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DOE/RL-2010-83
Revision 1

Sampling and Analysis Plan for Soil Desiccation Pilot Test

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY Richland Operations Office

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Title *Sampling and Analysis Plan for the Soil Desiccation Pilot Test*

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Signature Date 10-20-2010

Executive Summary

This sampling and analysis plan (SAP) describes the field sampling activities and quality assurance (QA) processes for obtaining data of sufficient quality and quantity during conduct of the Soil Desiccation Pilot Test (SDPT) in the BC Cribs and Trenches Area. Specific information will be obtained during operation of the SDPT that will be used to evaluate soil desiccation as a possible treatment technology for significantly reducing the mobility of contaminants with the potential to have adverse groundwater impact.

This SAP supports the remedial investigation/feasibility study (RI/FS) for the 200-BC-1 operable unit (OU). The 200-BC-1 OU includes the BC Cribs and Trenches waste sites located in the southeastern portion of the 200 Area National Priorities List site. This SAP is an extension of the *Field Test Plan for the Soil Desiccation Pilot Test* (DOE/RL-2010-04),[1] which is a necessary part of the RI/FS process as initiated by the original work plan for these waste sites, the *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan* (DOE/RL-2000-38).[2] The BC Cribs and Trenches waste sites have since been moved into the 200-BC-1 OU to focus on their characterization and eventual remediation.

The SDPT will be conducted at the 299-E13-62 Well, which is located within the cribs portion of the BC Cribs and Trenches area. This location was selected as the target region for the SDPT based on extensive data collection and site characterization during the installation of the borehole from which the 299-E13-62 Well was constructed. Additional characterization data was obtained recently to confirm that the selected region is suitable for operating the SDPT.

The SDPT will require the installation of approximately 20 new monitoring holes near the 299-E13-62 Well that will serve as the nitrogen injection well for the SDPT. The holes will have instrumentation to monitor desiccation progress and collect data to facilitate evaluation of soil desiccation as a potential remedy to protect groundwater from mobile contaminants. Following the period of active desiccation, up to eight additional boreholes will be installed to ground-truth (validate) the data collected from in situ instruments and sensors and to monitor rewetting. At least two of these boreholes will be

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[1] DOE/RL-2010-04, 2010, *Field Test Plan for the Soil Desiccation Pilot Test,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

[2] DOE/RL-2000-38, 2000, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

installed within four months after termination of active desiccation. The locations and timing of the installation of other boreholes will be based on analysis of data collected during active desiccation and from the initial ground-truthing boreholes.

The four chapters within this SAP contain the following information:

- Chapter 1 summarizes the recent data quality objective process and required data for electrical resistivity evaluation.
- Chapter 2 describes the quality assurance project plan.
- Chapter 3 describes the field sampling plan and field-related activities/plans.
- Chapter 4 provides a list of the references cited.

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Terms

AEA	alpha energy analysis
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M HILL Plateau Remediation Company
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DPHP	dual probe heat pulse (sensor)
DQO	data quality objective
DR	decision rule
DS	decision statement
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERT	electrical resistivity tomography
FTP	Field Test Plan
GEA	gamma energy analysis
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Documents*
HDU	heat dissipation unit
HEIS	*Hanford Environmental Information System* database
ICP/MS	inductively coupled plasma/mass spectrometry
NA	not applicable
OU	operable unit
PNNL	Pacific Northwest National Laboratory
QA	quality assurance

QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RI/FS	remedial investigation/feasibility study
SAP	sampling and analysis plan
SDPT	Soil Desiccation Pilot Test
TBD	to be determined
TCP	thermocouple psychrometer
UCL	upper confidence limit
US ACE	United States Army Corps of Engineers
WAC	*Washington Administrative Code*

1 Introduction

The U.S. Department of Energy, Richland Operations Office (DOE-RL) report, *Deep Vadose Zone Treatability Test Plan for the Hanford Central Plateau* (DOE/RL-2007-56), includes a focus on soil desiccation as a potential remedial action. This sampling and analysis plan (SAP) specifies vadose zone data to be collected in association with the installation of approximately 20 monitoring holes in the BC cribs and trenches area of the Hanford Site, including the data to be collected during the active portion of the Soil Desiccation Pilot Test (SDPT), and the data to be collected afterward. Data collection requirements were identified during the data quality objectives (DQOs) process (SGW-39506, *Data Quality Objectives Summary Report for the BC Cribs and Trenches Area Soil Desiccation Pilot Test – Characterization of the Soil Desiccation Pilot Test Site*). The data requirements are primarily directed at evaluating soil desiccation as a potential groundwater protection remedy.

This SAP supports the remedial investigation/feasibility study (RI/FS) for the 200-BC-1 operable unit (OU). The 200-BC-1 OU includes the BC Cribs and Trenches waste sites, which are located in the southeastern portion of the 200 Area National Priorities List site. This SAP is an extension of the *Field Test Plan for the Soil Desiccation Pilot Test* (DOE/RL-2010-04), which is a necessary part of the RI/FS process as initiated by the original RI/FS work plan for these waste sites. The original RI/FS work plan is the *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan* (DOE/RL-2000-38). The BC Cribs and Trenches waste sites have since been moved into the 200-BC-1 OU to focus on their characterization and eventual remediation.

1.1 Data Quality Objectives

Completion of the DQO process for this activity (SGW-41327, *Data Quality Objectives Summary Report for the Soil Desiccation Pilot Test*) (hereafter referred to as the DQO summary report) was consistent with the process described in *Guidance for the Data Quality Objectives Process*, EPA QA/G-4 (EPA/600/R-96/055), which was replaced by *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4 (EPA/240/B-06/001). The DQO process is a strategic planning approach for defining data collection design criteria. The DQO process is used to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application.

This section presents a summary of the key outputs resulting from the DQO process. The decision statements (DSs) and decision rules (DRs) in Table 1-1 were developed during the preceding DQO process. For additional details, refer to the DQO summary report (SGW-41327).

1.1.1 Statement of the Problem

The purpose of this SAP is to define data collection during conduct of the SDPT. Successful test results rely on the ability to remove sediment pore water to the extent that associated mobile contamination transport is slowed to the point where the groundwater drinking water standard is not exceeded.

1.1.2 Decision Statements and Decision Rules

DSs are developed during the DQO process to consolidate potential questions and alternative actions. DRs are generated from the DSs. A DR is an "IF…THEN…" statement that incorporates the parameter of interest, unit of decision making, action level, and action(s) that would result from resolution of the decision. Table 1-1 presents the DSs and DRs that were identified in the DQO summary report (SGW-41327).

The DRs are not explicitly quantitative because the purpose of the evaluation is to assess whether soil desiccation can effectively protect groundwater from mobile contaminants in the vadose zone. Data generated for this SAP will be appropriately applied to the DRs in Table 1-1.

Table 1-1. Summary of Decision Rules

Decision Statement	Decision Rule
DS No. 1 – Determine whether soil desiccation can significantly reduce sediment moisture content, or if not, a different remedy must be considered; or if it is not, consider abandoning desiccation as a practical remedy.	**DR No. 1** – If the true population (as estimated by the detected or average values as appropriate) soil moisture in central soil desiccation Zone D has been reduced to ≤5 wt% sediment moisture content during the soil desiccation treatability test, then consider it as a potential groundwater protection remedy; otherwise, consider abandoning desiccation as a practical remedy unless more detailed analysis shows the extent of desiccation achieved to be acceptable.
DS No. 2 – Determine whether a significant rate of sediment desiccation can be accomplished during the test; or if not, consider abandoning desiccation as a practical remedy.	**DR No. 2** – If the true population (as estimated by the detected or average values as appropriate of temporal moisture content change) rate of sediment desiccation in soil desiccation Zone D is greater than or equal to a soil desiccation rate of 53 m^3 sediment/month and at least 85% of the extracted gas originates from the injection well during the soil desiccation treatability test, then consider it as a potential groundwater protection remedy; otherwise, consider abandoning desiccation as a practical remedy unless more detailed analysis shows the extent of desiccation achieved to be acceptable.
DS No. 3 – Determine the cost of performing sediment desiccation; or if not, consider abandoning desiccation as a practical remedy.	**DR No. 3** – If the total cost of performing soil desiccation can be estimated consider it as a potential groundwater protection remedy; or if not, consider abandoning desiccation as a practical remedy.
DS No. 4 – Determine whether soil desiccation exhibits long-term effectiveness that protects groundwater; or if not, consider abandoning desiccation as a practical remedy.	**DR No. 4** – If soil desiccation exhibits long-term effectiveness that protects groundwater (as estimated by numerical simulation using input from the test), then it may be considered as a potential groundwater protection remedy; or if not, consider abandoning desiccation as a practical remedy unless more detailed analysis shows the extent of desiccation achieved to be acceptable.

Source:

SGW-39506, *Data Quality Objectives Summary Report for the BC Cribs and Trenches Area - Characterization of the Soil Desiccation Pilot Test Site.*

1.1.3 Error Tolerance and Decision Consequences

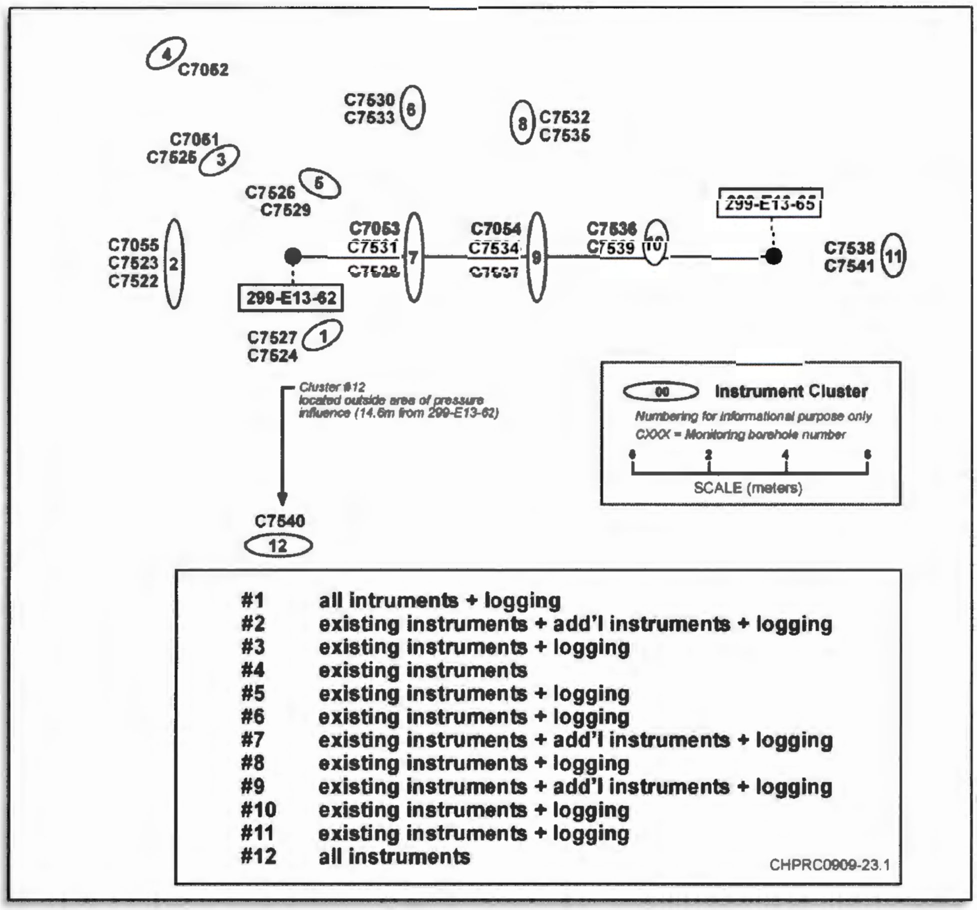
As explained for the DSs and DRs, evaluation of the data is based on qualitative criteria rather than quantitative statistical analyses. The borehole locations and the sediment sampling and analyses activities are based on professional judgment for acquiring information that will resolve the DRs. Professional judgment included an evaluation of laboratory testing and modeling/numerical simulations in the context of data collected during characterization of the SDPT site.

1.2 Summary of Data Quality Objectives (Sampling Design)

This section presents a summary of data required to address the DSs as presented in the DQO.

In situ instrumentation and characterization tools are designed to monitor movement of the desiccation front and changes in sediment characteristics beyond the desiccated region. Passage of the drying front will be inferred from sediment temperature changes that will be measured using thermisters and/or heat dissipation units (HDUs), from humidity sensors and thermocouple psychrometers (i.e., devices that measure sediment matric potential), and from sediment gas samples that evaluate tracer gas concentrations. Sediment moisture content will be measured using the HDUs (indirectly, by measuring sediment matric potential), dual-probe heat-pulse sensors, and periodic neutron logging and cross-hole radar. Electrical resistivity characterization will be performed using electrodes emplaced in selected monitoring holes. This is expected to corroborate the spatial moisture variations indicated by other measurement methods. Because some of the selected monitoring and sampling techniques require different types of subsurface access, some of which are not compatible, most monitoring locations will include clusters of monitoring holes.

Approximately 20 additional monitoring holes will be installed to monitor subsurface conditions during the SDPT. The locations and relationship of monitoring holes to the existing injection and extraction wells is shown in Figure 1-1.



Note: Borehole locations are approximate. Adjustment is anticipated to provide unobstructed line-of-sight between holes selected to be used for cross-hole radar. Numbers provide unique monitoring cluster identification.

Figure 1-1. SDPT Borehole and Monitoring Hole Locations

During conduct of the SDPT and following the period of active desiccation, instrumentation from those holes will provide data to monitor desiccation progress and potential rewetting of the dried out region after the period of active desiccation.

Additional instrumentation will be installed above ground to monitor the injected nitrogen and extracted soil gas streams associated with the SDPT, and collected condensate will be periodically analyzed.

Analytical results and other data obtained will be compared to the DRs in Table 1-1.

Table 1-2 presents the selected analytical methods and performance requirements that will meet the data needs. The analyses identified in Table 1-2 will be completed by an analytical laboratory and will include the laboratory quality control (QC) requirements specified in Section 2.2.5 of this SAP. A detailed sampling and data collection design is presented in Chapter 3.

1.3 Targeted Parameters

The targeted parameters for evaluating the vicinity of Well 299-E13-62 include risk-based and other contaminants of potential concern (COPCs), anions and cations, and geochemical and physical sediment properties. Non-radionuclide and radionuclide lists of COPCs for the BC cribs and trenches area are shown in *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites* (DOE/RL-2004-66), Tables 3-1 and 3-2. A subset of the risk-based COPCs shown in these tables (i.e., nitrate and technetium-99) were retained as targeted parameters. Other targeted parameters are those that contribute to high ionic strength and thus facilitate the electrical resistivity tomography (ERT) characterization tool to be used to monitor drying progress. Other targeted parameters are chosen to ensure worker and public safety and to provide data that will help assess soil desiccation potential.

Table 1-2. Information Required to Resolve the Decision Statements

DS No.	Required Information Category	Specific Information Needed	Field Test Methods	Analytical Methods	Sediment Quantitation Limit (mg/kg)	Pore Water Quantitation Limit (mg/L)	Precision	Accuracy
1, 2	Distribution of subsurface moisture, contaminants and sediment properties Overall desiccation progress	Sediment moisture content	Hanford Site-specific versions of the following methods are available from field loggers: ASTM D5753-05 (general logging guidelines) and ASTM D6727-01 (neutron logging)	ASTM D2216-05	1 vol%	NA	≤20%	80-120%
			In situ field instruments (HDU, thermisters, TCPs, DPHPs & humidity sensors [to indicate passage of drying front])	NA	NA	NA	HDU: ≤20% Thermister: ≤0.1°C. TCP: ≤20% DPHP: ≤20% Humidity sensor: ≤5%	Variable
			ERT using in situ field electrodes	NA	NA	NA	NA	NA
			Cross-hole radar	NA	NA	NA	NA	NA
		Definition of gas flow paths	Portable field instrument(s) to determine tracer gas concentrations in in situ gas samples	Dependant on gas composition	NA	NA	Dependant on gas composition	Dependant on gas composition
		Injected nitrogen properties	Field instruments (temperature, pressure, humidity, flow rate)	NA	NA	NA	T: ≤1.0°C P: ≤0.2"H_2O Humidity: ≤1% Flow rate: ≤25 cfm	Variable
		Extracted soil gas properties	Field instruments (temperature, pressure, humidity, flow rate)	NA	NA	NA	T: ≤1.0°C P: ≤0.2"H_2O Humidity: ≤1% Flow rate: ≤25 cfm	Variable

Table 1-2. Information Required to Resolve the Decision Statements

DS No.	Required Information Category	Specific Information Needed	Field Test Methods	Analytical Methods	Sediment Quantitation Limit (mg/kg)	Pore Water Quantitation Limit (mg/L)	Precision	Accuracy
		Lithology	Hanford Site-specific versions of the following methods are available from field loggers: ASTM D5753-05 (general logging guidelines) and ASTM D6274-98 (gamma logging)	Sediment types and depths by ASTM D2488-06	1 vol%	NA	≤20%	80-120%
3	Cost	Power consumption	Installed meter	NA	NA	NA	≤2%	98-102%
		Well spacing	In situ pressure monitoring instruments to determine zone of pressure influence	NA	NA	NA	≤0.2%	99-101%
			Thermisters (to measure temperature change associated with passage of drying front)	NA	NA	NA	≤0.1°C	99.5-100.5%
		Desiccation rate	HDU and TCP to measure matric potential of soil in contact with instrument	NA	NA	NA	≤20%	80-120%
			Tracer gas analysis to measure volume swept by injected gas	Dependant on gas composition	TBD	TBD	Dependant on gas composition	Dependant on gas composition
			Neutron logging to measure local changes in sediment moisture	NA	NA	NA	≤5%	95-105%

Table 1-2. Information Required to Resolve the Decision Statements

DS No.	Required Information Category	Specific Information Needed	Field Test Methods	Analytical Methods	Sediment Quantitation Limit (mg/kg)	Pore Water Quantitation Limit (mg/L)	Precision	Accuracy
			ERT to measure large-scale changes in sediment conductivity	NA	NA	NA	NA	NA
			Cross-hole radar to measure large-scale changes in sediment moisture content	NA	NA	NA	≤20%	80-120%
			Field instruments (HDU, TCP, DPHP, thermisters, humidity sensor)	NA	NA	NA	HDU: ≤20% Thermister: ≤0.1°C TCP: ≤20% DPHP: ≤20% Humidity sensor: ≤5%	HDU: 80-120% Thermister: 99-101% TCP: 80-120% DPHP: 80-120% Humidity sensor: 95-105%
	Protection of groundwater	Sediment moisture content	Neutron logging	NA	1%	NA	≤20%	80-120%
			ERT	NA	NA	NA	NA	NA
			Cross-hole radar	NA	NA	NA	≤20%	80-120%
			Sediment/pore water analysis for technetium-99, nitrate, sodium	Technetium-99 ICP/MS 6020, EPA Method 200.8, or wet chemical separation with liquid scintillation counter	15 pCi/g	15 pCi/L	≤30%	70-130%
				Nitrate EPA Method 9056 or Method 300.0	2/5	1 to 5, depending on method	≤30%	70-130%
				Sodium ASTM C1111-04 or EPA Method 6010B, 200.8, or 6020	250	5	≤30%	70-130%

Table 1-2. Information Required to Resolve the Decision Statements

DS No.	Required Information Category	Specific Information Needed	Field Test Methods	Analytical Methods	Sediment Quantitation Limit (mg/kg)	Pore Water Quantitation Limit (mg/L)	Precision	Accuracy
4		Contaminant transport	Sediment/pore water analysis for technetium-99, nitrate, sodium	Technetium-99 ICP/MS 6020, EPA Method 200.8, or wet chemical separation with liquid scintillation counter	15 pCi/g	15 pCi/L	≤30%	70-130%
				Nitrate EPA Method 9056 or Method 300.0	2/5	1 to 5, depending on method	≤30%	70-130%
				Sodium ASTM C1111-04 or EPA Method 6010B, 200.8, or 6020	250	5	≤30%	70-130%

Notes:

Precision and accuracy requirements are identified and defined in EPA references and laboratory analysis and QA procedures.

For EPA Method 200.8, see EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For EPA Method 300.0, see EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes*. Four-digit EPA methods are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

ASTM C1111-04, *Standard Test Method for Determining Elements in Waste Streams by Inductively Coupled Plasma-Atomic Emission Spectroscopy*.

ASTM D2216-05, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*.

ASTM D2488-06, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*.

ASTM D5753-05, *Standard Guide for Planning and Conducting Borehole Geophysical Logging*.

ASTM D6274-98, *Standard Guide for Conducting Borehole Geophysical Logging-Gamma*.

ASTM D6727-01, *Standard Guide for Conducting Borehole Geophysical Logging-Neutron*.

Table 1-3 summarizes the final set of targeted parameters that are identified in the DQO.

Table 1-3. Targeted Parameters

Risk-Based COPCs*	Anions and Cations	Geochemical and Physical Properties
Nitrate (as nitrogen)	Sodium	Sediment moisture content
Technetium-99		Sediment hydraulic conductivity
		Specific electrical conductivity of sediment pore water
		Borehole neutron and natural gamma logs
		Sediment intrinsic and large-scale air permeability
		Extracted air flow rate, temperature, humidity, applied vacuum, and differential pressure between wells

* COPCs are from DOE/RL-2004-66, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites.*

2 Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. This QAPjP complies with the following requirements:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5*
- DOE/RL-96-68, 2007, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD)

The sections in this chapter describe the quality requirements and controls applicable to this investigation.

2.1 Project Management

This section addresses the basic areas of project management and ensures that the project has a defined goal, that the participants understand the goal and the approach to be used, and that the planned outputs have been appropriately documented.

2.1.1 Project/Task Organization

CH2M HILL Plateau Remediation Company (CHPRC) or its approved subcontractor is responsible for collecting, packaging, and shipping samples to the laboratory. CHPRC will select a laboratory to perform the analyses; the selected laboratory must conform to HASQARD procedures (or equivalent), as approved by DOE-RL and the U.S. Environmental Protection Agency (EPA). CHPRC is responsible for managing all interfaces among subcontractors involved in executing the work described in this SAP. The project organization, shown in Figure 2-1, is described in the subsections below.

2.1.1.1 Regulatory Project Manager

As the lead regulatory agency, the EPA has assigned a project manager for overseeing the cleanup projects and activities. As the lead regulatory agency, the EPA has approval authority for the work performed under this Field Test Plan (FTP). EPA will work with DOE to resolve concerns regarding the work as described in this FTP in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989), hereafter referred to as the Tri-Party Agreement.

2.1.1.2 Tri-Party Agreement Project Manager and DOE-RL Technical Lead

The DOE-RL is responsible for the Hanford cleanup. The Tri-Party Agreement Project Manager is responsible for authorizing the contractor to perform Hanford Site activities in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Atomic Energy Act of 1954*; and the Tri-Party Agreement. In addition, the Tri-Party Agreement Project Manager is responsible for obtaining lead regulatory agency approval of the FTP that authorizes the activities under the Tri-Party Agreement (Ecology et al., 1989). The DOE-RL Technical Lead is responsible for working with the contractor and the regulatory agencies to identify and work through issues, and providing technical input to the Tri-Party Agreement Project Manager.

2.1.1.3 Deep Vadose Zone Manager

The Deep Vadose Zone Manager provides oversight for all activities and coordinates with DOE-RL, the regulators, and CHPRC management in support of sampling activities. In addition, the Deep Vadose Zone Manager provides support to the Field Team Lead to ensure that work is performed safely and cost effectively. The Deep Vadose Zone Manager maintains the approved QAPjP.

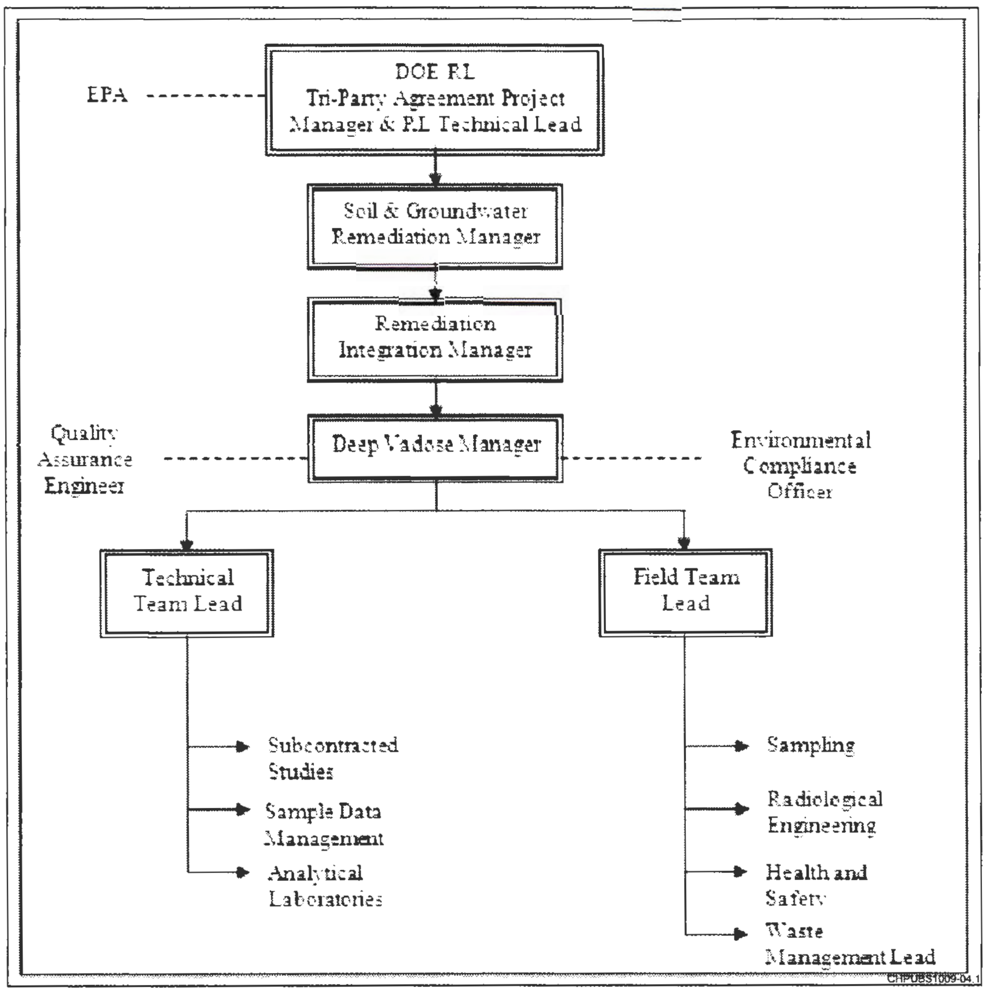


Figure 2-1. Project Organization Chart

2.1.1.4 Field Team Lead

The Field Team Lead has overall responsibility for the planning, coordination, and execution of field activities. Specific responsibilities include converting the sampling design requirements into field task instructions that provide specific direction for field activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The Field Team Lead communicates with the Technical Lead to identify field constraints that could affect the sampling design. In addition, the Field Team Lead directs the procurement and installation of materials and equipment needed to support fieldwork.

The Field Team Lead oversees field sampling activities including sample collection and packaging; provision of certified clean sampling bottles/containers; documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging; and transportation of samples to the laboratory or shipping center.

2.1.1.5 Technical Lead

The Technical Lead is responsible for direct management of sampling documents and requirements, and subcontracted tasks. The Technical Lead ensures that field personnel, including samplers and others responsible for implementation of the SAP and QAPjP, are provided with current copies of this document and any revisions thereto. The Technical Lead works closely with the Quality Assurance (QA) and Health and Safety organizations and the field personnel to promulgate these requirements with them and the other lead disciplines in planning and implementing the scope of work. The Technical Lead coordinates with and reports to DOE-RL and CHPRC management on all sampling activities. The Technical Lead has discretionary authority to make the final sampling objective determination and supports DOE-RL in coordinating sampling activities with the regulators. In the event of uncertainty, DOE-RL and EPA are contacted.

2.1.1.6 Quality Assurance Engineer

The QA Engineer is matrixed to the Deep Vadose Zone Manager and is responsible for QA issues on the project. Responsibilities include oversight of implementation of the project QA requirements; review of project documents including DQO summary reports, SAPs, and the QAPjP; and participation in QA assessments on sample collection and analysis activities, as appropriate.

2.1.1.7 Environmental Compliance Officer

The Environmental Compliance Officer, matrixed to the Deep Vadose Zone Manager, provides technical oversight, direction, and acceptance of project and subcontracted environmental work and develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The Environmental Compliance Officer also reviews plans, procedures, and technical documents to ensure that all environmental requirements are addressed; identifies environmental issues that affect operations and develops cost effective solutions; and responds to environmental and regulatory issues or concerns raised by the DOE and/or regulatory agency staff.

2.1.1.8 Waste Management Lead

The Waste Management Lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance and interpreting the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste acceptance criteria.

2.1.1.9 Radiological Engineering

The Radiological Engineering organization is responsible for the radiological engineering and health physics support for the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure, and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to hazards at ALARA levels. Radiological Engineering interfaces with the project Health and Safety Representative and plans and directs radiological control technician support for all activities.

2.1.1.10 Sample and Data Management

The Sample and Data Management organization ensures that laboratories providing analytical services for this SAP conform to HASQARD requirements (or their equivalent), as approved by DOE-RL, the EPA, and the Washington State Department of Ecology (Ecology). Sample and Data Management receives the analytical data from the laboratories, performs data entry into the *Hanford Environmental Information System* (HEIS) database, and arranges for data validation.

2.1.1.11 Health and Safety

The Health and Safety organization's responsibilities include coordination of industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or by internal CHPRC work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personal protective equipment requirements are coordinated with Radiological Engineering.

2.1.2 Problem Definition/Background

The definition of the problem was provided in Section 1.1.1 of this SAP.

2.1.3 Project/Task Description

Twenty additional monitoring holes will be installed for collecting information during conduct of the SDPT. During conduct of the SDPT, instrumentation associated with these holes will monitor desiccation progress during the active portion of the test and sediment rewetting following shutdown of the vapor extraction equipment. Data will be used to evaluate soil desiccation as a potential remedy to protect groundwater from mobile contaminants deep in the vadose zone. Following completion of the period of active desiccation, up to eight additional boreholes will be installed to ground-truth the data and monitor rewetting. Evaluation will be in the form of a treatability test report.

2.1.4 Quality Objectives and Criteria

Quality objectives and criteria (including analytical methods, detection limits, and precision and accuracy requirements for each analysis to be performed) are summarized in Table 1-2.

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by accuracy and precision, by evaluation against the identified DQOs, and by evaluation against the work activities identified in this SAP. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method, which are addressed in the subsections below.

2.1.4.1 Representativeness

Representativeness is a measure of how closely analytical results reflect the actual concentration and distribution of the constituents in the matrix sampled. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) are discussed in subsequent sections of this SAP. The required documentation will establish the protocols to be followed and will ensure appropriate sample identification and integrity.

2.1.4.2 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Radionuclide measurements that require chemical separations use this technique to measure method performance. For radionuclide measurements that are analyzed by gamma spectroscopy, laboratories typically compare the results of blind audit samples against known standards to establish accuracy. Validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generating in-house statistical limits based on three standard deviations. Table 1-2 lists the accuracy requirements for fixed laboratory analyses for the project.

2.1.4.3 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements. Analytical precision requirements for fixed laboratory analyses are listed in Table 1-2.

2.1.4.4 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained by using standard procedures, uniform methods, and consistent units.

2.1.4.5 Completeness

Technetium-99, sodium, and nitrate are the most important analytes for the technical evaluation. The analytical data set for this SAP will be considered incomplete if these analytes are not included. If one or more of the other analytical parameters in Table 1-2 are not reported, the Technical Lead, or designee, will determine whether the data set is complete for this SAP.

Other data elements are equally important to the success of this treatability test. It is essential that data associated with monitoring desiccation progress, including the quantity of water removed, are collected; otherwise, the test will have been a wasted effort.

2.1.4.6 Detection Limits

Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Detection limits identified for analyses for this project are listed in Table 1-2.

2.1.5 Special Training Certification

Typical training or certification requirements have been instituted by CHPRC to meet the training requirements imposed by such documents as the CHPRC contract (DE-AC06-08RL14788, *CH2M HILL Plateau Remediation Company Plateau Remediation Contract*), regulations, DOE orders, contractor requirements documents, American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) standards, and the *Washington Administrative Code* (WAC). The Environmental Health and Safety Training Program provide workers with the knowledge and skills necessary to execute assigned duties safely. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training
- Eight-Hour Hazardous Waste Worker Refresher Training (as required)
- Radiological Worker Training
- Hanford General Employee Training

A graded approach is used to ensure that workers receive a level of training that is commensurate with their responsibilities and that complies with applicable DOE orders and government regulations. Specialized employee training includes pre-job briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations. Field personnel training records will be documented and kept on file by the training organization. Training requirements for specific tasks are determined by personnel with expertise in the relevant subject area. The Field Team Lead is responsible for ensuring that training requirements are appropriately established.

2.1.6 Documentation and Records

The Technical Lead ensures that the Field Team Lead, samplers, and others responsible for implementation of this SAP and the QAPjP are provided with current copies of this document and any revisions thereto. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that comprise a collection of document control systems and processes that use a graded approach for the preparation, review, approval, distribution, use, revision, storage/retention, retrieval, disposition, and protection of documents and records generated or received in support of CHPRC work.

All information pertinent to data collection and field sampling and analysis will be recorded in bound logbooks or other forms of media as required by applicable protocols. The sampling team will be responsible for recording all relevant sampling information in the logbooks. Entries made in the logbook will be dated and signed by the individual making the entry.

A treatability test report, based on the data collected, will be prepared. The report will support the development and evaluation of remedial alternatives through the feasibility study process.
A contractor-level document (i.e., a borehole summary report) will be produced to summarize field activities and to capture field screening and geophysical data that are collected during installation of the boreholes used to collect in situ data. Another borehole summary report will capture similar data from those boreholes installed to collect sediment samples following the active portion of the test. The borehole summary report will be consistent with similar documents that are prepared for other boreholes at the Hanford Site. Project documentation and records will be prepared, approved, and maintained according to DOE-RL and contractor requirements.

2.2 Data Generation and Acquisition

This section presents the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory QC. The requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

2.2.1 Sampling Process Design

Professional judgment was applied to select monitoring locations, sediment sampling intervals, sediment samples, and condensate samples that are planned for laboratory analyses. Specific locations of the resulting sediment samples will be determined following the active portion of this test, based on progress of the desiccation front as indicated by in situ instrumentation and geophysical characterization. Proposed locations may be influenced by site-specific conditions (e.g., limited sample volume or inability to obtain a sample). The field team will note in the daily field sampling logbook any instance when samples cannot be collected because of field conditions, and these events will be discussed in the follow-up borehole summary report. Sample locations may be adjusted based on visual or field screening methods that may indicate a better sampling location to meet the DQOs (e.g., higher concentrations at a different depth). Additional depth locations may be sampled based on the judgment of field personnel and the Technical Lead and based on real-time field conditions.

The monitoring and sampling borehole locations will be staked before the field engineer begins drilling. Minor changes in sample locations can be made and documented in the field with the approval of the Technical Lead. Changes to sample locations that could result in impacts to meeting the DQOs will require DOE-RL and EPA approval.

2.2.2 Sampling Methods

The planned borehole grab and condensate sampling for this SAP will be performed in accordance with established sampling practices and requirements pertaining to sample collection, collection equipment, and sample handling. The Field Team Lead is responsible for ensuring that all field procedures are followed completely and that field personnel are trained adequately. The Field Team Lead must document situations that may impair the usability of the samples and/or data in the field logbook or on nonconformance report forms in accordance with internal corrective action procedures, as appropriate. The Field Team Lead will note any deviations from the standard procedures for sample collection, COPCs, sample transport, or monitoring that occurs. The Field Team Lead also will be responsible for coordinating all activities relating to the use of field monitoring equipment (e.g., dosimeters and industrial hygiene equipment). Field personnel will document in the logbook all noncompliant measurements taken during field sampling. Ultimately, the Field Team Lead will be responsible for developing, implementing, and communicating corrective action procedures, for documenting all deviations from procedure, and for ensuring that immediate corrective actions are applied to field activities. Problems with sample collection and custody or data acquisition that adversely impact the quality of data, impair the ability to acquire data, or fail to follow procedure will be documented in accordance with internal corrective action procedures, as appropriate.

Sample preservation, containers, holding times, and sampling method details for chemical and radiological analytes of interest and physical property analyses are presented in Section 3.1.4. Final sample collection requirements will be identified on the Sampling Authorization Form.

2.2.3 Sample Handling, Shipping, and Custody Requirements

Level 1 EPA pre-cleaned sample containers will be used for samples collected for chemical analysis. Reusable containers used for sample collection (e.g., bowls and scoops) will be cleaned to Level 1 EPA protocol before each use. Container sizes may vary depending on laboratory-specific volumes and requirements for meeting analytical detection limits. Planned container types and volumes are identified in Section 3.1.4. The final types and volumes will be indicated on the Sampling Authorization Form.

The CHPRC sample and tracking database will be used to track the samples from the point of collection through the laboratory analysis process. The HEIS database is the repository for laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project in accordance with onsite organization procedures. Each chemical/radiological and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed, water resistant labels:

- Sampling Authorization Form
- HEIS number
- Sample collection date and time
- Name of person collecting the sample
- Analysis required
- Preservation method (if applicable)

A custody seal (i.e., evidence tape) will be affixed to the lid of each sample jar in a manner that will indicate potential tampering with the sample. The container seal will be inscribed with the sampler's initials and the date.

All information pertinent to field sampling and analysis will be recorded in field checklists and bound logbooks in accordance with existing sample collection protocols. Laboratory custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process. The sampling team will be responsible for recording all relevant sampling information. Entries made in the logbook will be dated and signed by the individual making the entry. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records by CHPRC also will be followed.

Sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from collection through ultimate disposal, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Wire or laminated waterproof tape will be used to seal the coolers. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before the sample is shipped and will transmit the copy to Sample and Data Management within 48 hours of shipping.

It is not necessary to indicate the planned analyses on the chain-of-custody form for every sample, because not all samples will be analyzed. Grab sediment samples are planned at 0.76 m (2.5 ft) intervals in the borehole. The sediment samples that are planned for analyses, and the targeted analyses for the borehole, are described in Table 1-2. All samples will be transported to the laboratory that is selected to perform the analyses. The Technical Lead, in consultation with the laboratory, may modify the samples selected for analyses and the specific targeted analyses that are performed on each sample. The chain-of-custody forms for sample intervals that are planned for analyses in each borehole will indicate the selected analyses shown in Table 1-2. The analyzing laboratory will screen samples with electrical resistivity measurements and then select samples for a complete set of analyses, in consultation with the Technical Lead.

The radiological control technician will measure both the contamination levels on the outside of each sample jar and the dose rates on each sample jar. The radiological control technician also will measure the radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR) and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. The sampler will send copies of the shipping documentation to Sample and Data Management within 48 hours of shipping.

2.2.4 Analytical Methods

Analytical parameters and methods are listed in Table 1-2. These analytical methods are controlled in accordance with the laboratory's QA plan and the requirements of this SAP.

Laboratories providing analytical services in support of this SAP will report errors to the CHPRC Sample Management Project Coordinator who will then initiate a Sample Disposition Record. The error reporting process is intended to document analytical errors and the resolution of those errors with the Technical Lead.

The corrective action program addresses the following:

- Evaluation of impacts of laboratory QC failures on data quality
- Root cause analysis of QC failures

- Evaluation of recurring conditions that are adverse to quality
- Trend analysis of quality affecting problems
- Implementation of a quality improvement process
- Control of nonconforming materials that may affect data quality

2.2.5 Quality Control Requirements

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. When field sampling is performed, care will be taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity.

Field QC samples will be collected to evaluate the potential for cross-contamination and field sampling performance. Field QC for sampling under this SAP will require the collection of field duplicates and equipment rinsate blanks. The QC samples and the required frequency for collection are described in this section. The field geologist may request that additional equipment blanks be taken. The QC samples will be collected as part of the verification and confirmatory sampling activities.

The collection of QC samples for onsite measurements is not applicable to the field screening techniques described in this SAP. Field screening instrumentation will be calibrated and controlled as discussed in Section 2.2.7 and Section 2.2.8, as applicable.

The laboratory method blank, laboratory control sample/blank spike, and matrix spike are defined in Chapter 1 of *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B* (SW-846), and will be run at the frequency specified in that reference.

Table 2-1 lists the field QC requirements for sampling. If only disposable equipment is used, or equipment is dedicated to a particular borehole, an equipment rinsate blank is not required.

Table 2-1. Field Quality Control Requirements

Sample Type	Frequency	Purpose
Duplicate	5% (1 sample in 20)	Evaluate potential for cross contamination and field sampling performance
Equipment rinsate	One per 30 samples	Check the effectiveness of the decontamination process

2.2.5.1 Field Duplicates

Field duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently. These samples are not to be homogenized together. One field duplicate will be collected for every 20 samples collected from the borehole. The duplicate generally should be collected from an interval that is expected to have some contamination, so that valid comparisons between the samples can be made (i.e., at least some of the COPCs will be above detection limit). When sampling with a split spoon, the duplicate sample likely will be from a separate split spoon, either above or below the main sample, because of sample volume requirements.

2.2.5.2 Equipment Rinsate Blanks

Equipment blanks will consist of high purity water that is washed through decontaminated sampling equipment and placed in containers, as identified on the project Sampling Authorization Form. One equipment blank will be collected for every 30 sample retrieval trips in each borehole. The field geologist may request that additional equipment blanks be taken. When characterization analysis is for radionuclides only, equipment rinsate blanks will be analyzed for the following:

- Gamma emitters
- Gross alpha
- Gross beta

When characterization analysis is for radionuclides and chemical constituents, equipment rinsate blanks will be analyzed for the following:

- Gamma emitters
- Gross alpha
- Gross beta
- Metals
- Anions

2.2.5.3 Field Transfer Blanks

No field transfer blanks are required.

2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance

All onsite environmental instruments will be tested, inspected, and maintained in accordance with the manufacturers' operating instructions and in accordance with approved work packages. Results from testing, inspection, and maintenance activities are documented in logbooks and/or work packages.

Measurement and testing equipment used in the field or in the laboratory that directly affect the quality of analytical data will be subject to preventive maintenance measures to minimize the downtime of the measurement system. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., parts lists and documentation of routine maintenance) will be included in the individual laboratories' and the onsite organization's QA plans or operating procedures (as appropriate). Analytical laboratory instruments and measuring equipment are tested, inspected, and maintained in accordance with the laboratories' QA plans. Daily response checks for environmental and radiological field survey instruments are performed in accordance with approved work packages.

2.2.7 Instrument/Equipment Calibration and Frequency

All onsite environmental instruments are calibrated in accordance with the manufacturers' operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or with auditable HASQARD and contractual requirements. The results from all instrument calibration activities are recorded in logbooks and/or work packages.

Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratories' QA plans. Calibration of radiological field survey instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory (PNNL) staff on an annual basis, as specified in their program documentation. Field instrumentation, calibration, and QA checks will be performed in accordance with the following:

- Calibration of radiological field instruments on the Hanford Site is performed under contract by PNNL staff, as specified in their program documentation. Daily calibration checks will be performed and documented for each instrument used to characterize areas that are under investigation. These checks will be made on standard materials that are sufficiently similar to the matrix under consideration, so that direct comparison of data can be made. Analysis times will be sufficient to establish detection efficiency and resolution.
- Instrumentation used to collect test data will be calibrated and maintained in accordance with the CHPRC QA program.

2.2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables for sampling and analysis activities will be acquired according to applicable procurement specifications. Supplies and consumables will be checked and accepted by users before they are used. Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with the laboratories' QA plans.

Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use. Contamination is monitored using the QC sample process discussed in Section 2.2.

2.2.9 Non-Direct Measurements

Non-direct measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Non-direct measurements will not be evaluated as part of this activity.

2.2.10 Data Management

Data resulting from the implementation of this SAP will be managed and stored in accordance with applicable programmatic requirements governing data management procedures. At the direction of the Technical Lead, all analytical data packages will be subject to final technical review by qualified personnel (as determined by the Technical Lead) before the results are submitted to the regulatory agencies or before they are included in reports. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies will be provided in accordance with the Tri-Party Agreement, Section 9.6 (Ecology et al., 1989).

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed laboratory sample collection activities, as discussed in the sampling teams' procedures. In the event that specific procedures do not exist for a particular work evolution, or if additional guidance to complete certain tasks is needed, a work package will be developed for adequate control of the activities, as appropriate. Examples of the sample teams' requirements include activities associated with the following:

- Chain-of-custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks and checklists
- Sample packaging and shipping

Approved work control packages and procedures will be used to document radiological measurements when this SAP is being implemented. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site radiological records
- Minimum standards and practices necessary for preparing, performing, and retaining radiological related records
- Indoctrination of personnel on the development and implementation of survey/sample plans
- Requirements associated with preparing and transporting regulated material

The sampling team, and the laboratory that is selected to analyze sediment samples, will cross-reference analytical data and radiation measurements to facilitate interpretation of the investigation results. Errors reported by the laboratories are reported to the Sample Management Project Coordinator, who initiates a Sample Disposition Record. This process is used to document analytical errors and to establish resolution with the Technical Lead.

2.3 Assessment and Oversight

Assessment and oversight activities evaluate the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

2.3.1 Assessments and Response Action

The CHPRC QA group may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements.

Deficiencies identified during these assessments will be reported in accordance with existing programmatic requirements. The CHPRC QA group coordinates deficiency reporting according to CHPRC's QA Program. When appropriate, corrective actions will be taken by the Deep Vadose Zone Manager.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. CHPRC conducts oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work. No laboratory assessments currently are planned for this SAP.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. These issues will be reported by laboratory personnel to Sample and Data Management, which will communicate the issues to the Technical Lead and Manager. Subsequently, standard reporting protocols (e.g., project status reports) will be used to communicate these issues to management. Because performance or system assessments are not planned as part of this activity, the Technical Lead will not be providing audit or assessment reports to management for this activity, unless an unanticipated request is made for such an assessment to be conducted. At the end of the project, a DQA report will be prepared to evaluate whether the type, quality, and quantity of data that were collected meet the intent of the DQOs and SAP.

2.4 Data Validation and Usability

Data validation and usability activities occur after the data collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying project objectives.

The steps in the data validation and usability process are (1) review, (2) verification, (3) validation, and (4) quality assessment.

2.4.1 Data Review, Verification, and Validation

Data is generated and reviewed by the laboratory. The laboratories under contract to CHPRC review the data and provide case narratives that describe the QC evaluation of the data set. The data review is used in the subsequent data verification and validation activities, described below.

2.4.2 Verification and Validation Methods

Completed laboratory data packages will be verified by qualified Sample and Data Management personnel or by a qualified independent contractor. Verification consists of confirming that sampling and chain-of-custody documentation is complete and that sample numbers can be tied to the specific sampling locations, checking required deliverables, comparing requested versus reported analyses, and identifying transcription errors. Once the deliverables are verified, the data are validated.

Validation, as defined in Chapter 1 of SW-846, indicates that data validation is the process of evaluating the available data against project DQOs. Data validation may be performed by Sample and Data Management or by a party independent of both the data collector and the data user. Specifically, the process of validation includes:

- Documenting any errors found in the data for subsequent project resolution
- Verifying compliance with the QA requirements
- Checking QC values against defined limits
- Applying qualifiers to analytical results for defining the limitations in the use of the data

Validation will include evaluating and qualifying the results based on holding times, method blanks, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate. No other validation or calculation checks will be performed.

Level C data validation, as defined in the contractor's validation procedures that are based on the EPA's functional guidelines (Bleyler 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*) will be performed for a minimum of five percent of the laboratory generated chemical and radiochemical data by matrix and analyte group. When outliers or questionable results are identified, additional data validation will be performed. The additional validation will be performed for up to five percent of the data. The additional validation will begin with Level C and may increase to Level D and Level E, as needed, to ensure that the data are usable. Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the data set. Data validation will be documented in data validation reports, which will be provided to Sample and Data Management and in the DQA report (see Section 2.4.3). At least one data validation package will be generated. Sample and Data Management is responsible for distributing the data validation report to the Technical Lead and to others, as necessary.

2.4.3 Reconciliation with User Requirements

The determination of data usability will be documented in the DQA report. The DQA process is defined in *Data Quality Assessment: A Reviewer's Guide*, EPA QA/G-9R (EPA/240/B-06/002). The EPA DQA process will be used for laboratory data. The analytical data will be reviewed to determine whether precision, accuracy, and completeness of objectives have been satisfied. Verified and/or validated data will be reviewed to assess their usability. The quality and quantity of the entire data set will be reviewed to determine whether DQOs have been met. The Technical Lead is responsible for ensuring that the DQA is performed. The DQA results will be reported to the Technical Lead.

3 Sampling Objectives

The objective of the field sampling plan is to provide clear identification of project sampling and analysis activities and requirements. The field sampling plan is based on the sampling design identified during the DQO process (SGW-39506).

3.1 Sampling Locations and Frequency

Figure 3-1 schematically portrays the SDPT. Simply stated, dry nitrogen will be injected into one well and moisture-laden soil gas will be extracted from a nearby well. Each well is screened from the 9 to 15 m (30 to 50 ft) below ground surface (bgs) region where the vadose zone has previously been determined to exhibit high concentrations of mobile contaminants (technetium-99 and nitrate) and moisture. Equipment consists of two blowers (one to push dry nitrogen into the injection well, and another to establish a vacuum in the extraction well), a system to condition (dehumidify and adjust temperature) the injected nitrogen, and a system to condition the extracted soil gas before it enters the exhaust blower. Extracted soil gas conditioning may include condensate or water droplet removal and filtration.

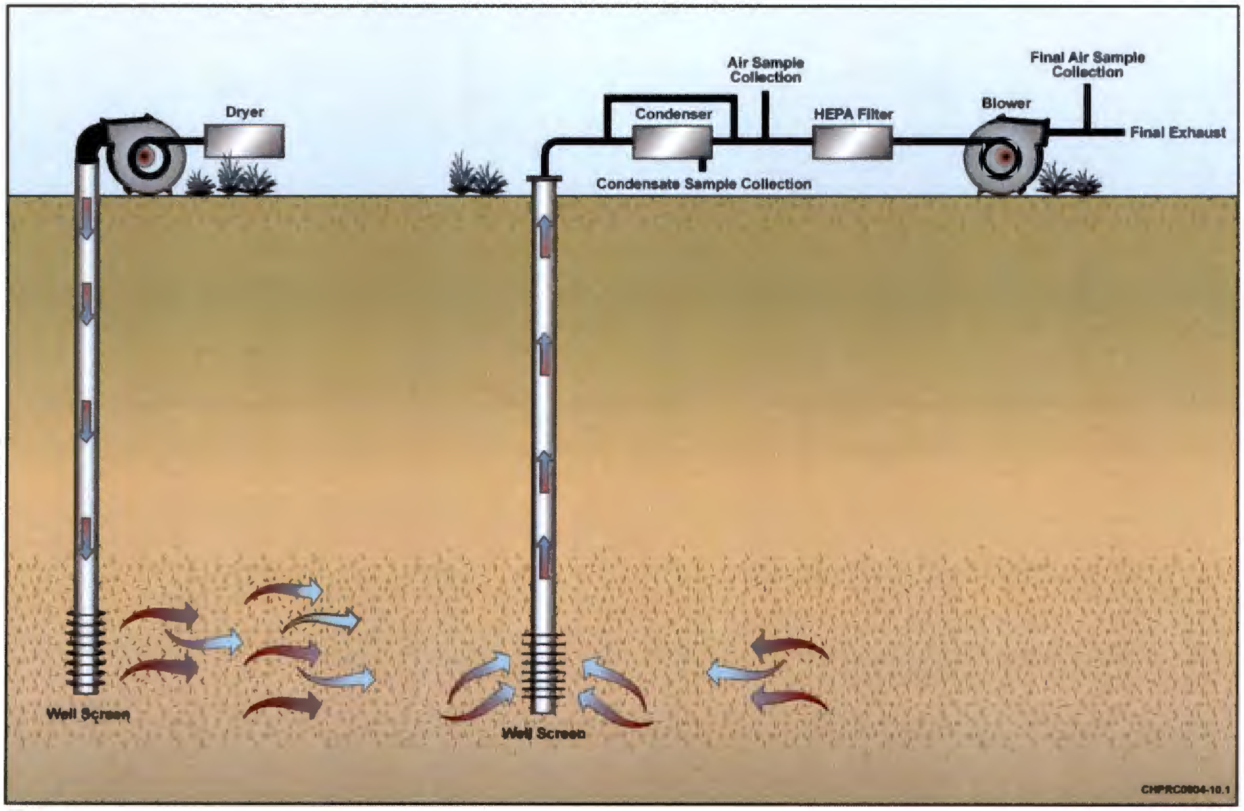


Figure 3-1. Air Handling System Schematic

Schematic layouts of the SDPT, including the locations of in situ monitoring instruments, were shown previously in Figure 1-1. The area anticipated to be desiccated during the 6-month period of active pumping, and nearby environs, will be instrumented to monitor desiccation progress and related parameters. Various in situ instrumentation is provided to monitor sediment temperature and moisture content, soil gas humidity, and pressure. Soil gas sample collection capability is provided to monitor tracer gas concentration. Aboveground data collection will provide monitoring of injected and extracted gas flow rate, pressure, humidity, and temperature. Condensate sample collection capability is provided to support disposition of collected condensate.

Data will be collected during installation of the boreholes located at monitoring locations, prior to the active portion of the test with focus on the extraction well, during the active portion of the test when soil gas is being removed via the blower, and following the active portion of the test after the blowers have been shut down.

Table 3-1 identifies individual monitoring holes within each monitoring cluster. Figure 3-2 identifies individual monitoring hole locations.

Table 3-1. Identification of SDPT Monitoring Holes

Monitoring Cluster ID	Well ID	Monitoring Hole Function	Instrument and Depth
1	C7524	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7527	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
2	C7522	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7523	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
	C7055*	Measure sediment temperature, collect soil gas	Thermister: Every 0.6 m (2 ft) from 4.1 to 21.1 m

Table 3-1. Identification of SDPT Monitoring Holes

Monitoring Cluster ID	Well ID	Monitoring Hole Function	Instrument and Depth
		samples, provide capability for ERT	(13.3 to 69.3 ft) Gas sampler: 10.8 and 13.8 m (35,3 and 45.3 ft) Electrodes: Every 0.6 m (2 ft) from 3.7 to 21.4 m (12.3 to 70.3 ft)
3	C7525	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
	C7051*	Measure sediment temperature, collect soil gas samples, provide capability for ERT	Thermister: Every 0.6 m (2 ft) from 3.5 to 20.5 m (11.4 to 67.4 ft) Gas sampler: 10.2 and 13.2 m (33.4 and 43.4 ft) Electrodes: Every 0.6 m (2 ft) from 3.2 to 20.8 m (10.4 to 68.4 ft)
4	C7052*	Measure sediment temperature, collect soil gas samples, provide capability for ERT	Thermister: Every 0.6 m (2 ft) from 4.1 to 21.2 m (13.5 to 69.5 ft) Gas sampler: ~10.8 and 13.9 m (35.5 and 45.5 ft) Electrodes: Every 0.6 m (2 ft) from 3.8 to 21.5 m (12.50 to 70.5 ft)
5	C7526	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0 and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0 and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0 and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7529	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation

Table 3-1. Identification of SDPT Monitoring Holes

Monitoring Cluster ID	Well ID	Monitoring Hole Function	Instrument and Depth
6	C7530	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7533	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
7	C7528	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7531	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
	C7053*	Measure sediment temperature, collect soil gas samples, provide capability for ERT	Thermister: Every 0.6 m (2 ft) from 3.9 to 21.0 m (12.9 to 68.9 ft) Gas sampler: 10.6 and 13.7 m (34.9 and 44.9 ft) Electrodes: Every 0.6 m (2 ft) from 3.6 to 21.3 m (11.9 to 69.9 ft)

Table 3-1. Identification of SDPT Monitoring Holes

Monitoring Cluster ID	Well ID	Monitoring Hole Function	Instrument and Depth
8	C7532	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7535	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
9	C7534	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7537	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
	C7054*	Measure sediment temperature, collect soil gas samples, provide capability for ERT	Thermister: Every 0.6 m (2 ft) from 3.9 to 20.9 m (12.7 to 68.7 ft) Gas sampler: 10.6 and 13.6 m (34.7 and 44.7 ft) Electrodes: Every 0.6 m (2 ft) from 3.6 to 21.2 m (11.7 to 69.7 ft)

Table 3-1. Identification of SDPT Monitoring Holes

Monitoring Cluster ID	Well ID	Monitoring Hole Function	Instrument and Depth
10	C7536	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7539	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation
11	C7538	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)
	C7541	Provide capability to perform neutron moisture logging and cross-hole radar	Closed end tube with no instrumentation

Table 3-1. Identification of SDPT Monitoring Holes

Monitoring Cluster ID	Well ID	Monitoring Hole Function	Instrument and Depth
12	C7540	Measure sediment temperature and humidity, collect soil gas samples, provide capability for ERT Measure soil moisture content	Thermister: Every 0.6 m (2 ft) from 3.4 to 21 m (11 to 69 ft) Humidity sensor: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Thermocouple psychrometer: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Gas sampler: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) HDU: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Dual-Probe Heat-Pulse probe: ~9.9, 11.4, 13.0, and 14.5 m (32.5, 37.5, 42.5, and 47.5 ft) Electrodes: Every 1.5 m (5 ft) from 3.0 to 21.3 m (10 to 70 ft)

Notes:

Refer to Figures A1-1 and A1-2 for monitoring cluster locations.

Locations of monitoring holes to provide capability to perform neutron logging and cross-hole radar are subject to minor adjustment to ensure line-of-sight unobstructed by metallic items.

In selected instrumented boreholes, will attempt to place instrument clusters in adjacent coarse and fine-grained strata.

* Monitoring hole previously installed.

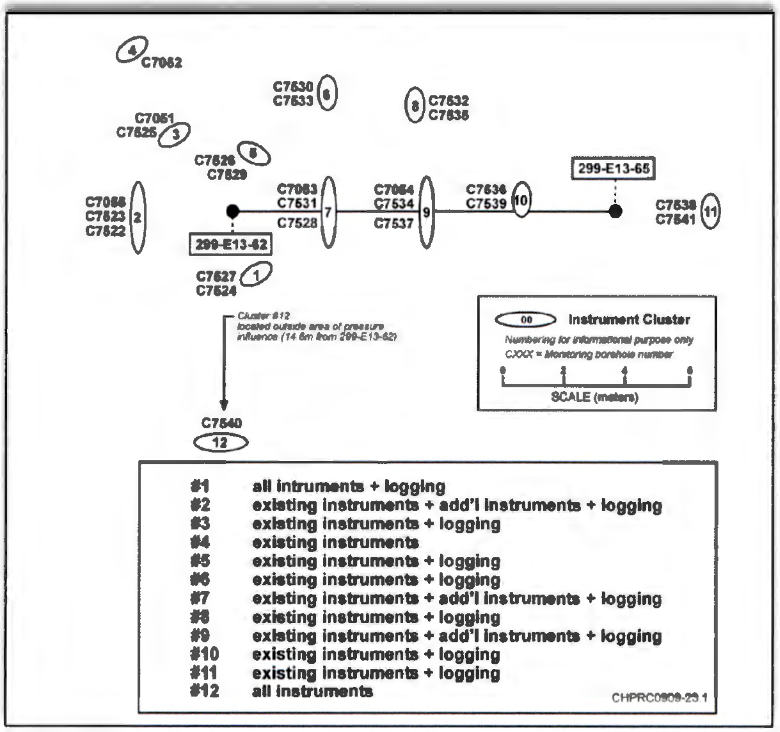


Figure 3-2. Layout of Individual Monitoring Holes

3.1.1 Sampling Methodology Prior to Active Portion of Test

The injection and extraction wells have already been installed and initial characterization has been performed (PNNL-17821, *Electrical Resistivity Correlation to Vadose Zone Sediment and Pore-Water Composition for the BC Cribs and Trenches Area*, DOE/RL-2009-119, *Characterization of the Soil Desiccation Pilot Test Site*). Required additional characterization of the extraction well (299-E13-65) is to conduct permeability testing similar to that performed for the injection well (299-E13-62). The well will be "stressed" by applying a vacuum and then measuring pressure response at nearby monitoring locations. A step test, where applied vacuum is varied, and a constant rate test will be conducted. Table 3-2 lists the data collection required.

For the injection and extraction wells, depth discrete sediment air permeability will be evaluated using the PneuLog technology. This technology is a proprietary logging system that measures flow into the screened well while it is under stress from an exhaust blower. Data will be used in interpreting pilot test results.

No sediment samples will be collected from the monitoring boreholes.

Table 3-2. Sediment Air Permeability Data Collection for Extraction Well

Borehole Identification	Sampling Frequency	Sampling Method
299-E13-65	At least once for each test	Step test per US ACE (EM 1110-1-4001) Continuous test per US ACE PneuLog® technology logging
299-E13-62	At least once	PneuLog technology logging

Source:

EM 1110-1-4001, *Engineering and Design: Soil Vapor Extraction and Bioventing*, US ACE

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Baseline soil gas pressure and composition data will be obtained to ensure that effects of barometric pressure changes can be accommodated. Sediment temperature is not expected to change with the seasons. Neutron logging, cross-hole radar, and ERT will be performed prior to starting up the active portion of the test. Tracer gas evaluation will be performed, before active desiccation begins, to provide initial subsurface gas flow path information. Table 3-3 lists the baseline data collection activities to be performed prior to initiating the active portion of the test.

3.1.2 Sampling Methodology During Active Portion of Test

The objective is to monitor desiccation progress with the primary focus along a line between the injection and extraction wells. Secondary focus is off to the side of the direct line between the wells to establish the shape of the desiccated region. Finally, monitoring is located at points opposite the direction of soil gas transport near the injection and extraction wells to assess impact at those locations.

Each monitoring location includes capability to measure sediment temperature, humidity, matric potential (indirect measure of moisture content) and soil gas pressure; collect soil gas; perform electrical resistance tomography; and perform geophysical logging (neutron logging to measure local sediment moisture content and cross-hole radar to assess far-field changes in moisture content).

Table 3-3. In Situ Instrumentation Sampling Prior to Active Portion of Test

Location	Instrument (Attribute)	Frequency
Monitoring Cluster Boreholes	Thermister (temperature)	Monitor from installation/hookup to start of active desiccation until data indicate instrument equilibration
	Heat dissipation unit (soil matric potential)	Monitor from installation/hookup to start of active desiccation until data indicate instrument equilibration
	Thermocouple psychrometer (soil matric potential, humidity)	Monitor from installation/hookup to start of active desiccation until data indicate instrument equilibration
	Humidity sensor	Monitor from installation/hookup to start of active desiccation until data indicate instrument equilibration
	Dual probe heat pulse sensor	Monitor from installation/hookup to start of active desiccation until data indicate instrument equilibration
	Heat dissipation unit	Monitor from installation/hookup to start of active desiccation until data indicate instrument equilibration
	Gas sampler (pressure, composition)	Pressure At least 5 days of continuous data Gas Sample collection Two samples over a 2-week period at the end of instrument equilibration
	Neutron logging (soil moisture)	Once through temporary steel casing during borehole installation, once through PVC casing within 4 weeks of installation, and once at end of instrument equilibration period
	Cross-hole radar (soil moisture)	Once at end of instrument equilibration period
	Electrode (soil electrical resistivity)	Once at end of instrument equilibration period
299-E13-62 and 299-E13-65	Electrode (soil electrical resistivity)	Once at end of instrument equilibration period
	Thermister (temperature)	Monitor from installation/hookup to start of active desiccation until data indicate instrument equilibration
	Neutron logging (soil moisture)	Once through temporary steel casing during borehole installation
	Cross-hole radar (soil moisture)	Anytime

A monitoring cluster consists of two co-located boreholes as described in Figure 1-1, Figure 3-2, and Table 3-1. Exceptions are four locations where previously installed monitoring boreholes may be within the desiccation front path (each of these boreholes have a subset of the desired instrumentation), resulting in three co-located boreholes in each cluster that provide redundant data collection capability. Two other locations each possess a single monitoring borehole.

Table 3-4 lists the sampling locations and frequencies for in situ instrumentation.

If unexpected areas of interest are observed, additional sampling will be considered. Laboratory analyses and analytical performance requirements are summarized in Table 1-2.

Table 3-4. In Situ Instrumentation Locations and Sampling Frequency During Active Portion of Test

Location	Instrument (Attribute)*	Frequency
Monitoring Clusters 1-12	Thermister (temperature)	Continuous at logging frequency determined by field hydrologist
	Heat dissipation unit (soil matric potential)	Continuous at logging frequency determined by field hydrologist
	Thermocouple psychrometer (soil moisture)	Continuous at logging frequency determined by field hydrologist
	Humidity sensor (soil gas humidity)	Continuous at logging frequency determined by field hydrologist
	Gas sampler (pressure, composition)	Pressure Continuous at logging frequency determined by field hydrologist Gas Sample collection Periodically; as needed to assess breakthrough of tracer gases and for monitoring humidity
	Neutron logging (soil moisture)	Periodically, based on information about drying front obtained through other instruments
	Cross-hole radar (soil moisture)	Periodically, based on information about drying front obtained through other instruments
	Electrode	Monthly with locations selected based on data on drying front progress from other instruments
299-E13-62	Electrode (soil electrical resistivity)	Monthly with locations selected based on data on drying front progress from other instruments
	Thermister (temperature)	Continuous at logging frequency determined by field hydrologist
299-E13-65	Electrode (soil electrical resistivity)	Monthly with locations selected based on data on drying front progress from other instruments
	Thermister (temperature)	Continuous at logging frequency determined by field hydrologist

* Not all instruments and logging capabilities are present at each monitoring cluster.

All gas samples from the extraction well and monitoring boreholes will be delivered to the laboratory that is selected to perform the analyses. Analysis requirements will be established based on the composition of tracer gases.

Additional sampling and data collection will focus on the aboveground portion of the test equipment. The injection and extraction wells will be instrumented to monitor injected air and extracted soil gas parameters. Also, condensate will be periodically analyzed to determine if it is contaminated and to support its disposal. Table 3-5 defines above ground sampling requirements.

Table 3-5. Aboveground Sampling Requirements

Sampling Location	Parameter	Sampling Method	Frequency	Laboratory Analyses	
				Analytical Methods	Number and Type of Quality Control Samples
299-E13-62 (injected gas)	Pressure Temperature Flow rate Humidity	In-line instrumentation	Continuous	NA	NA
299-E13-65 (extracted gas)	Pressure Temperature Flow rate Humidity	In-line instrumentation	Continuous	NA	NA
Condensate Collection Vessel	Gross alpha, beta, gamma Technetium-99 Nitrate	Grab sample	Bi-monthly	See Table 1-2	1 duplicate 1 rinsate
Power Meter	Power consumption	Meter	Continuous	NA	NA

Note:

Additional samples may be collected if approved by the Deep Vadose Zone Technical Lead or delegate.

3.1.3 Sampling Methodology Following Active Portion of Test

Sampling will continue following completion of the active portion of the test to evaluate effectiveness of desiccation and rewetting of the dried out region. Selected sediment samples will be collected to complement data collected from in situ instruments. Instruments designed to monitor sediment moisture will continue to be monitored to assess changes in sediment moisture content. Table 3-6 and Table 3-7 define the sampling requirements for sediment analytical analyses and for extended instrument monitoring, respectively.

3.1.4 Sampling Preservation, Container, and Holding Times

Table 3-8 describes sample preservation, container, and holding time requirements.

Table 3-6. Sediment Sampling Locations Following Active Portion of Test

Location	Depth	Attribute	Frequency	Laboratory Analyses: Analytical Methods	Laboratory Analyses: Number and Type of Quality Control Samples
New boreholes-locations[a]	Every 0.76 m (2.5 ft) from 6.1-18.3 m (20-60 ft) bgs	Moisture content	Within 4 months after termination of active desiccation	Selected samples will be analyzed as shown in Table 1-2[b]	Duplicate, 5%
		Technetium-99			
		Nitrate			

a. Locations near selected instrument clusters were based on position relative to desiccation front at time blower was shut down:

- Within the desiccated region, including fringe area where solutes may have concentrated
- Where disparate geophysical data exist

b. EPA and DOE will approve the locations and number of samples.

Table 3-7. In Situ Sampling Locations and Sampling Frequency Following Active Portion of Test

Location[a]	Instrument (Attribute)	Frequency[b]
All monitoring clusters, as appropriate	Thermister (temperature)	Continuous at logging frequency determined by field hydrologist
	Heat dissipation unit (soil moisture content)	Continuous at logging frequency determined by field hydrologist
	Dual probe heat pulse (Soil Moisture content)	Continuous at logging frequency determined by field hydrologist
	Thermocouple psychrometer (soil gas humidity)	Continuous at logging frequency determined by field hydrologist
	Humidity sensor (soil gas humidity)	Continuous at logging frequency determined by field hydrologist
	Gas sampler (composition)	Weekly for first month then monthly and then reduced if warranted based on the initial response and the response observed in other instruments
	Electrode (soil electrical resistivity)	Monthly and then reduced if warranted based on the initial response and the response observed in other instruments
	Neutron logging (soil moisture)	Monthly and then reduced if warranted based on the initial response and the response observed in other instruments
	Cross-hole radar (soil moisture)	Monthly and then reduced if warranted based on the initial response and the response observed in other instruments
299-E13-62	Electrode (soil electrical resistivity)	Monthly and then reduced if warranted based on the initial response and the response observed in other instruments
	Thermister (temperature)	Continuous at logging frequency determined by field hydrologist

Table 3-7. In Situ Sampling Locations and Sampling Frequency Following Active Portion of Test

Location[a]	Instrument (Attribute)	Frequency[b]
299-E13-65	Electrode (soil electrical resistivity)	Monthly and then reduced if warranted based on the initial response and the response observed in other instruments
	Thermister (temperature)	Continuous at logging frequency determined by field hydrologist

a. Locations correspond with Figure 1-1 and Table 3-1.

b. Frequency may be adjusted based on monitoring hole position relative to region desiccated during action portion of test.

Table 3-8. Sample Preservation, Container, and Holding Times for Samples

Analytes	Priority	Holding Time	Container Number	Container Type	Volume[a]	Preservation	Packing Requirements
Geochemical Analytical Samples							
Anions[b]	1	28 days from leach to analysis	1	Plastic, wide-mouth	500 g	None	None
Technetium-99	1	6 months					
Geotechnical/Physical Analytical Samples							
Moisture content	1	As soon as possible after opening container	1	Plastic, wide-mouth	500 g	None	None
Condensate (Technetium-99, nitrate)	1	28 days	1	Plastic, wide-mouth	500 mL	≤6°C	None

a. Optimal volumes, which may be adjusted downward to accommodate the possibility of small sample recoveries. Minimum sample size will be defined on the Sampling Authorization Form.

b. Anions are nitrate (as nitrogen), chloride, fluoride, phosphate, and sulfate. Anions are collected in one bottle and analyzed by ion chromatography.

3.2 Well Decommissioning/Completion

Following test completion and upon EPA approval, the wells and monitoring boreholes will be decommissioned by being backfilled with bentonite, or in an alternate manner in accordance with an appropriate decommissioning procedure, to meet the requirements of WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells."

3.3 Management of Waste

Waste generated by sampling activities will be managed in accordance with an approved waste control plan (SGW-34277, *Waste Control Plan for the BC Cribs and Trenches Area in the 200-BC-1 OU*) that was prepared in response to the waste DQO (SGW-34278, *Data Quality Objectives Summary Report for 200-BC-1 Operable Unit Investigation-Derived Waste*). The waste control plan establishes the requirements for management and disposal of generated waste. Investigation-derived waste from these sampling activities will be handled as CERCLA waste. Unused samples will be archived for potential later analysis. Laboratory waste will be dispositioned in accordance with the laboratory contract and agreements concerning return to the Hanford Site. In accordance with 40 CFR 300.440, "National Oil, and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off-Site Response Actions," Task Lead approval is required before unused samples or wastes are returned from offsite laboratories.

3.4 Health and Safety

Health and safety requirements will be contained in a health and safety plan specifically created for this task. Air monitoring will be conducted in accordance with the radiological monitoring plan prepared for this study. Both the health and safety plan and air monitoring plan will be issued separately before fieldwork is initiated.

4 References

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