characterization strategies) will minimize the hazardous waste generated during site investigation activities. Hazardous and/or mixed waste, if it is generated, shall be managed and disposed of in accordance with DOE Orders and U.S. Department of Transportation (DOT) and RCRA regulations. Decontamination activities will be performed in accordance with approved procedures as specified in the project field sampling instructions and will be designated according to the COCs present at the site.

5.1 Waste Minimization

The characterization activities have been designed to minimize the amount of IDW produced. Initial site preparation activities (i.e., excavation of access ways and/or ramps) have been planned to remove as little soil as possible from the units. The initial removal of contaminated sludge/sediment (South SCEP Study Area 1 [see Section 3.1 and Appendix C, Section C.1.4 of this plan]) from the bottom of the South SCEP will be conducted, in part, to minimize the contamination of investigation equipment entering the pond, which results in the production of lesser amounts of decontamination rinsate (see Section 5.6 for additional information on the management of the wastes from specific study areas). Characterization excavation is planned for only narrow trenches and potholes (as opposed to larger scale excavation) to minimize the amount of soil removed from the units. Finally, excavated soil which is not obviously impacted (i.e., not visually impacted) will be placed back into the unit upon the completion of characterization activities to be addressed later during closure activities. Soil from the South SCEP Study Areas 3 and 4 and the North SCEP Study Areas 1 and 2 are expected to be included in the material which is placed back into the unit during or at completion of the characterization activities.

5.2 Potential Waste Streams

Based on preliminary sampling results and process knowledge, no radioactive wastes or mixed wastes are anticipated. It is also unlikely that hazardous wastes will be produced from the North SCEP, and there should be mostly low concentrations of hazardous constituents from the South SCEP. The wastes produced from both SCEPs will be primarily hydrocarbon-contaminated wastes.
Wastes generated during the characterization of the SCEPs 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 (PPE)
- Samples returned from the laboratory
- Contaminated and uncontaminated soil
- Asbestos-cement piping

Although not common, 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 not expected to result in the return of any samples from the SCEPs characterization activities.

5.3 **Investigation-Derived Waste Characterization Sample Collection**

Characterization samples will also be used to support the waste management objectives. For this purpose, a statistically-adequate number (currently estimated as up to 25 samples [at least two samples from each roll-off bin], all from the South SCEP Study Areas 1 and 2) of the samples that are selected for off-site analysis will also be analyzed for parameters that are required for waste management (see Section 5.4 of this plan). Only samples from the South SCEP will be analyzed for waste management purposes since these are the only soils to be disposed of as a result of the characterization activities.

5.4 **Investigation-Derived Waste Sample Analysis**

Table 5-1 lists the analytical methods that will be applied to soil samples used for waste management purposes and to any decontamination rinsate samples taken for analysis. The EPA 8015 Modified method for TPH (EPA, 1986) is planned for use by the on-site laboratory only. All of the other analytical methods will be used by the off-site laboratory. The analytical
methods have been chosen based on the results of the preliminary investigations, process knowledge on the past use of the SCEPs, the needs of waste management, and any additional regulatory and DOE guidance and/or requirements.

5.5 Waste Determination

The status of IDW (i.e., TPH, RCRA-hazardous, low-level radioactive waste [LLW], mixed waste) will be determined through the application of statistical analyses of sample data as described in Chapter 9 of SW-846 (EPA, 1986) for determining the RCRA status of waste. The action levels for IDW contaminants are presented in Table 5-2.

Table 5-1
Waste Management Analytical Methods

<table>
<thead>
<tr>
<th>Media</th>
<th>Analytical Parameter</th>
<th>Analytical Methoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation-Derived Waste</td>
<td>Total Petroleum Hydrocarbons</td>
<td>EPA 8015 Modified</td>
</tr>
<tr>
<td>(Soil and/or Liquid Waste)</td>
<td>Total Volatile Organic Compounds (VOCs)</td>
<td>EPA 8240</td>
</tr>
<tr>
<td></td>
<td>Toxicity Characteristic (TC) VOCs</td>
<td>EPA 1311/8240</td>
</tr>
<tr>
<td></td>
<td>TC Metals: (Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver)</td>
<td>EPA 1311/6010</td>
</tr>
<tr>
<td></td>
<td>TC Metals: Mercury</td>
<td>EPA 1311/7470</td>
</tr>
<tr>
<td></td>
<td>TC Semi-Volatile Organic Compounds</td>
<td>EPA 1311/8270</td>
</tr>
<tr>
<td></td>
<td>Total Polychlorinated Biphenyls</td>
<td>EPA 8080</td>
</tr>
<tr>
<td></td>
<td>Gross Alpha/Beta (decontamination rinsate only)</td>
<td>SM 7110b</td>
</tr>
<tr>
<td></td>
<td>Gamma Scan (decontamination rinsate only)</td>
<td>HASL 300, 4.5.2.3c</td>
</tr>
</tbody>
</table>

a SW-846 (EPA, 1986) unless otherwise noted
b Standard Methods for the Examination of Water and Waste Water (APHA, 1992)
c Environmental Methods Laboratory Procedure Manual, HASL-300 (DOE, 1992a)
Table 5-2
Action Levels for IDW Contaminants

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Action Level</th>
<th>Source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPH(^a)</td>
<td>100 ppm(^b)</td>
<td>NAC(^c) 459.9973</td>
<td>Regulated by the NDEP(^d)</td>
</tr>
<tr>
<td>TC(^e) VOCs(^f)</td>
<td>TC List</td>
<td>40 CFR(^g) 261.24</td>
<td></td>
</tr>
<tr>
<td>Total VOCs</td>
<td>Above the detection limits and above LDRs(^h)</td>
<td>40 CFR 261 268.40</td>
<td>Applicable to listed hazardous wastes only.</td>
</tr>
<tr>
<td>TC Metals</td>
<td>TC List</td>
<td>40 CFR 261.24</td>
<td>--</td>
</tr>
<tr>
<td>TC SVOCs</td>
<td>TC List</td>
<td>40 CFR 261.24</td>
<td>--</td>
</tr>
<tr>
<td>Total PCBs(^i)</td>
<td>50 ppm</td>
<td>TSCA(^j)</td>
<td>--</td>
</tr>
<tr>
<td>Radiological</td>
<td>Component specific</td>
<td>NTS PO(^k)</td>
<td>Decontamination rinsate only</td>
</tr>
</tbody>
</table>

\(^a\)Total petroleum hydrocarbons  
\(^b\)Parts per million  
\(^c\)Nevada Administrative Code (NAC)  
\(^d\)Nevada Division of Environmental Protection  
\(^e\)Toxicity characteristic  
\(^f\)Volatile organic compounds  
\(^g\)Code of Federal Regulations  
\(^h\)Land Disposal Restrictions  
\(^i\)Polychlorinated biphenyls  
\(^j\)Toxic Substances Control Act  
\(^k\)Nevada Test Site Performance Objective for Certification of Nonradioactive

5.6 Waste Management

Plate 3 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.

If mixed waste is produced, the appropriate waste data must also be obtained or developed in accordance with the transuranic (TRU) Pad waste acceptance criteria. The number of samples necessary to satisfy the various mixed waste management requirements (i.e., RCRA, NVO-325 [DOE, 1992b]) 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.

Solid materials other than soil wastes are waste only by virtue of contact with contaminated media. Therefore, sampling and analysis of the investigation-derived waste (other than excavated soil, piping), 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 specified in Table 5-1. Through administrative controls, it will be ensured that no additional contaminants are added to the waste. For administrative purposes, the waste will be managed as at least four waste streams: nonimpacted soil, impacted soil/sludge, solid waste, and decontamination rinsate. Each waste stream will be segregated, and additional segregation may occur within each waste stream. For example, the soil waste produced from each separate study area will be segregated. Wastes will be managed on site within the defined site boundaries until analytical results are received to determine the disposition of the waste. Liquid low-level or mixed wastes, if present, will be absorbed or solidified prior to disposal or storage. Access to wastes temporarily staged at the project site will be controlled through placing the waste packages or waste soil piles within an access-controlled accumulation area. All waste containers (i.e., roll-off bins) or soil piles shall be covered and/or locked (i.e., drums) and appropriately labeled. Waste containers shall be inspected weekly while awaiting laboratory results to ensure that the waste containers are not leaking or damaged.

Most IDW streams will be placed in waste containers such as DOT-approved drums (i.e., for contaminated PPE and decontamination rinsates) or roll-off bins (i.e., contaminated soil, asbestos-cement piping). The contents of each container will be recorded, and each container will be appropriately marked and labeled in accordance with RCRA and DOE requirements.

Soil waste will be segregated according to the conceptual model study area from which it is removed (see Sections 3.1 and C.1.4). Soil and/or sludge from South SCEP Study Areas 1 and 2 will be placed in roll-off bins and covered with plastic until analytical results are available and the soil can be properly disposed. Soil from South SCEP Study Areas 3 and 4 and North SCEP Study Areas 1 and 2 (i.e., soil that is either TPH-impacted or unimpacted, as determined by the on-site laboratory) will be staged on and covered with 20-mil plastic sheeting within a soil berm until it can be placed back into the excavations (i.e., when a portion or all of the characterization field activities are complete). The anticipated volume of waste-contaminated soil to be generated during the characterization is approximately 500 to 750 cubic meters (650 to 980 cubic yards). Approximately 76 cubic meters (100 cubic yards) is expected to be disposed of as IDW while the rest will be placed back into the excavations.

In the unlikely event that mixed waste is generated, it will be stored at the Area 5 Radioactive Waste Management Site Transuranic Waste Storage Pad in appropriate containers after having met the appropriate waste acceptance criteria. Low-level waste is not anticipated but, if
generated, it will be disposed of at the NTS under the *Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements* (DOE, 1992b). Hazardous 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, boundaries of the contamination removed (if applicable), estimated boundaries of remaining contamination (if applicable), 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 and field screening data

- 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
7.0 References

APHA, see American Public Health Association.


BN, see Bechtel Nevada.


DOE, see U.S. Department of Energy.


DRI, see Desert Research Institute.

EPA, see U.S. Environmental Protection Agency.


IT, see IT Corporation.


NDEP, see Nevada Division of Environmental Protection.

Nevada Division of Environmental Protection. 1994. “Finding of Alleged Violation and Order.” Carson City, NV.

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


Appendix A

Environmental Setting
A.1.0 Environmental Setting

A.1.1 Topography
Area 6 of the NTS is in Yucca Flat which is a typical north-south-oriented basin within the basin-and-range physiographic province of the western United States. Bounded on the east and west by mountains, Yucca Flat is void of significant topography. The flat is approximately 31 km (19 mi) long and 16 km (10 mi) wide, with elevation ranging from 900 to 1,400 m (3,000 to 4,600 ft) above mean sea level (amsl) (DRI, 1988). Yucca Flat is a closed basin, with all runoff draining towards the basin axis and then south to the local base level, Yucca Lake (playa). The Area 6 SCEPs are located on the Yucca Lake bed near the western edge of the playa. The site topography consists of semi-flat surfaces with small drainages.

A.1.2 Soils and Stratigraphy
The shallow soils in Yucca Flat are typically formed on medial to distal alluvial and colluvial deposits. Soils and stratigraphy are important because of their physical and chemical properties which may inhibit the migration of chemicals of potential concern. Soil compositions are mostly sand, silt, and clay in a matrix supporting gravels to cobbles (up to 25.4 centimeters [10 inches]). The compositions of the pebbles and cobbles are mostly limestone and volcanics. In the area of the SCEPs, these generally unconsolidated valley-fill deposits are mixed with evaporite deposits associated with the Yucca Lake playa. The Quaternary alluvial deposits at the site are up to 90 m (300 ft) thick (DOE, 1988a).

Currently, no study of the subsurface has been conducted in the vicinity of the SCEPs. However, the surface geology of the area suggests that the subsurface is likely to consist of a sequence of interfingering fine-grained lake/playa sediments and coarse-grained alluvial sediments.

A.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).

Yucca Flat is a playa on the NTS that receives and collects surface runoff during heavy precipitation. The runoff collects at Yucca Lake, an ephemeral surface water-body at the southern end of Yucca Flat, approximately 0.8 km (0.5 mi) northeast of the SCEPs. Until it
dissipates through evaporation or infiltration, surface water may be present in Yucca Lake for a few days or weeks. There has been one documented release from the Area 6 SCEPs to surface water in Yucca Lake (Section 2.2.2).

Vertical cracks attributed to natural desiccation of fine-grained materials and/or tectonic activity have opened in the playa deposits of Yucca Lake (Doty and Rush, 1985; Colton, 1965). The rapid drainage of surface runoff into these cracks led to concern that water, along with any chemicals of potential concern or radionuclide constituents from NTS activities, was recharging the regional Paleozoic carbonate aquifer. The results of surface water and storm-water sample analyses for chemicals of potential concern and radionuclide constituents indicate that playa water entering such cracks does not present a human-health hazard (Doty and Rush, 1985).

Therefore, even if any chemicals of potential concern present in the SCEPs were to be released to standing water on Yucca Lake, it is highly unlikely that those chemicals would move with surface runoff to the regional aquifer through vertical cracks in the playa. Surface runoff away from the SCEPs is insignificant because the SCEPs are designed to retain precipitation and other liquids.

A.1.4 Groundwater
The depth to the water table at the SCEPs is estimated at approximately 300 m (1,000 ft). Within Yucca Flat, both the carbonate aquifers and the valley-fill aquifers to supply water. Beneath the central part of Yucca Flat, the volcanic and Paleozoic rocks are saturated, and the lower part of the valley fill is also saturated. A vertical potentiometric gradient exists between aquifers in the valley fill, the volcanics, and the Paleozoic rocks. The shallower units have higher potentiometric heads than the deeper units. Regionally, groundwater migrates through the valley fill and volcanic units to the carbonate units. Groundwater flows southward from Yucca Flat to Frenchman Flat through the carbonate rocks with eventual discharge to springs in the Ash Meadows area of the Amargosa Desert. The discharge area is about 58 km (36 mi) southwest of the Area 6 SCEPs.

The local water table in the area of the SCEPs is estimated to be approximately 460 m (1,500 ft) below the surface (DRI, 1988). Based on this depth, vertical and horizontal migration pathways through the unsaturated zone are likely to encounter a wide variety of lithology and structural mediums.
Because the SCEPs are unlined surface impoundments, a perched water table may exist beneath the ponds as a result of continued recharge of pond contents. Results of Schlumberger soundings and geoelectric cross sections conducted at Yucca Lake did not indicate the presence of a perched water table, although this was not the purpose of the study, and the resolution (i.e., electrode spacing) may have been too coarse to detect perched water (Zohdy and Bisdorf, 1979). A resistivity investigation conducted at the Area 6 Decontamination Pond Facility, located approximately 0.8 km (0.5 mi) from the Area 6 SCEPs, did not confirm the presence or absence of a perched water table in the area, although it was noted that the auger bit was moist at a terminal drilling depth of 21 m (69 ft) in one of the boreholes (REECo, 1991c).

Two groundwater test wells (Well C and Well C1) are located 4.0 km (2.5 mi) south of the SCEPs at the southeastern tip of Yucca Lake. Both wells penetrate the Paleozoic carbonate aquifer through a 242-m (794-ft) thick tuff aquitard (Fernald, 1979). At the SCEPs, the water table lies within the tuff aquitard at a depth of about 300 m (1,000 ft) below ground surface. A potential release of hazardous waste constituents from the SCEPs would have to move about 300 m (1,000 ft) through unsaturated material to reach the water table. The possibility exists for accelerated vertical migration of chemicals of potential concern through local fractures. Pathways for migration of chemicals of potential concern from the SCEPs to groundwater sources will be assessed during site characterization.
Appendix B
Results of Previous Evaluations
B.1.0 Results of Previous Evaluations

Samples of both soil and water have been obtained from the SCEPs on at least five occasions in the past. The following sections discuss the results of these sampling events.

B.1.1 1988 Preliminary Evaluation
In 1988, Battelle Columbus Division conducted a preliminary evaluation of the SCEPs to evaluate whether potentially hazardous wastes were being discharged to the SCEPs. Samples were obtained from the sediments and influent of both ponds and analyzed for VOCs, semi-volatile organic compounds (SVOCs), toxicity characteristic (TC) SVOCs, and TC metals. However, because of data quality problems, the laboratory data for the sample analysis results were never presented in a final report of findings that can be cited.

B.1.2 1991 North SCEP Release Evaluation
On August 12, 1991, a heavy rainfall caused the failure of one of the North SCEP berms and the release of oily water which covered an area of approximately 700 square meters (7,500 square feet) (REECo, 1991b). On August 14, 1991, one soil and one water sample from the spill area and one water sample from within the pond were obtained and analyzed for total petroleum hydrocarbons (TPH), TC metals, VOCs, and SVOCs. The results of the analysis soil sample showed no contaminants of concern elevated above regulatory action levels.

B.1.3 1994 Preliminary Evaluation of South SCEP
In August 1994, REECo conducted a sampling event in response to an NDEP FOAV and Order regarding unpermitted discharges into the South SCEP (NDEP, 1994; REECo, 1994). Liquid and soil/sediment within the pond were sampled and analyzed for total and TC metals, VOCs, and SVOCs, TPH, radionuclides, pH, and flash point.

Although total concentrations of arsenic, barium, cadmium, and chromium appeared elevated in some of the samples, none of the samples showed TC metal values elevated to even near the regulatory thresholds (i.e., Title 40, Code of Federal Regulations [CFR] § 261.24). No RCRA-regulated total or TC, VOCs, or SVOCs were identified in the samples above regulatory limits. TPH ranged from 29,200 to 56,600 mg/kg in the soil samples taken. TPH in the range of diesel was identified in samples ranging from nondetected in one sample to 19,300 mg/kg in a sample taken from the vicinity of the pond outflow pipe. TPH in the range of gasoline was not detected.
in the samples. TPH in the range of waste oil ranged from 29,200 to 37,300 mg/kg in the samples. No man-made radionuclides or elevated levels of natural radionuclides were detected in the samples. The results of these analyses are summarized on Table B-1.

**B.1.4 1994 Preliminary Evaluation of North SCEP**

In September 1994, IT Corporation (IT) conducted a preliminary sampling event at the North SCEP (IT, 1995). Soil/sediment samples were obtained from four locations within the pond and on the pond berm and were analyzed for total VOCs and SVOCs, TC metals, TPH, and radionuclides.

The results of the analyses indicated the presence of elevated levels of TPH in one sample and its field duplicate (1,940 and 2,370 mg/kg respectively) taken from approximately 20 feet east of the pond outflow pipe. However, since EPA Method 418.1 was used for the TPH analysis, it is likely that the results of analyses using EPA Method 8015 Modified or its equivalents (as required by regulation), would be lower than these levels. The levels would probably still be above the regulatory action level of 100 mg/kg. Europium-155 was also reported by the laboratory as detected in one sample. However, further study of the analysis results indicated that this isotope had been misidentified by the laboratory; and thus, no man-made radionuclides were detected in the samples (IT, 1995). The results of these analyses are summarized on Table B-1.

**B.1.5 1994 Geophysical Evaluation of the North and South Steam Cleaning Effluent Ponds**

In October and November 1994, a geophysical investigation was conducted at the North and South SCEPs (IT, 1994) with the following objectives:

- Determine if leachate migration away from the ponds 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.
<table>
<thead>
<tr>
<th>LOCATION DESCRIPTION</th>
<th>NORTH STEAM CLEANING EFFLUENT POND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Sample Outside of Pond</td>
<td>North Berm</td>
</tr>
<tr>
<td>DEPTH (cm)</td>
<td>0-15.2 (0-6)</td>
</tr>
<tr>
<td>SAMPLE #</td>
<td>SCP00003</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Analyte</th>
<th>Units</th>
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</tr>
</thead>
<tbody>
<tr>
<td>TPH by 418.1¹</td>
<td>mg/kg</td>
<td>NA²</td>
</tr>
<tr>
<td>TPH by 8015 Mod⁴</td>
<td>mg/kg</td>
<td>100⁵</td>
</tr>
<tr>
<td>TPH Diesel⁶</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>TPH Gasoline⁷</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>TPH Oil⁸</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>µg/kg</td>
<td>30,000¹¹</td>
</tr>
<tr>
<td>2-Butanone</td>
<td>µg/kg</td>
<td>36,000¹¹</td>
</tr>
<tr>
<td>Total Xylenes</td>
<td>µg/kg</td>
<td>30,000¹¹</td>
</tr>
<tr>
<td>Arsenic</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>Barium</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>Chromium</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>TC Barium</td>
<td>mg/l</td>
<td>100.0¹²</td>
</tr>
<tr>
<td>TC Cadmium</td>
<td>mg/l</td>
<td>1.0¹²</td>
</tr>
<tr>
<td>TC Mercury</td>
<td>mg/l</td>
<td>0.2¹²</td>
</tr>
</tbody>
</table>

Note: Shaded cells indicate analyses not performed; bold values are at or above the applicable regulatory action levels

¹Samples analyzed for TPH, total volatile organic compounds (VOCs), toxicity characteristic (TC) VOCs, TC semivolatile organic compounds (SVOCs), TC metals.
²Samples analyzed for TPH, total volatile organic compounds (VOCs), total semi-volatile organic compounds (SVOCs), total metals, TC VOCs, TC SVOCs, and TC metals.
³Nevada Administrative Code 459.9973
⁴Title 40 Code of Federal Regulations § 268.40
⁵Title 40 Code of Federal Regulations § 261.24
⁶Field duplicate sample
⁷Total Petroleum Hydrocarbons
⁸U.S. Environmental Protection Agency (EPA) Method 418.1
⁹Milligrams/Kilogram
¹⁰Not Applicable
¹¹Not detected above contract required detection limits
¹²EPA Method 8015 Modified
¹³TPH components in the range of Diesel (C₅-C₁₄)
¹⁴TPH components in the range of Gasoline (C₄-C₁₀)
¹⁵TPH Components in the range of Oil (C₁₅-C₃₇)
¹⁶Micrograms/Kilogram
¹⁷Toxicity Characteristic
¹⁸Milligrams/Liter
<table>
<thead>
<tr>
<th></th>
<th>ND** (IT, 1994)</th>
<th>SOUTH STEAM CLEANING EFFLUENT POND** (REECo, 1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0' East of Outflow Pipe</td>
<td>Below Exposed Outfall Pipe</td>
</tr>
<tr>
<td>0-20.3</td>
<td>0-20.3</td>
<td>0-15.2</td>
</tr>
<tr>
<td>(0-8)</td>
<td>(0-8)</td>
<td>(0-6)</td>
</tr>
<tr>
<td>SCP00006</td>
<td>SCP00007dup</td>
<td>6-SCEP1a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,940</td>
<td>2,370</td>
<td>56,600</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19,300</td>
</tr>
<tr>
<td></td>
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<td>37,300</td>
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<td></td>
<td>42</td>
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<td>0.83</td>
<td>0.70</td>
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</tr>
<tr>
<td>0.011</td>
<td>0.008</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>ND</td>
<td>0.00075</td>
</tr>
</tbody>
</table>

*Is, gross alpha/beta, and gamma spectroscopy (all radionuclide results were below detection limits)*

*metals, gamma spectroscopy, pH (not reported on table), and flash point (not reported on table)*
To accomplish these objectives, electromagnetic (EM) 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 possible fluid/leachate migration away from the North SCEP in an east-northeast direction. However, surface conditions and subsurface utilities in the area of the North SCEP (i.e., gravel road and fencing) may have skewed some of the data values, resulting in an inaccurate interpretation of subsurface conditions. No subsurface anomalies were observed in the area of the South SCEP where subsurface migration was expected.

**B.1.6 1995 Preliminary Evaluation of North and South Steam Cleaning Effluent Ponds**

In September 1995, IT conducted a preliminary sampling event at the North and South SCEPs. The results of this preliminary sampling are presented here. Soil/sediment samples were obtained from four locations within the North SCEP and seven locations within the South SCEP (see Figures B-1 and B-2). Sample locations included the pond bottoms and berms and were analyzed for either TPH alone or for a suite of analyses that included total VOCs, TC VOCs, TC SVOCs, TC metals, and TPH.

The results of analyses for the North SCEP samples indicated the presence of limited TPH contamination in the soil in the bottom of the pond. The TPH contamination was in the range of oil and was noted in one sample at 53 milligrams per kilogram (mg/kg) and in a second sample at 650 mg/kg with a field duplicate sample result of 470 mg/kg. Four other samples from various locations and depths in the pond and pond berm had no detected TPH. No total VOCs, TC VOCs, TC SVOCs, or TC metals were identified in the sample and field duplicate obtained from the center of the pond and analyzed for these parameters. Table B-2 summarizes this data.

The results of analyses for the South SCEP samples indicated TPH contamination in 15 out of 16 of the samples and field duplicate taken. The TPH contamination consisted primarily of oil with some mixtures of TPH in the range of oil, gasoline, and/or diesel. TPH was detected in five samples below the regulatory action level of 100 mg/kg (i.e., 29 to 62 mg/kg). Nine samples contained TPH levels ranging from 610 to 61,000 mg/kg. Three samples, one from the wet pond bottom, one from the dry pond bottom, and one from the sludge on the berm surface on the south side of the pond, were analyzed for total VOCs, TC VOCs, TC SVOCs, TC metals, and TPH.
Figure B-1
Site Plan and Sample Locations,
Area 6 North Steam Cleaning Effluent Pond

B-5
Figure B-2
Site Plan and Sample Locations,
Area 6 South Steam Cleaning Effluent Pond

Contour Interval = 0.5 Meters
<table>
<thead>
<tr>
<th>POND</th>
<th>NORTH STEAM CLEANING EFFLUENT POND</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION DESCRIPTION</td>
<td>Pond Bottom Southwest Quadrant</td>
</tr>
<tr>
<td>LOCATION #</td>
<td>1</td>
</tr>
<tr>
<td>DEPTH (inches)</td>
<td>30.5 (12)</td>
</tr>
<tr>
<td>SAMPLE #</td>
<td>SCEP 00002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Unit</th>
<th>Action Level</th>
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</thead>
<tbody>
<tr>
<td>TPH*</td>
<td>mg/kgb</td>
<td>100'</td>
</tr>
<tr>
<td>Acetone</td>
<td>µg/kg</td>
<td>160,000'*</td>
</tr>
<tr>
<td>Benzene</td>
<td>µg/kg</td>
<td>10,000'*</td>
</tr>
<tr>
<td>cis-1,2-Dichloroethene</td>
<td>µg/kg</td>
<td>NA</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>µg/kg</td>
<td>10,000'*</td>
</tr>
<tr>
<td>PCE'</td>
<td>µg/kg</td>
<td>6,000'*</td>
</tr>
<tr>
<td>Toluene</td>
<td>µg/kg</td>
<td>10,000'</td>
</tr>
<tr>
<td>m,p-Xylene</td>
<td>µg/kg</td>
<td>30,000'</td>
</tr>
<tr>
<td>α-Xylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCa Cadmium</td>
<td>mg/l</td>
<td>1.0**</td>
</tr>
</tbody>
</table>

Note: Shaded cells indicate analyses not performed; bold values are at or above the applicable regulatory action levels.

*Samples for full screen analysis including TPH, total volatile organic compounds (VOCs), TC VOCs, TC semi-volatile organic compounds, and TC metals.

*TPH components are in the range of Oil (C10-C25).

**TPH components are in the range of Gasoline (C4-C11), Diesel (C9-C24), and Oil (C16-C30).

*TPH: *Title 40 Code of Federal Regulations § 268.40 **Title 40 Code of Federal Regulations § 261.24

*Field duplicate sample

*Total Petroleum Hydrocarbons

*Milligrams/Kilogram

*Not detected above contract required detection limits

*Micrograms/Kilogram

*Not Applicable

*Tetrachloroethylene

*Toxicity Characteristic

*Milligrams/Liter
### SOUTH STEAM CLEANING EFFLUENT POND

<table>
<thead>
<tr>
<th>Under Berm Side</th>
<th>Wet Pond Bottom</th>
<th>Dry Pond Bottom</th>
<th>Berm Sludge South Side</th>
<th>Dry Pond Bottom</th>
<th>Edge of Wet Pond Bottom Southeast Side</th>
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</thead>
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<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>S</td>
<td>61.0 (24)</td>
<td>5.1-25.4 (2-10)</td>
<td>0-30.5 (0-12)</td>
<td>45.7 (18)</td>
<td>91.4 (36)</td>
</tr>
<tr>
<td>P</td>
<td>SCEP 00012</td>
<td>SCEP 00014'</td>
<td>SCEP 00017</td>
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<td>SCEP 00019</td>
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<table>
<thead>
<tr>
<th>Component</th>
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<th>42,000*</th>
<th>7,900*</th>
<th>2,400*</th>
<th>5,100**</th>
<th>770*</th>
<th>29***</th>
<th>61,000**</th>
<th>1,800**</th>
<th>700***</th>
<th>42***</th>
<th>41***</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>630</td>
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<td>ND</td>
<td>0.016</td>
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</table>

Components are in the range of Diesel \(C_{27}-C_{29}\) and Oil \(C_{14}-C_{34}\)
The sample from the dry pond bottom had a TPH concentration of 7,900 mg/kg (in the range of oil) and a TC cadmium level of 0.016 milligrams per liter (mg/l), but no other constituents were identified. The TC cadmium level is well below the 1.0 mg/l for cadmium.

The sample from the wet pond bottom contained TPH in the range of oil above the regulatory action level and low levels of acetone, benzene, ethylbenzene, tetrachloroethene, toluene, and xylene, all of which were at least one order of magnitude below the regulatory action level. TPH was detected at 42,000 mg/kg in the sample.

The sample from the berm sludge contained TPH in the range of gasoline, diesel, and oil (61,000 mg/kg), cis-1,2-dichloroethene (1,300 micrograms per kilogram [µg/kg]), ethylbenzene (7,100 µg/kg), toluene (10,000 µg/kg), and xylene (58,000 µg/kg). The TPH is above the NDEP action level (NAC 459.9973) while the ethylbenzene, toluene, and xylene are all above RCRA land disposal restriction (LDR) levels (Title 40 CFR 268.40).

Although the ethylbenzene, toluene, and xylene may only be hydrocarbon components (i.e., not RCRA hazardous waste regulated), there is not sufficient process knowledge to show that they are not the result of the use of solvents, and because of this, they must be considered F-listed (i.e., hazardous wastes from non-specific sources) RCRA wastes (Title 40 CFR 261.31) subject to the LDRs. Table B-2 summarizes these analytical results.
Appendix C

Data Quality Objectives
C.1.0 Data Quality Objectives

- The following sections discuss and document the majority of the results of the first six steps of the DQO process (EPA, 1994). The conceptual model for the site, which is developed as part of Step 1, the problem statement, was presented earlier in body of the characterization plan in Section 3.1. The results of Step 7, Optimize the Design, are presented as the Sampling and Analysis Plan in Section 4.0 of the characterization plan.

C.1.1 Problem Statement (Step 1)

The following problem statement applies to the characterization of the SCEPs throughout the planned and proposed contingent characterization activities.

Potential RCRA-regulated hazardous and NDEP-regulated hydrocarbon wastes have been discharged to the SCEPs. 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 and NDEP requirements.

C.1.2 Identification of Decisions (Step 2)

The principle study question to be resolved through the results of the characterization activities can be expressed as follows:

Is the conceptual model for the site correct with respect to contaminant types and extent?

The question can be divided into two primary components: contaminant characterization and contaminant migration. This division is reflected throughout the DQO process, and the question is best addressed through the application of a decision process for the characterization strategy based on the conceptual model. The following sections discuss the decision process.

C.1.2.1 The Decision Process

The decision process for this site characterization plan is presented graphically on Plate 3. The process includes decisions used in resolving the principle study question presented in the previous section and generally guiding the progress of the characterization activities during each phase of the characterization. The decision process is designed to guide the field sampling program to successful completion and result in the collection of data that support recommendations for further characterization activities or closure/remedial action plans for the site. The process has been broken down into a total of four groups of decisions (i.e., Decision
Groupings): one involving the investigation of contaminant types and three involving the assessment of the extent of contaminant migration. The Decision Groupings are as follows:

- Contaminant characterization
- Vertical contaminant migration
- Shallow perched groundwater
- Lateral contaminant migration

The DQO process has been applied to each of these Decision Groupings. More quantitative DQOs, such as numbers of samples to be collected, sample intervals, and analytical requirements, will be provided in the Sampling and Analysis Plan (Section 4.0) and in site-specific instructions to the sampling and analysis field teams. These are initially determined by the conceptual model, but will ultimately be determined by the amount of contaminated soil identified at the SCEPs. DQOs have been developed to adhere to the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters, as discussed in the RCRA Industrial Sites Quality Assurance Project Plan (DOE, 1994).

The decision process may be applied to both the pond and its associated piping, sediment traps, and other facilities. However, the scope of this characterization is currently limited to the ponds and surrounding areas. Decisions are to be made during implementation of the field sampling and analysis program on the basis of data from mobile laboratory analyses as well as upon receipt of off-site, fixed-base laboratory results. The individual Decision Groupings are discussed in the following sections.

**C.1.2.1.1 Contaminant Characterization Decision Grouping**

The object of this grouping is to determine whether the type of contamination that exists was predicted in the conceptual model for the site. The results of this grouping affect both IDW issues as well as future closure issues. In order to satisfy this grouping, samples must be obtained and analyzed for the suspected RCRA-regulated COCs and TPH.

**C.1.2.1.2 Vertical Contaminant Migration Decision Grouping**

The object of the questions in the grouping is to determine whether the vertical extent of contamination at the site exceeds what was predicted in the conceptual model and whether it has been adequately evaluated. The result of the questions is the continuation of subsurface investigation activities downward to the vertical extent predicted by the model. If contamination exceeds the depths predicted by the model, then the model will be revised, and investigations
may continue until either the vertical extent of the contamination is obtained or the maximum
effective depth of the excavation or drilling equipment is met. In the case where the maximum
effective depth of the equipment is met, once the conceptual model is revised, either an
additional characterization phase may be indicated or the use of different equipment (i.e., a track
hoe instead of a backhoe or an air-rotary drill rig instead of a hollow-stem auger rig) in the
current phase may be employed to increase the depth to which the site may be evaluated.

The initial test of the conceptual model under this Decision Grouping will come during the
excavation of the sludge/sediment located at the base of the pond. If the depth of the
sludge/sediment exceeds the predicted depth, then the conceptual model will need to be revised
and contingent investigation techniques considered.

**C.1.2.1.3 Shallow Perched Groundwater Decision Grouping**

Shallow perched groundwater is possible at the site but not expected. If perched groundwater is
encountered, this grouping shall be used to determine first whether the conceptual model is
correct with respect to the presence or absence of shallow perched groundwater below the site.
Second, to determine if perched groundwater is impacted by contamination resulting from the
SCEPs. Because a complete characterization of perched groundwater is not planned, the result of
the Decision Grouping is to require the following steps if perched groundwater is encountered:

- Revision of the conceptual model for the site
- Installation of shallow groundwater monitoring well(s)
- Initial sampling and evaluation of the perched groundwater
- Determination of whether additional groundwater assessment (i.e., an additional
  characterization phase) is warranted at the site

In general, perched groundwater samples and resulting investigation-derived waste shall be
evaluated through application of the Contaminant Characterization Decision Grouping and the
Waste Management Strategy (see Section 5.0 of this plan). The Shallow Perched Groundwater
Decision Grouping will then only be applied to the determination of whether or not shallow
perched groundwater has been encountered and is impacted by COCs likely to have originated
from the SCEPs.
C.1.2.1.4 Lateral Contaminant Migration Decision Grouping

The object of the questions in this grouping is to determine whether the lateral extent of contamination at the site exceeds what was predicted in the conceptual model and whether it has been adequately evaluated. The result of the questions is the continuation of subsurface investigation activities to the lateral extent predicted by the model. If contamination exceeds the lateral extent predicted by the model, then the model will be revised and a determination will be made as to whether the current investigation activities should continue further, whether the results indicate the necessity of additional characterization activities in the following phase(s), or whether to develop additional characterization phases to fully evaluate the lateral migration.

In order to answer the questions in this grouping, subsurface sample data must be available and indicate the absence or concentration of contaminants in the subsurface at the site. This data will need to be applied to the entire site through the production of maps showing the aerial distribution of contamination.

C.1.3 Decision Inputs (Step 3)

In order to resolve the decision statements, the environmental variables to be measured during the characterization include chemical and radiological parameters for soil, sediment, and/or sludge samples and qualitative field observations for the evaluation of the presence of shallow perched groundwater below the site. Table C-1 summarizes the parameters to be analyzed. All the variables to be analyzed will be the result of the analysis of samples obtained during the preliminary and current characterization activities. In addition, sample locations and depths, soil types, and other field measurements will be collected and/or documented during the characterization activities to support contaminant modeling efforts that will be conducted upon receipt of the on-site and/or off-site laboratory analytical results. If the conceptual model’s predicted contaminant volume (i.e., vertical and lateral extent) is exceeded, samples for the analysis of physical parameters (i.e., bulk density, porosity, permeability) may also be collected in order to support possible remedial feasibility evaluation for the site.

The chemical parameters chosen for analysis are based on the chemicals known and/or suspected to have been used in the facilities formerly connected to the SCEPs and the results of preliminary evaluations at the site. Also influencing the choice of chemical analyses are the requirements of RCRA and the various lists of hazardous wastes contained therein. The selected radiological parameters are based on standard NTS requirements for substantiating the absence of radiological contaminants from NTS sources. The analytical parameters selected may be modified.
(i.e., expanded or reduced) for subsequent characterization activities (e.g., Phase II activities, if required) based on the results of completed sampling and modification of the conceptual model.

### Table C-1
**Environmental Variables to be Analyzed as Decision Inputs**

<table>
<thead>
<tr>
<th>Media</th>
<th>Chemical and Radiological Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>Total Petroleum Hydrocarbons</td>
</tr>
<tr>
<td></td>
<td>Total Volatile Organic Compounds (VOCs)</td>
</tr>
<tr>
<td></td>
<td>Toxicity Characteristic (TC) VOCs</td>
</tr>
<tr>
<td></td>
<td>TC Semivolatile Organic Compounds</td>
</tr>
<tr>
<td></td>
<td>TC Metals</td>
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<tr>
<td></td>
<td>Gross Alpha/Beta</td>
</tr>
<tr>
<td></td>
<td>Gamma Scan</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Dependant on soil results</td>
</tr>
</tbody>
</table>

#### C.1.4 Study Boundaries (Step 4)

The following section identifies the characteristic study boundaries (i.e., those which define the population of interest), spatial study boundaries (i.e., those which limit the lateral and vertical extent of the characterization), and temporal study boundaries (i.e., those which constrain the time frame during which the data generated will be considered valid for the current condition of the site) for the characterization. With these boundaries in mind, the scale of decision-making for the DQOs is also determined (i.e., populations or subpopulations for which decisions will be made based on the spatial or temporal boundaries).

Based on the conceptual model for the site, the South SCEP has been divided into four different study areas and the North SCEP into two different study areas (see Figures 3-1 through 3-3). The separation of these study areas is based on the expected COCs in each area and the physical location of each area. The spatial study boundaries vary, as depicted in Figures 3-1 through 3-3, for each study area to be characterized during the planned activities.

The temporal boundary for the characterization will begin with the 1994 preliminary sampling events at the SCEPs and will include the 1995 preliminary sampling event. It will end when all
planned characterization activities are complete. This boundary may be extended to include additional characterization activities which are not currently planned, depending on the amount of time necessary to implement the additional activities. The characteristic boundaries (as defined in the conceptual model) are defined as follows:

- **South SCEP**
  - Study Area 1 - Contaminated sludge, sediment, and/or soil in the pond bottom, RCRA-regulated VOCs and/or metals present (i.e., above detection limits), but below LDR levels, TPH above NDEP action levels
  - Study Area 2 - Contaminated sludge on the surface of the pond berms, RCRA-regulated VOCs and/or metals present (i.e., above detection limits) and above LDR levels, TPH above NDEP action levels
  - Study Area 3 - Contaminated soil below and around the pond surface, TPH above NDEP action levels only
  - Study Area 4 - Uncontaminated (or TPH contaminated above detection limit, but below the applicable action level) soil below and around the pond

- **North SCEP**
  - Study Area 1 - Contaminated sediment and/or soil in the pond bottom, TPH above NDEP action levels only
  - Study Area 2 - Uncontaminated (or TPH contaminated above detection limit, but below the applicable action level) soil below and around the pond

The scale of decision-making is based on the study areas into which the SCEPs have been divided. Decisions will be made in order to provide data to support or refute the characteristic and spatial study boundaries for each of the study areas presented above.

The overall spatial boundary for the characterization activities are the currently designated site boundaries (see Plate 1). The specific, vertical, lateral, and sample-bounded spatial boundaries for the characterization are discussed in the following sections.

**C.1.4.1 Vertical Study Boundaries**
The vertical study boundaries are equal to minimum and maximum depths of regulated contamination for each of the study areas (see Figures 3-1 through 3-3) identified in the South
and North SCEPs as predicted in the conceptual model plus or minus 50 percent (i.e., 3.1 ± 1.5 m [10 ± 5 ft] for South SCEP Study Area 3). With the exception of South SCEP Study Area 3, the surface represents the minimum depth of the vertical study boundaries. The minimum depth of the study boundary for the South SCEP Study Area 3 ranges from the surface to 1.5 ± 0.8 m [5 ± 2.5 ft]. Within these ranges, the conceptual model will not need to be modified to remain valid. The following are the maximum depths for each of the study areas based on the conceptual model:

- **South SCEP**
  - Study Area 1 - 1.5 ± 0.8 m (5 ± 2.5 ft)
  - Study Area 2 - 0.6 ± 0.3 m (2 ± 1 ft)
  - Study Area 3 - 3.1 ± 1.5 m (10 ± 5 ft)
  - Study Area 4 - not applicable

- **North SCEP**
  - Study Area 1 - 0.8 ± 0.4 m (2.5 ± 1.3 ft)
  - Study Area 2 - not applicable

If the vertical extent of contamination exceeds that predicted in the model, the vertical study boundary may be modified to equal 200 percent of that predicted in the conceptual model or a maximum of 6.1 ± 1.5 m (20 ± 5 ft). The decision to extend the vertical boundary will be based on the stability of the excavation, the availability of equipment from NTS sources, and the estimated cost/benefit of such a modification. However, the vertical boundary will not be extended by increasing the basic scope of the excavation activities (i.e., benching and shoring to increase the possible excavation depth). If excavations were to prove unstable or the vertical extent of contamination were to exceed 200 percent of the depth in the conceptual model, then the second phase of characterization activities involving the use of a hollow-stem auger drill rig would be implemented. If it becomes necessary, the vertical study boundary for the second characterization phase will be determined based on the indications of the vertical extent of contamination from the previous activities.

### C.1.4.2 Lateral Study Boundaries

The lateral spatial boundaries are equal to the maximum lateral extent (as measured from the approximate center of the SCEPs or the specific study area) of regulated contamination for each of the study areas identified in the South and North SCEPs as predicted in the conceptual model,
plus or minus 25 percent (e.g., 10.0 ± 2.5 m [33 ± 8 ft] for South SCEP Study Area 3). Within this range, the conceptual model will not need to be modified to remain valid. The following are the maximum lateral extent for each of the study areas based on the conceptual model.

- **South SCEP**
  - Study Area 1 - 10.0 ± 2.5 m (33 ± 8 ft) diameter
  - Study Area 2 - 17.0 ± 4.3 m (56 ± 14 ft) diameter
  - Study Area 3 - 34.0 ± 8.5 m (112 ± 28 ft) diameter
  - Study Area 4 - not applicable

- **North SCEP**
  - Study Area 1 - 14.0 ± 3.5 m (46 ± 12 ft) diameter
  - Study Area 2 - not applicable

If the lateral extent of contamination exceeds that predicted in the model, the lateral study boundary may be modified to equal 150 percent of that predicted in the conceptual model or a maximum of 51.0 ± 12.8 m (168 ± 42 ft) diameter for South SCEP and 21.0 ± 5.3 m (69 ± 18 ft) for North SCEP. The decision to extend the lateral boundary will be based on the rules presented in Section C.1.5.3. (However, the depth and stability of the excavation and the estimated cost/benefit of such a modification will also affect the decision to extend the boundary). If such a modification presents unreasonable safety problems or is deemed to not provide added benefit with relation to cost, then the lateral boundaries will not be extended for the excavation phase, but instead will be extended for the drilling phase of the characterization. If the depth of the contamination exceeds the original conceptual model (i.e., 3.1 ± 1.5 m [10 ± 5 ft]), then the lateral boundaries will not be increased without significant modification to the conceptual model and a likely change in investigative method (i.e., Phase II drilling investigation). If it becomes necessary, the lateral study boundary for the second characterization phase will be determined based on the indications of the lateral extent of contamination from the previous activities.

**C.1.4.3 Sample-Bounded Study Areas**

An important subset of the vertical and lateral study areas is the sample-bounded study area. Characterization samples shall be collected at regular intervals in trenches and/or soil borings (see Sections 4.4.1 and 4.4.2 of this plan). However, for the purpose of this characterization, sample-bounded study areas are defined as areas of the site which are surrounded by vertical and/or lateral sample locations which are no greater than a designated distance (see Sections 4.2 and 4.3 of this plan) apart based on the type of evaluations being conducted (i.e., backhoe
trenching vs. auger drilling). These distances are not based on sampling intervals, but instead have been established by the project scoping team based on professional judgement. Although there are maximum distances set for the purpose of these study areas, there are no set distances or minimum distances set below these maximums. The purpose of determining the maximum size of sample-bounded study areas is to assign limits on the distance over which data from one sample location may be used to hypothesize the type and extent of contamination in the surrounding area.

**C.1.5 Decision Rules (Step 5)**

Decision rules have been developed for the characterization to define the parameters of interest, specify the action levels, and integrate previous DQO outputs into statements that describe a logical basis for choosing among alternative actions. The following sections discuss the statistical parameters and action levels that are utilized by the decision rules.

**C.1.5.1 Statistical Parameters**

Whenever possible, statistical data analysis will be conducted on sample data to substantiate the conceptual model with respect to the COCs within each study area and the transition (i.e., the Study Boundary) from one study area to another (i.e., from South SCEP Study Area 3 [TPH only] to Study Area 4 [uncontaminated or contaminated below the TPH action level]). The use of statistics will depend on the availability of adequate sample groups (i.e., groups of samples large enough to apply statistical analysis) since there may be times when, because of site conditions or other constraints, a large enough sample group may not be available. Statistical analysis results will also require confirmation through the preparation of contaminant maps and models in order to ensure that the analysis is sound. When applicable, the statistical parameter to be used will be the mean of the applicable COC concentration values for each study area. The applicable COCs for substantiating the conceptual model within each study area have been presented in Section C.1.4 and are based on the conceptual model and the characteristic study boundaries. The following are examples of what may be statistically determined in order to substantiate the transition (site wide) from one study area to another:

- South SCEP
  - Study Area 1 or 2 to Study Area 3 - Individual RCRA-regulated contaminants are no longer present above the detection limits for total concentrations or above the TC limits for TC concentrations.
- Study Area 3 to Study Area 4 - TPH concentrations are no longer above the NDEP action level.

- North SCEP

- Study Area 1 to Study Area 2 - TPH concentrations are no longer above the NDEP action level.

Other transitions may occur on the site (i.e., South SCEP Study Area 2 to Study Area 4) and will be monitored; however, these transitions would require a change in the conceptual model for the site.

**C.1.5.2 Action Levels**

The characterization action levels for COCs are based on different sources depending on the parameter of interest, as defined in the conceptual model and defined as the characteristic study boundaries, and the purpose of the analysis. Table C-2 presents the sources for the action levels that will be used for the different COCs during this characterization.

**C.1.5.3 Rules**

The decision rules for the characterization phases and the Decision Groupings are presented in the form of process flow charts in Figures C-1 through C-5. These flow charts break down the different decision groupings presented in Plate 2 into the actual decisions that use the statistical parameters and/or the action levels and study boundaries in order to derive answers to the questions presented in the decision groupings. In the flow charts, “if” statements are represented by diamonds (i.e., decision points), and “then” statements are represented by the squares and rounded squares, and ovals (i.e., resulting required actions, alternate actions, and end points).

**C.1.6 Decision Error Limits (Step 6)**

The following sections present the definition of the tolerable limits on decision errors for the characterization. To do this, the possible range of the parameters of interest (e.g., contaminant concentrations) must be estimated, the decision errors identified, the null and alternate hypotheses ($H_0$ and $H_a$) chosen, and the resultant false positive and false negative ($F^+$ and $F^-$) decisions determined.
C.16.1 Range of the Parameters

Where possible, the range of parameters will be based on historic sampling data. However, because this data is limited, it is possible that the ranges may be exceeded and/or additional parameters (i.e., contaminants) may be identified during the characterization. Table C-3 presents the ranges of COCs observed in data from preliminary sampling activities at the site.

Table C-2
Action Levels for Identified Contaminants

<table>
<thead>
<tr>
<th>Media</th>
<th>Parameter</th>
<th>Action Level</th>
<th>Source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>TPH</td>
<td>100 ppm</td>
<td>NAC 459.9973</td>
<td>Regulated by the NDEP</td>
</tr>
<tr>
<td></td>
<td>TC VOCs</td>
<td>TC List</td>
<td>40 CFR 261.24</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>VOCs</td>
<td>Above the detection limits and above LDRs</td>
<td>40 CFR 261 268.40</td>
<td>Applicable to listed hazardous wastes only.</td>
</tr>
<tr>
<td>TC Metals</td>
<td>TC List</td>
<td>40 CFR 261.24</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Radiological</td>
<td>Component specific</td>
<td>NTS PO</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td>TPH</td>
<td>N/A</td>
<td>N/A</td>
<td>Action or cleanup levels may be established by the NDEP on a site-specific basis.</td>
</tr>
<tr>
<td></td>
<td>VOCs</td>
<td>MCLs</td>
<td>SDWA</td>
<td>--</td>
</tr>
<tr>
<td>Metals</td>
<td>MCLs</td>
<td>SDWA</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

a: Total petroleum hydrocarbons
b: Parts per million
c: Nevada Administrative Code
d: Nevada Division of Environmental Protection
e: Toxicity characteristic
f: Volatile organic compounds
g: Code of Federal Regulations
h: Land Disposal Restrictions
i: Nevada Test Site Performance Objective for Certification of Nonradioactive Hazardous Waste (BNC, 1996)
j: Maximum contaminant limits
k: Safe Drinking Water Act
LEGEND

- Beginning of Process
- Decision Points (i.e., "IF" Statements)
- Required Actions (i.e., "THEN" Statements)
- Alternate Required Actions (i.e., "THEN" Statements)
- Potential End Points

Likely Path of Activities
Potential Path of Activities

ACRONYM AND ABBREVIATION LIST

CFR - Code of Federal Regulations
COCs - Contaminants of Concern
IDW - Investigation-Derived Waste
MCL - Maximum Contaminant Level
RCRA - Resource Conservation and Recovery Act
SCEP - Steam Cleaning Effluent Pond
TPH - Total Petroleum Hydrocarbon

Figure C-1
Legend for the Decision Rule Diagrams

C-12
The contamination is RCRA-regulated (i.e., hazardous).

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

YES

The contamination is TPH and RCRA hazardous.

NO

The contamination is RCRA hazardous.

Do man-made radionuclide concentrations exceed action levels?

YES

The contamination is radioactive and RCRA-regulated hazardous (i.e., mixed waste contamination).

NO

The contamination is RCRA-regulated hazardous.

Do TPH concentrations exceed the del or do character exceed level?

YES

Possible path for South SCEP

NO

The contamination is TPH and RCRA-regulated hazardous (i.e., mixed waste contamination).

The contamination is radioactive and RCRA-regulated hazardous (i.e., RCRA hazardous waste contamination).

Figure

Decision Rules For Conta
Area 6 Steam Cleani
The contamination is not TPH or RCRA hazardous. The contamination is TPH.

- **YES**
  - Do TPH concentrations exceed the NDEP action level of 100 ppm?
  - The contamination is TPH.
  - Do man-made radionuclide concentrations exceed action levels?
    - **YES**
      - The contamination is radioactive and TPH (i.e., low-level waste contamination).
    - **NO**
      - The contamination is TPH.

- **NO**
  - The contamination is not TPH or RCRA hazardous.
  - Do man-made radionuclide concentrations exceed action levels?
    - **YES**
      - The contamination is radioactive (i.e., low-level waste contamination).
    - **NO**
      - The contamination is not radioactive, TPH, or RCRA hazardous waste (i.e., uncontaminated).
Evaluation of vertical contaminant migration.

**YES**
- Does analysis of a sample or samples indicate that regulated contaminant concentrations exceed the specified action levels at the current sampling depth?

**NO**
- Vertical contaminant migration has not exceeded the current sampling depth.

**YES**
- Vertical contaminant migration has exceeded the current sampling depth.

**YES**
- Have at least two uncontaminated sampling intervals been documented?

**NO**
- Conduct further investigation of vertical contaminant migration below the current sampling depth to substantiate the plume edge.

**NO**
- Conduct further investigation of vertical contaminant migration at the current location.

**YES**
- Have the current study area boundaries been met or exceeded?

**NO**
- No further investigation of vertical contaminant migration is necessary.

**YES**
- Modification of the conceptual model and further investigation of vertical contaminant migration is necessary.

**NO**
- No further investigation of vertical migration is necessary.

- Continue investigation of vertical migration along different trends from the source.

---

**Figure C-3**

Decision Rules for Vertical Contaminant Migration Evaluation

Area 6 Steam Cleaning Effluent Ponds
Preliminary evaluation of shallow groundwater.

Has saturated soil been encountered and/or standing water been observed in excavations or soil borings conducted during the characterization activities?

YES

Install shallow groundwater monitoring well(s).

NO

Sample groundwater and analyze for COCs observed in contaminated soil.

Do COCs exceed detection limits?

NO

Continue with planned site characterization activities.

YES

Do COC levels exceed the Maximum Contaminant Levels (MCLs) in 40 CFR 141?

YES

Evaluate the need for further characterization of groundwater contamination at the site.

NO

Evaluate IDW for management requirements.

Figure C-4
Decision Rules for Preliminary Shallow Perched Groundwater Evaluation
Area 6 Steam Cleaning Effluent Ponds
Evaluation of lateral contaminant migration.

Does analysis of a sample or samples indicate that regulated contaminant concentrations exceed the specified action levels at the current distance from the source?

Lateral contaminant migration away from the source has exceeded the current distance from the source.

Have the current study area boundaries been met or exceeded?

YES

Modification of the conceptual model and further investigation of lateral contaminant migration is necessary.

NO

Conduct further investigation of lateral contaminant migration away from the source along the current sampling trend.

Lateral contaminant migration away from the source has not exceeded the current distance from the source.

Is the closest sample location along the current sampling trend greater than the maximum specified distance away?

NO

Is better definition of the plume or plume edge necessary in the area?

NO

No further investigation of lateral contaminant migration is necessary for the current study area along the current sampling trend.

YES

Conduct further investigation of lateral contaminant migration between the two sampling points to better define the plume or plume edge.

Has the lateral extent of contamination been evaluated or estimated in all directions from the source?

NO

Continue investigation of lateral migration along different trends from the source.

YES

No further investigation of lateral migration is necessary.

Figure C-5
Decision Rules for Lateral Contaminant Migration Evaluation
Area 6 Steam Cleaning Effluent Ponds

C-16
The COC for which the greatest amount of data is currently available is TPH. From the values presented in Table C-3, it is possible to suggest that the TPH range in the North SCEP is unlikely to exceed 1,000 mg/kg and in the South SCEP 100,000 mg/kg. Since most of the past sampling involved obtaining and analyzing samples from the areas of greatest potential impact, it is suggested that the range for VOCs will not likely be substantially greater than the range presented in Table C-3. Toxicity characteristic metals were either not observed above detection limits or were observed to be substantially below the TC action levels and are expected to remain so in samples collected for the characterization.

### Table C-3
**Observed Concentration Ranges for Identified Contaminants**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>North SCEP</th>
<th>South SCEP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area 1</td>
<td>Area 2</td>
</tr>
<tr>
<td>TPH</td>
<td>mg/kg</td>
<td>470 - 650 (2)</td>
<td>ND - 53 (8)</td>
</tr>
<tr>
<td>VOCs</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>Acetone</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>Benzene</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>cis-1,2-Dichloroethene</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>PCE</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>Toluene</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>Xylene</td>
<td>µg/kg</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>TC VOCs</td>
<td>µg/l</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>TC SVOCs</td>
<td>µg/l</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>TC Barium</td>
<td>mg/l</td>
<td>ND - 0.83 (4)</td>
<td>ND - 1.24 (3)</td>
</tr>
<tr>
<td>TC Cadmium</td>
<td>mg/l</td>
<td>ND - 0.011 (4)</td>
<td>ND (3)</td>
</tr>
<tr>
<td>TC Mercury</td>
<td>mg/l</td>
<td>ND (4)</td>
<td>ND (3)</td>
</tr>
</tbody>
</table>

Note: the numbers in parentheses indicate the number of samples upon which the range was based.

*Total petroleum hydrocarbons by EPA Method 8015 Modified
^Milligrams per kilogram
^Not detected
^Volatile organic compounds
^Micrograms per kilogram
^Not analyzed
^Tetrachloroethene
^Toxicity characteristic
^Micrograms per liter
^Semivolatile organic compounds
^Milligrams per liter
C.1.6.2 Identification of Decision Errors and Assignment of Hypotheses

Decision errors have been identified and used to assign the null and alternate hypotheses through the development of a flow diagram (Plate 4) which depicts the true state of nature, the potential decision errors, the potential consequences associated with the decision errors, and resultant severity of the consequences. In order to identify the primary potential decision errors for the characterization, the four decision groupings have been consolidated into the two primary decision error(s) for contaminant characterization and contaminant migration. The following summarizes the results presented in the flow diagram on Plate 4:

- **Contaminant Characterization**

  Decision Errors:
  The contamination does/does not exceed RCRA, RCRA TC, RCRA LDR, and/or TPH action levels applicable to each individual study area in the conceptual model.

  \[ H_0: \] The contamination exceeds RCRA, RCRA TC, RCRA LDR, and/or TPH action levels applicable to each individual study area in the conceptual model.

  \[ H_a: \] The contamination does not exceed RCRA, RCRA TC, RCRA LDR, and/or TPH action levels applicable to each individual study area in the conceptual model.

  \[ F+: \] The contamination does not exceed RCRA, RCRA TC, RCRA LDR, and/or TPH action levels applicable to each individual study area in the conceptual model.

  \[ F-: \] The contamination exceeds RCRA, RCRA TC, RCRA LDR, and/or TPH action levels applicable to each individual study area in the conceptual model.

- **Contaminant Migration**

  Decision Errors:
  Regulated contaminant concentrations do/do not exceed the spatial boundaries proposed in the conceptual model.

  \[ H_0: \] Regulated contaminant concentrations exceed the spatial boundaries proposed in the conceptual model.
Regulated contaminant concentrations do not exceed the spatial boundaries proposed in the conceptual model.

Regulated contaminant concentrations do not exceed the spatial boundaries proposed in the conceptual model.

Regulated contaminant concentrations exceed the spatial boundaries proposed in the conceptual model.

C.1.6.3 Identification of Tolerable Error Limits

When possible and applicable, statistical methods will be employed in the analysis of sample data obtained during the characterization activities (see Section C.1.5.1 for additional information on application and methods) that are detailed in Section 4.0 of the characterization plan. When statistical analysis can be employed, it will also be used to evaluate the sample data with respect to established tolerable error limits.

Tolerable error limits for the characterization will be established through the application of confidence intervals for the mean. In order to do this, a range of possible parameter values where the consequences of decision errors are relatively minor (i.e., grey region) must first be established. For parameters where there is an applicable regulatory action level, the grey region will be equal to twenty percent of the action level. For example, for TPH concentrations, when the null hypothesis is that the sample population is impacted by TPH above the action level, the grey area would be equal to concentrations between 80 ppm (i.e., 80% of the action level) and 100 ppm (i.e., the NDEP action level in soil). For parameters where there is no action level available, twenty percent of the contract-required detection limit (CRDL) shall be used.

Decision Error Limits have been assigned based on the consequences of the decision errors, the costs associated with obtaining and analyzing increasing numbers of samples, and general recommendations by the EPA on confidence levels for planned removals and remedial responses (EPA, 1989). Table C-4 specifies the Decision Error Limits for the characterization on a generic basis that will be applied to each COC identified.
# Table C-4
Decision Error Limits

<table>
<thead>
<tr>
<th>True Concentration</th>
<th>Correct Decision</th>
<th>Type of Error</th>
<th>Tolerable Probability of Incorrect Decision</th>
<th>Level of Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 80% action level</td>
<td>Not exceeded</td>
<td>False Negative</td>
<td>10%</td>
<td>90%</td>
</tr>
<tr>
<td>80 - 100% action level</td>
<td>Not exceeded</td>
<td>False Negative</td>
<td>Grey Region</td>
<td>Grey Region</td>
</tr>
<tr>
<td>&gt; 100% action level</td>
<td>Does exceed</td>
<td>False Positive</td>
<td>10%</td>
<td>90%</td>
</tr>
</tbody>
</table>
**Distribution List**

<table>
<thead>
<tr>
<th>Copies</th>
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</thead>
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<tr>
<td>1</td>
<td>DOE/Nevada Operations Office</td>
</tr>
<tr>
<td></td>
<td>Technical Information Resource Center</td>
</tr>
<tr>
<td></td>
<td>P.O. Box 98518</td>
</tr>
<tr>
<td></td>
<td>Las Vegas, Nevada 89193-8518</td>
</tr>
<tr>
<td>2</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td></td>
<td>Office of Scientific and Technical Information</td>
</tr>
<tr>
<td></td>
<td>175 Oak Ridge Turnpike</td>
</tr>
<tr>
<td></td>
<td>Post Office Box 62</td>
</tr>
<tr>
<td></td>
<td>Oak Ridge, Tennessee 37831</td>
</tr>
</tbody>
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Plates
NOTICE