

1223856

DOE/RL-2014-20

Revision 0

Sampling and Analysis Plan for the 200-PW-1 Operable Unit CY2014 Rebound Sampling



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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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Sampling and Analysis Plan for the 200-PW-1 Operable Unit CY2014 Rebound Sampling

Project No: 200-PW-1

Document Type: PLAN

Program/Project: SGWP

M. E. Byrnes

CH2M HILL Plateau Remediation Company

Date Published
April 2014

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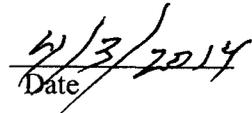
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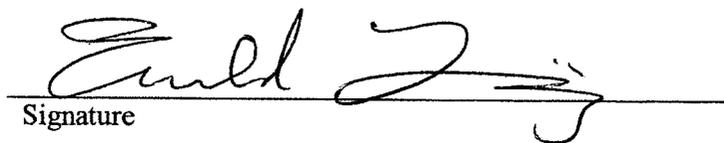
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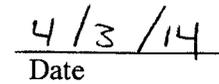

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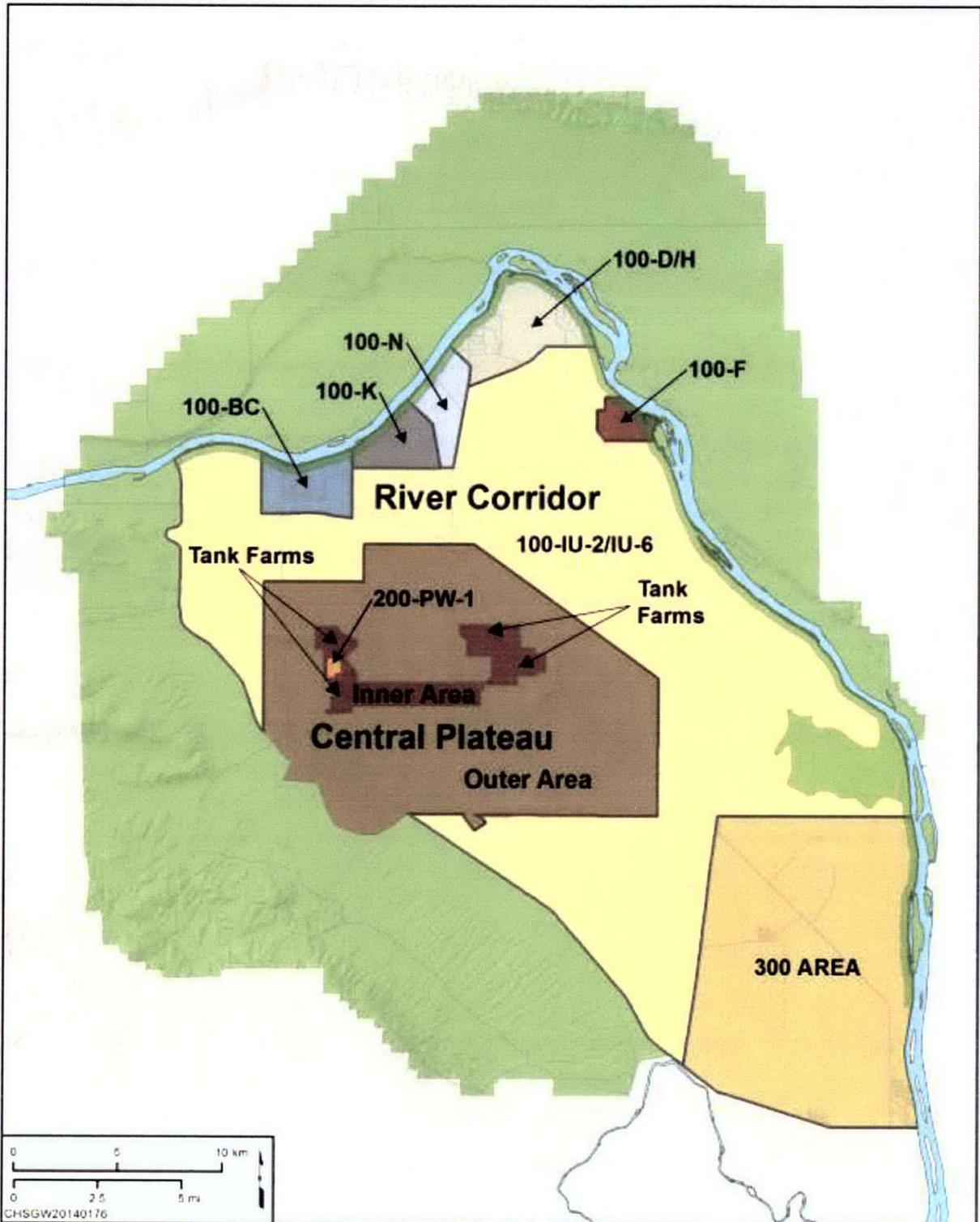
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Terms

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTR	Buyer's Technical Representative
CAS	Chemical Abstract Service
CCS	continuing calibration check standards
CCU	Cold Creek unit
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
CFR	Code of Federal Regulations
CHPRC	CH2M HILL Plateau Remediation Company
COC	chain of custody
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office (also known as RL)
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ft	foot
FWS	Field Work Supervisor
gal	gallon
GC/MS	Gas Chromatography/Mass Spectrometry
HASQARD	<i>Hanford Analytical Services Quality Assurance Requirements Documents</i>
HEIS	Hanford Environmental Information System
L	liter
lb	pound
LCS	laboratory control standards
MDL	method detection limit
min	minute
N/A	not available, not applicable
OU	operable unit
PFP	Plutonium Finishing Plant
PNNL	Pacific Northwest National Laboratory
POC	point of contact
ppmv	parts per million volume

QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
RCT	Radiological Control Technician
RD/RAWP	remedial design/remedial action work plan
RI	remedial investigation
ROD	record of decision
RPD	relative percent difference
SAF	Sample Analysis Form
SAP	sampling and analysis plan
SMR	Sample Management and Reporting
SVE	soil vapor extraction
TPA	Tri-Party Agreement
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
VOC	volatile organic compound

Additionally, the SAP includes sampling from wells/probes at the perimeter of the SVE study area, to support assessment of unidentified contaminant source areas above cleanup levels.



Source: Modified from DOE/RL-2011-118, Hanford Site Groundwater Monitoring for 2011.

Figure 1-1. Location of the 200-PW-1 Operable Unit in the 200 West Area of the Hanford Site

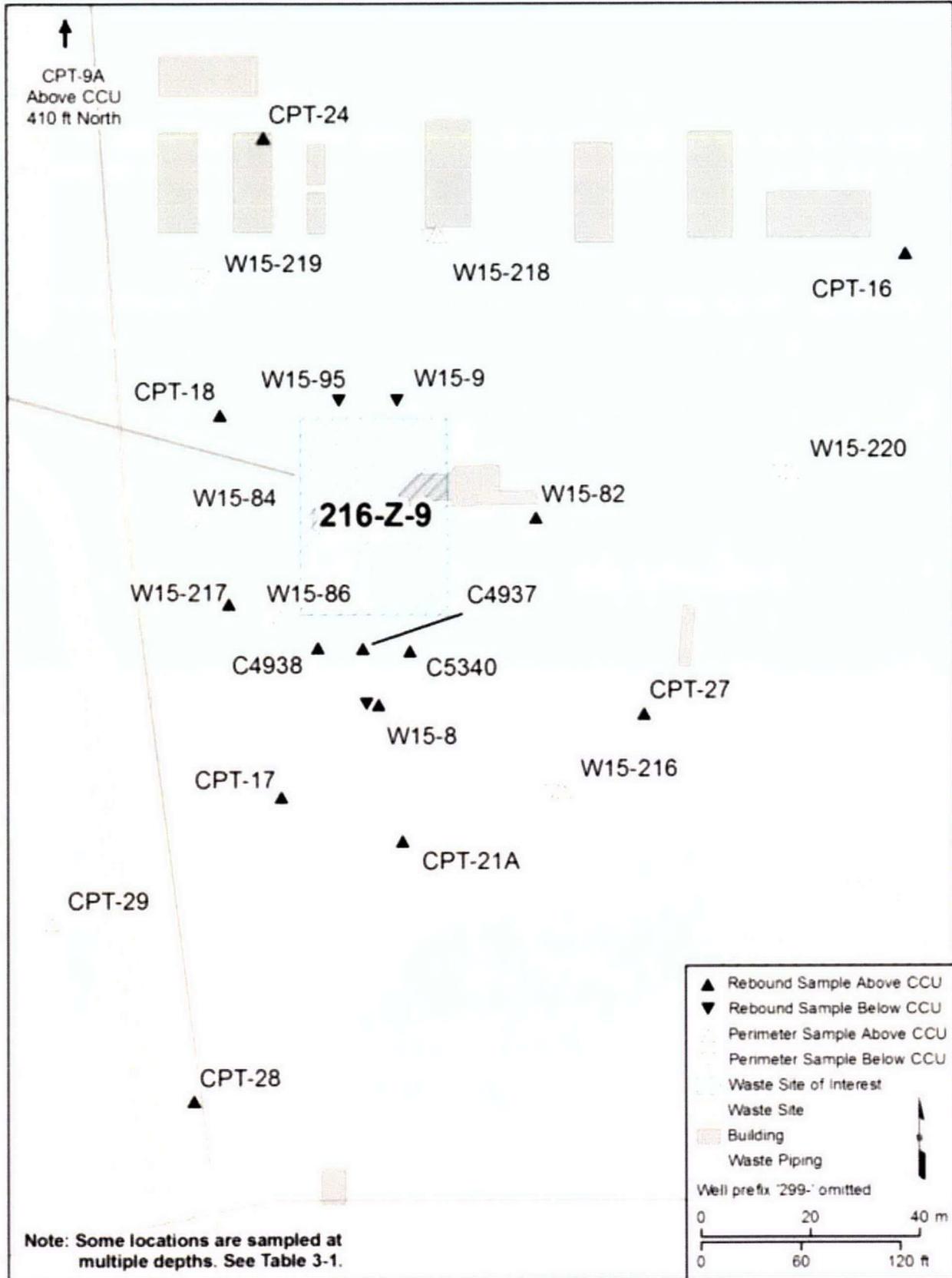


Figure 1-2. Proposed Soil Vapor Sampling Locations Near 216-Z-9.

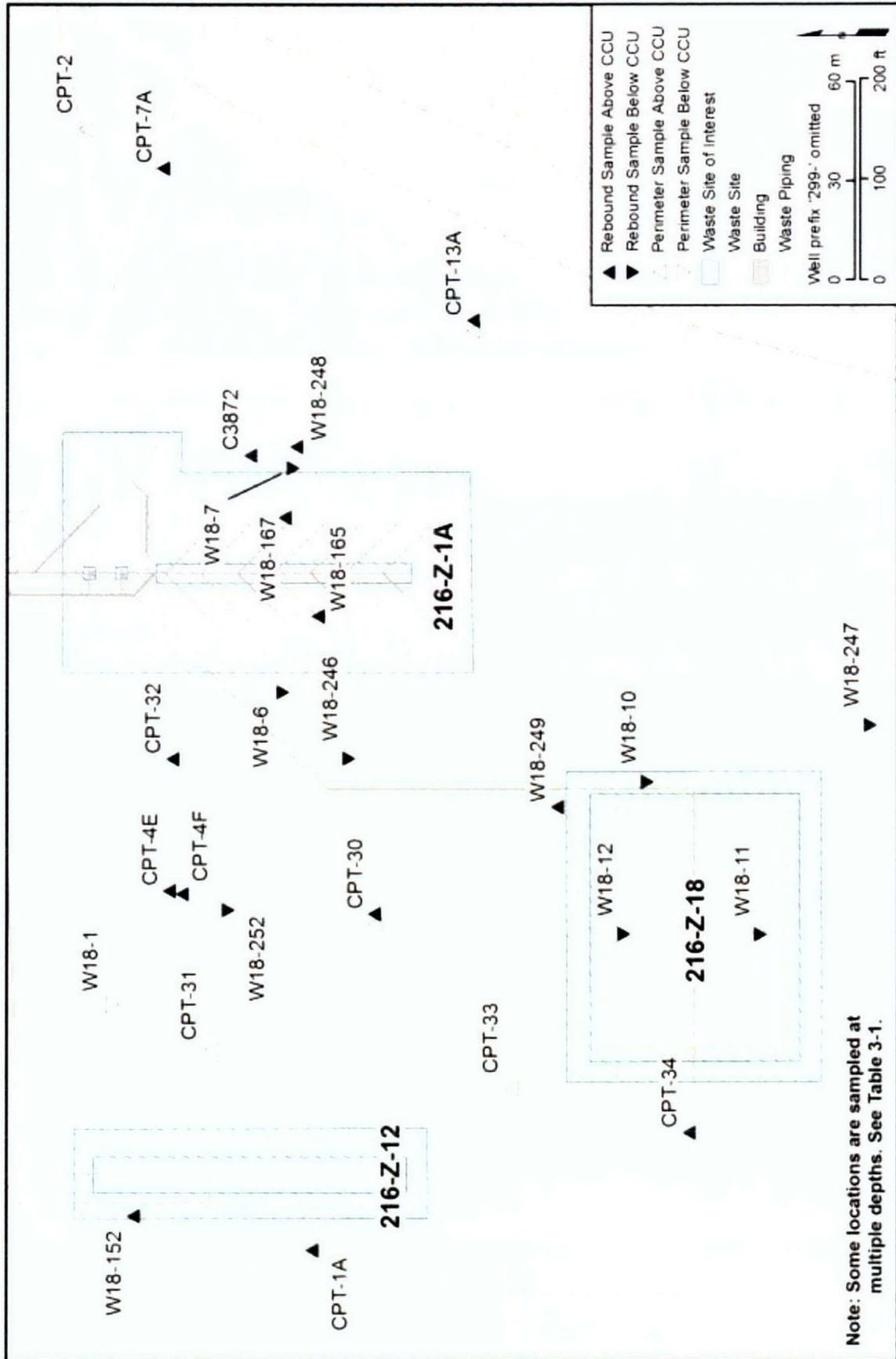


Figure 1-3. Proposed Soil Vapor Sampling Locations Near 216-Z-1A, 216-Z-18 and 216-Z-12.

1.4 Objective

The primary objective is to collect and analyze soil vapor samples that reflect current concentrations of carbon tetrachloride and methylene chloride in the vadose zone at the 200-PW-1 OU. Analytical data will help define the magnitude and trending of contaminant concentration rebound over the 18-month period following the most recent shutdown of the active SVE systems (October 2012).

Comparison with previous soil vapor data from the same sample locations will provide an indication of the threat to groundwater posed by residual carbon tetrachloride and methylene chloride in the vadose zone of the 200-PW-1 OU. This, in turn, will support decision making regarding attainment of the SVE remediation goals.

A secondary objective is to collect and analyze soil vapor samples from the wells/probes at the perimeter of the SVE study area to support assessment of unidentified contaminant source areas above cleanup levels.

1.5 Scope

This SAP guides the collection and analysis of soil vapor samples from existing 200-PW-1 soil vapor monitoring and extraction locations (Figure 1-2 and Figure 1-3). Additionally, the status of each well with respect to its isolation from barometric effects (i.e., sealed to preclude barometric effects, partially sealed, not sealed, unknown) will be documented during the sampling.

Sample locations include:

- Locations monitored after SVE shutdown in October 2012.
- Locations formerly used as passive SVE (below the Cold Creek unit[CCU])
- Locations below the CCU (216-Z-9)
- Locations at the perimeter of the study area.

1.6 Site Geology/Hydrogeology

Detailed discussion of the stratigraphic units beneath the 200-PW-1 OU are provided in Section 3.1.3 of DOE/RL-2006-51, *Remedial Investigation Report for the Plutonium/Organic Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units* (RI). Briefly, the vadose zone underlying the primary carbon tetrachloride disposal sites of the 200-PW-1 OU consists of approximately 70 m (230 ft) of relatively permeable sand and gravel within the Ringold Formation (lower portion) and Hanford formation (upper portion). This section is interrupted from a depth of 38 to 45 m (125 to 148 ft) by the CCU, a less permeable interval composed of 4 m (13 ft) of silt and sand and 3 m (10 ft) of carbonate-rich silt and sand. Because of its higher concentration of calcium carbonate, the less permeable CCU is informally referred to as the “caliche layer.” The less permeable CCU interval constitutes a relatively low-flow zone and effectively divides the subsurface into the following two distinct higher flow zones:

- an upper zone from the ground surface to the top of the less permeable layer, and
- a lower zone from the bottom of the less permeable layer to the water table (greater than 70 m [230 ft] below ground surface [bgs]).

1.7 Statement of the Problem

Carbon tetrachloride and methylene chloride soil vapor concentrations in the 200-PW-1 OU have been steadily decreasing since 1992 due to the implementation of SVE operations. The most recent soil vapor sampling results show carbon tetrachloride and methylene chloride vapor concentrations well below the soil vapor cleanup levels specified in the 200-PW-1 ROD (carbon tetrachloride: 100 ppmv, methylene chloride: 50 ppmv) in all soil vapor extraction and monitoring wells, and in all but one soil vapor probe, CPT-28 at 87 ft bgs, where carbon tetrachloride results slightly exceeded the soil vapor cleanup level. Because soil vapor impacts to groundwater are now projected to be insignificant, EPA approved a one year rebound study between April 2013 and April 2014.

The two active SVE systems were last operated on October 4, 2012. The last soil vapor samples were collected at SVE extraction and monitoring wells and probes on March 17, 2013. Passive SVE operations were permanently discontinued in March 2013. It is now necessary to design a soil vapor sampling program to measure representative soil vapor concentrations at SVE extraction and monitoring wells and probes, determine any trends, evaluate whether the residual contamination will cause groundwater cleanup levels to be exceeded, and ensure other soil vapor carbon tetrachloride sources have not been missed.

At issue is whether residual carbon tetrachloride and methylene chloride soil vapors in the vadose zone of the 200-PW-1 OU pose an unacceptable threat to groundwater.

1.8 Decision Statements and Decision Rules (or Data Needs)

The decision statements consolidate potential questions and alternative actions. Table 1-1 presents the decision statements and decision rules identified during the streamlined data quality objectives (DQOs) process.

Table 1-1. Decision Statements and Decision Rules

No.	Decision Statement	Decision Rule	Are Additional Data Needed?
1	Determine whether calendar year 2014 carbon tetrachloride and methylene chloride soil vapor concentrations meet the 200-PW-1 ROD cleanup goals and reflect insubstantial rebound trends, and therefore could lead to EPA approval to begin preparing closure documentation (DOE/RL-2014-18, <i>Path Forward For Future 200-PW-1 Operable Unit Soil Vapor Extraction Operations</i> , Figure 6-1); or, depending on the amount of rebound observed, perform either an additional year of rebound study or conduct an active cycle of SVE operations during an additional year.	If CY2014 carbon tetrachloride and methylene chloride soil vapor concentrations are below the cleanup levels specified in the 200-PW-1 ROD (100 ppmv and 50 ppmv, respectively), and reflect insubstantial rebound trends, then evaluate groundwater protectiveness and, if appropriate, request EPA approval to begin preparing closure documentation; otherwise, depending on the amount of rebound observed, either perform an additional year of rebound study, or conduct an active cycle of SVE operations during an additional year.	Yes

Table 1-1. Decision Statements and Decision Rules

No.	Decision Statement	Decision Rule	Are Additional Data Needed?
2	<p>Determine whether or not there are any wells/probes with anomalous concentrations* that suggest an unidentified contaminant source that could impact groundwater and, if necessary, prepare a design for additional characterization to obtain supplemental data; otherwise, no further characterization or monitoring is required.</p> <p>*For the purposes of this study, anomalous concentrations are defined as more than a 50% increase from the previous measurement at a given well and suggest a substantive increasing trend.</p>	<p>If the concentrations of carbon tetrachloride and methylene chloride in any wells/probes appear anomalous*, suggesting an unidentified contaminant source that could impact groundwater, prepare a design for additional characterization to obtain supplemental data; otherwise, no further characterization or monitoring is required.</p>	<p>Yes</p> <p>One more round of perimeter well/probe vapor sample data to supplement the existing data</p>
<p>Source References:</p> <p>SGW-33746, 2007, <i>Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Fiscal Year 2006</i>, Rev. 0, Fluor Hanford, Inc., Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=DA06100675. Note that previous reports from FY1992 to FY2005 are listed in Section 1.2 of SGW-33746.</p> <p>SGW-37111, 2008, <i>Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Fiscal Year 2007</i>, Rev. 0, Fluor Hanford, Inc., Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0809171000.</p> <p>SGW-40456, 2009, <i>Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Fiscal Year 2008</i>, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0095859.</p> <p>SGW-44694, 2010, <i>Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Fiscal Year 2009</i>, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=1008231055.</p> <p>SGW-49388, 2011, <i>Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Calendar Year 2010</i>, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=1111100718.</p> <p>SGW-51807, 2012, <i>Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Calendar Year 2011</i>, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. (no link)</p> <p>SGW-54566, 2013, <i>Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Calendar Year 2012</i>, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. (no link)</p>			

Table 1-1. Decision Statements and Decision Rules

No.	Decision Statement	Decision Rule	Are Additional Data Needed?
3	Determine whether existing CERCLA documentation adequately defines environmental impact pathways.	If existing CERCLA documentation sufficiently defines site-specific environmental impact pathways to support the closure process, then no further action is required; otherwise, revisit environmental impact pathways to identify aspects requiring further evaluation and prepare a plan to address those aspects.	No Environmental pathways are well defined at this time.
<p>Source References:</p> <p>DOE/RL-2006-51, 2007, <i>Remedial Investigation Report for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units</i>, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=DA05807591. http://www2.hanford.gov/arpir/?content=findpage&AKey=DA05807868. http://www2.hanford.gov/arpir/?content=findpage&AKey=0805130070. http://www2.hanford.gov/arpir/?content=findpage&AKey=0805130071.</p> <p>DOE/RL-2007-27, 2007, <i>Feasibility Study for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units</i>, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093807 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093806 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093805 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093804 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093803 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093802 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093801 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093800 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093799 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093798 http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093797</p>			
4	Determine whether existing CERCLA documentation adequately addresses cumulative risk to the environment.	If existing CERCLA documentation addresses cumulative risk to the environment sufficiently to support the closure process, then no further action is required; otherwise, revisit cumulative risk to identify aspects requiring further evaluation and prepare a plan to address those aspects.	No Human health and ecological risk were thoroughly addressed by the 200-PW-1/3/6 Baseline Risk Assessment.
Source References: See references for Decision Statement #3			
5	Determine whether existing SVE remediation goals are adequately defined to support a decision to terminate active SVE.	If existing documentation defines SVE remediation goals sufficiently to support a decision to terminate active SVE, then no further action is required; otherwise, revisit the SVE remediation goals to identify aspects requiring further evaluation and prepare a plan to address those aspects.	No The 200-PW-1/3/6 Record of Decision clearly identifies SVE remediation goals.

2 Quality Assurance Project Plan

This QAPjP establishes the quality requirements for environmental data collection, including planning, implementation, and assessment of sampling, field measurements, and laboratory analysis. This QAPjP complies with the requirements of the following documents:

- DOE O 414.1D, *Quality Assurance*
- 10 CFR 830, “Nuclear Safety Management,” Subpart A, “Nuclear Safety Management; Quality Assurance Requirements”
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5)
- *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD)

Sections 6.5 and 7.8 of the TPA Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*) require the quality assurance (QA)/quality control (QC) and sampling and analysis activities to specify the QA requirements for treatment, storage, and disposal units and past practice processes. Therefore, this QAPjP follows the QA elements of EPA/240/B-01/003. This QAPjP demonstrates conformance to Part B requirements of ANSI/ASQC E4-1994, *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*.

In addition to the requirements cited above, EPA-505-B-04-900A, *Intergovernmental Data Quality Task Force, Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP Manual*, was used as a resource for identification of QAPjP elements.

The Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) manual (EPA-505-B-04-900A) is not imposed through the TPA (Ecology et al., 1989a). However, it is a valuable resource that provides comprehensive treatment of quality elements that could be addressed in a SAP. It was also designed to be compatible with EPA/240/B-01/003, which forms the basis for this QAPjP.

This QAPjP is divided into the following four sections, which describe the quality requirements and controls applicable to this investigation.

Project Management (Section 2.1) – This section addresses elements of project management, including the project history and objectives, roles, and responsibilities of the participants. These elements ensure that the project has a defined goal, that the participants understand the goal and the approach to be used, and that the planning outputs are documented.

Data Generation and Acquisition (Section 2.2) – This section addresses aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and properly documented.

Assessment and Oversight (Section 2.3) - This section addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

Data Validation and Usability (Section 2.4) – This section addresses the QA activities occurring after the data collection or generation phase of the project is completed. Implementation of these elements ensures that data conform to the specified criteria, thus achieving the project objectives.

2.1 Project Management

This section addresses elements of project management, including the project history and objectives, roles, and responsibilities of the participants. These elements ensure that the project has a defined goal, that the participants understand the goal and the approach to be used, and that the planning outputs are documented.

2.1.1 Project/Task Organization

The primary contractor, or its approved subcontractor, is responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory. The project organization (in regard to sampling and characterization) is described in the following subsections and is shown graphically in Figure 2-1. The Project Manager maintains a list of individuals or organizations as points of contact for each functional element in the figure. For each functional primary contractor role, there is a corresponding oversight role within U.S. Department of Energy – Richland Operations Office (DOE-RL).

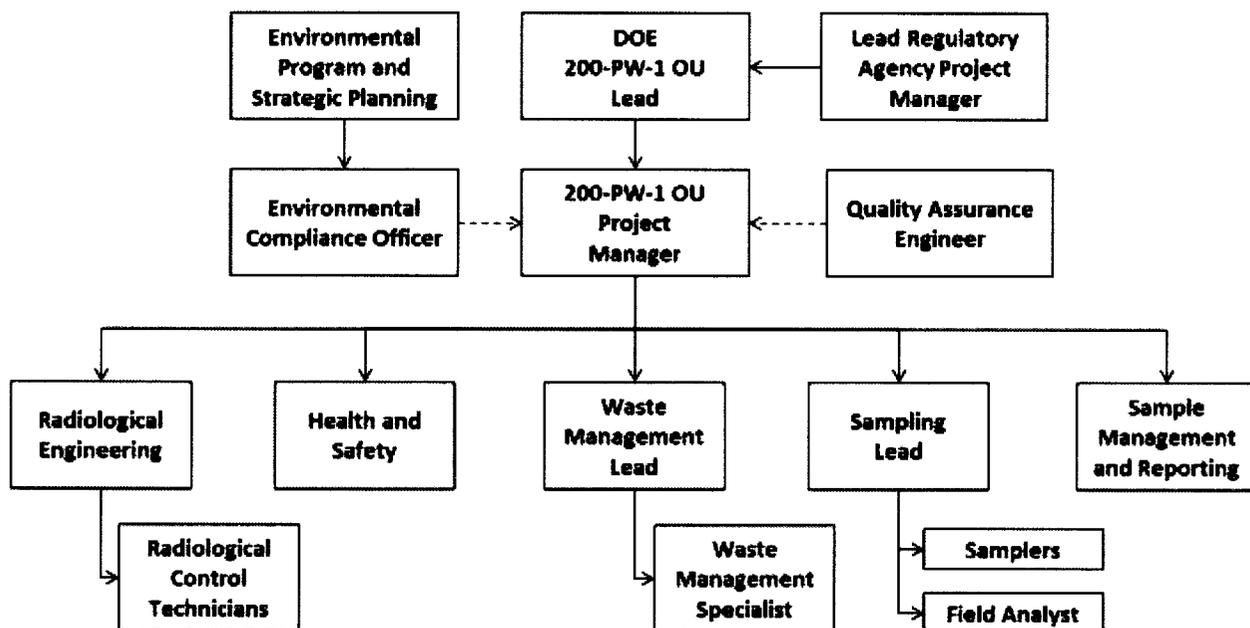


Figure 2-1. Project Organization

The project has several key positions within the DOE-RL organization, including the following:

- **Lead Regulatory Agency.** The lead regulatory agency has approval authority as lead regulatory agency for the 200-PW-1 OU and the work being performed under this SAP. The lead regulatory agency works with the RL to resolve concerns over the work as described in this SAP in accordance with the TPA (Ecology et al., 1989a). The lead regulatory agency for this work is the EPA.
- **DOE OU Lead.** The DOE OU Lead is responsible for authorizing the Contractor to perform activities under 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 TPA (Ecology et al., 1989a) for the Hanford Site. It is the responsibility of RL to obtain lead regulatory agency approval of the SAP authorizing the field sampling activities. The DOE

OU Lead is responsible for overseeing day-to-day activities of the Contractor performing the work scope and working with the Contractor and the regulatory agencies to identify and resolve issues.

- **200-PW-1 OU Project Manager.** The 200-PW-1 OU Project Manager (or designee) is responsible for managing sampling documents and requirements, field activities, subcontracted tasks, and ensuring the project file is properly maintained. The 200-PW-1 OU Project Manager ensures that the sampling design requirements are converted into field instructions (e.g., work packages) providing specific direction for field activities. The 200-PW-1 OU Project Manager works closely with QA, Health and Safety, and the Field Team Lead to integrate these and other lead disciplines in planning and implementing the work scope. The 200-PW-1 OU Project Manager maintains a list of individuals or organizations filling each of the functional elements of the project organization. In addition, the 200-PW-1 OU Project Manager is responsible for version control of the SAP to ensure that personnel are working to the most current job requirements. The 200-PW-1 OU Project Manager also coordinates with DOE-RL and the primary contractor management on all sampling activities. The 200-PW-1 OU Project Manager supports DOE-RL in coordinating sampling activities with the regulators.
- **Quality Assurance Engineer.** The QA point of contact (POC) is matrixed to the Project Manager and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements, reviewing project documents (including DQO summary report and SAP), and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA POC must be independent of the unit generating the data.
- **Environmental Compliance.** The Environmental Compliance Officer (ECO) is matrixed to the Project Manager and is responsible for environmental compliance on the project. The ECO 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 ECO also reviews plans, protocols, and technical documents to ensure that environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost effective solutions; and responds to environmental/regulatory issues or concerns raised by RL and/or regulatory agencies. The ECO also oversees project implementation for compliance with applicable internal and external environmental requirements.
- **Health and Safety.** The Health and Safety organization is responsible for coordinating 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 regulation or by internal primary contractor work requirements. In addition, the Health and Safety organization provides assistance to project personnel in complying with applicable health and safety standards and requirements. The Health and Safety organization coordinates with Radiological Engineering to determine personal protective clothing requirements.
- **Radiological Lead.** The Radiological Engineering lead is responsible for radiological/health physics support within 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, the Radiological Engineer lead identifies radiological hazards and implements appropriate controls to maintain worker exposures ALARA (e.g., requiring personal protective equipment). The Radiological Engineering lead also interfaces with the project Health and Safety contact, and plans and directs Radiological Control Technician (RCT) support for all activities.

- **Field Team Lead.** The Field Team Lead, or Lead Scientist, will act as the technical lead for the rebound study sampling and field analysis. The Lead Scientist is responsible for ensuring and documenting that the data are collected in accordance with the SAP. The Lead Scientist, in conjunction with the 200-PW-1 OU Project Manager, will provide clarification on rebound sampling requirements and implementation, as needed.

The Field Team Lead is responsible for planning and coordinating field sampling resources. The Field Team Lead ensures samplers are appropriately trained and available. Additional related responsibilities include ensuring that the sampling design is understood and can be performed as specified by directing training, mock ups, and practice sessions with field personnel.

The Field Team Lead directs the samplers. The samplers collect samples, including replicates/duplicates, and prepare sample blanks in accordance with the SAP, corresponding standard procedures, and work packages. The samplers complete field logbook entries, chain of custody forms, and shipping paperwork, and ensure delivery of the samples for analysis.

The Field Team Lead is responsible for planning and coordinating field analysis of soil vapor samples. The Field Team Lead ensures personnel performing field analysis of soil vapor samples using the Brüel & Kjær™ 1302 multi-gas analyzer are appropriately trained, and that the personnel and necessary facilities, equipment and supplies are available. Additional related responsibilities include ensuring that the analytical requirements are understood and can be performed as specified.

- **Sample Management and Reporting.** The Sample Management and Reporting (SMR) organization coordinates laboratory analytical work, ensuring that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent), as approved by DOE, EPA, and the Washington State Department of Ecology (Ecology). SMR receives the analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS), and arranges for data validation. SMR is responsible for informing the Project Manager of any issues reported by the analytical laboratory. The SMR organization develops and oversees implementation of the letter of instruction to the analytical laboratories, oversees data validation, and works with the Project Manager to prepare a characterization report on the sampling and analysis results.

The SMR organization is also responsible for conducting the DQO process, or equivalent. Additional related responsibilities include development of the DQOs and SAP, including the sampling design, preparing associated presentations, resolving technical issues, and preparing revisions to the SAP.

- **Contract Laboratories.** The contract laboratories analyze samples in accordance with established protocols and provide necessary sample reports and explanation of results in support of data validation. The laboratories must meet site-specified QA requirements and must have an approved QA plan in place.
- **Waste Management.** Waste Management communicates policies and protocols and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost effective manner. Waste Management is also responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpreting the characterization data to generate waste designations and profiles, and preparing and maintaining other documents confirming compliance with waste acceptance criteria.

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2.1.2 Problem Definition/Background

Carbon tetrachloride and methylene chloride soil vapor concentrations in the 200-PW-1 OU have been steadily decreasing since 1992 due to the implementation of SVE operations. Because vapor concentrations are now below the soil vapor cleanup levels specified in the 200-PW-1 OU ROD (carbon tetrachloride: 100 ppmv, methylene chloride: 50 ppmv) in all soil vapor extraction and monitoring wells, and in all but one soil vapor probe, where carbon tetrachloride results slightly exceeded soil vapor cleanup levels, and soil vapor impacts to groundwater are projected to be insignificant, EPA approved a one year rebound study between April 2013 and April 2014.

The two active SVE systems were last operated on October 4, 2012. The last soil vapor samples were collected at SVE extraction and monitoring wells and probes on March 17, 2013. Passive SVE operations were permanently discontinued in March 2013. It is now necessary to design a soil vapor sampling program to measure representative soil vapor concentrations at SVE extraction and monitoring wells and probes, determine any trends, evaluate whether the residual contamination will cause groundwater cleanup levels to be exceeded, and ensure other soil vapor carbon tetrachloride sources have not been missed.

2.1.3 Project/Task Description

This SAP governs soil vapor sampling to be conducted to assess the rebound of carbon tetrachloride and methylene chloride concentrations in soil vapor since shut down of the active SVE system in October 2012 and the permanent shutdown of the passive SVE system in March 2013.

Additional locations will also be sampled to assess for the presence of unidentified contaminant sources above cleanup levels. Table 2-1 summarizes the target analytes.

Table 2-1. Target Analyte List

Target	Justification/Rationale	Retain as Target Analyte in this SAP?		
		CERCLA Characterization	Waste Management	Support to Future Design Activities
Carbon Tetrachloride	Cleanup levels identified in Table 35 of the 200-PW-1 ROD (EPA 2011).	Yes	No	No
Methylene Chloride		Yes	No	No

Source: *Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units* (EPA 2011)

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

2.1.4 Quality Objectives and Criteria

The QA objective of this plan is to develop implementation guidance providing data of known and appropriate quality. Data quality indicators (DQIs) describe data quality by evaluation against identified DQOs and 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. The principal DQIs are precision, bias or accuracy, representativeness, comparability, completeness, and sensitivity. DQIs for soil vapor analysis conducted using the Brüel & Kjær 1302 photoacoustic multi-gas analyzer are described in Table 2-2. DQIs applicable to laboratory analysis of split samples are described in Table 2-3 of this SAP. The DQIs will be evaluated during the data quality assessment (DQA) process (Section 2.4.3).

**Table 2-2. Data Quality Indicators for VOC Analysis
Using the Brüel & Kjær 1302 and Innova 1312 Multi-gas Analyzers**

QC Measures	Activity (Quality Control Level 2)
Blanks	Performed at the beginning and end of analysis batch, more often at the discretion of the analyst (minimum of 1 per day). Method blanks shall be less than 3 times the method detection limit (MDL).
Initial calibration	Performed annually by instrument manufacturer or qualified vendor.
Initial calibration check standards (ICS)	Required at the beginning of each day or shift. Calibration checks (or repeat analysis of standard) should recover within $\pm 25\%$ or the instrument should be recalibrated.
Continuing calibration check standards (CCS)	Required at least once in the middle of each day or shift. Calibration checks (or repeat analysis of standard) should recover within $\pm 25\%$. Repeated failure of CCS will require procurement of a new standard or instrument recalibration.
Duplicates	One required per 20 samples or a minimum of 1 per day. Additional duplicates should be analyzed for those samples with suspected matrix interferences. Duplicates may also be analyzed if results for a well-studied area do not agree with historical data. Duplicates should agree within $\pm 25\%$ RPD for samples greater than 5 times
Laboratory control standards (LCS)	At least once during each day or shift. The LCS should recover within $\pm 25\%$. Failure of the LCS will require repeat analysis of the standard. Repeated failure of the LCS will require the instrument be recalibrated.

Table 2-3. Data Quality Indicators for Laboratory Analysis

DQI	Definition	Example Determination Methodologies	Project Specific Information	Corrective Actions
Precision	A measure of the degree of reproducibility of measurements under prescribed similar conditions. Sample precision is calculated on the basis of duplicate analyses.	<p>Use the same analytical instrument to make repeated analyses on the same sample.</p> <p>Use the same method to make repeated measurements of the same sample within a single laboratory or have two or more laboratories analyze identical samples with the same method.</p> <p>Split a sample in the field and submit both for sample handling, preservation and storage, and analytical measurements.</p> <p>Collect, process, and analyze collocated samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.</p>	<p>Field precision: At randomly selected locations, duplicate samples will be taken one per 20 samples per media.</p> <p>Laboratory precision; analysis of laboratory duplicate or matrix spike duplicate.</p>	<p>If duplicate data do not meet objective:</p> <p>Evaluate apparent cause (e.g., sample heterogeneity).</p> <p>Request re-analysis or re-measurement.</p> <p>Qualify the data before use.</p>

Table 2-3. Data Quality Indicators for Laboratory Analysis

DQI	Definition	Example Determination Methodologies	Project Specific Information	Corrective Actions
Accuracy	The degree to which a measurement agrees with an accepted reference or true value. Sample accuracy is expressed as the percent recovery of a spiked sample.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample); usually expressed either as percent recovery or as a percent bias.	Laboratory accuracy is determination based on matrix spikes and matrix spike duplicates. Note if any of the samples or analyses are more or less critical than the others in determining follow-up actions.	If recovery does not meet objective: Qualify the data before use. Request re-analysis or re-measurement.
Representativeness	The degree to which data accurately and precisely represents a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	Samples will be collected as described in the sampling design. Judgment sampling ensures areas most likely to be contaminated, based on current information, will be evaluated. Random sampling is based on ensuring all members of the group are equally likely to be chosen and allows probability statements to be made about the quality of estimates derived from the data. Note if any of the samples or analyses are more or less critical than the others in determining follow-up actions	If results are not representative of the system sampled: Identify the reason for the results not being representative. Reject the data, or, if data are otherwise usable, qualify the data for limited use and define the portion of the system that the data represent. Redefine sampling and measurement requirements and protocols. Resample and re-analyze.
Comparability	The confidence with which one data set can be compared to another. For each analyte, comparable precision and accuracy depend on the method and sample matrix.	Compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and quality assurance protocols.	Sampling personnel will use the same sampling protocols. Samples will be analyzed in the field using the same type of analytical equipment (B&K 1302 Photoacoustic Multi-gas Analyzer) following the same protocols. Splits will be collected using different protocols *(Summa	If data are not comparable to other data sets: Identify appropriate changes to data collection and/or analysis methods. Identify quantifiable bias, if applicable. Qualify the data as appropriate. Resample and/or

Table 2-3. Data Quality Indicators for Laboratory Analysis

DQI	Definition	Example Determination Methodologies	Project Specific Information	Corrective Actions
			<p>canisters) and submitted to an analytical laboratory for analysis. Comparability to primary samples will require professional judgment.</p> <p>Note if any of the samples or analyses are more or less critical than the others in determining follow-up actions.</p>	<p>re-analyze if needed.</p> <p>Revise sampling/analysis protocols to ensure future comparability.</p>
Completeness	<p>A measure of the amount of usable and/or valid data obtained from a measurement system compared to the total amount of data requested.</p>	<p>Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/acceptance criteria).</p>	<p>The percent complete will be assessed during data verification.</p> <p>Note if any of the samples or analyses are more or less critical than the others in determining follow-up actions.</p>	<p>If data set does not meet completeness objective:</p> <p>Identify appropriate changes to data collection and/or analysis methods.</p> <p>Identify quantifiable bias, if applicable.</p> <p>Qualify the data as appropriate.</p> <p>Resample and/or re-analyze if needed.</p> <p>Revise sampling/analysis protocols to ensure future comparability.</p>
Sensitivity	<p>The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.</p>	<p>Determine the minimum concentration or attribute to be measured by a method (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit). The practical quantitation limit is the lowest level which can be routinely quantified and reported by a laboratory.</p>	<p>Ensure sensitivity, as measured detection limits, is appropriate for the action levels.</p> <p>Note if any of the samples or analyses are more or less critical than the others in determining follow-up actions.</p>	<p>If sensitivity does not meet objective:</p> <p>Request re-analysis or re-measurement.</p> <p>Qualify/reject the data before use.</p>

Quality objectives and project-specific measurement requirements are presented in Table 2-4.

Table 2-4. Analytical Performance Requirements

CAS Number	Analyte	Matrix	Analytical Method	Cleanup Level ^a	Required Detection Limit	Accuracy Requirement (% Recovery)	Precision Requirement (RPD)
Field Analysis - Brüel and Kjær 1302 Photoacoustic Multi-gas Analyzer							
56-23-5	Carbon Tetrachloride	Soil vapor	Photoacoustic spectroscopy	100 ppmv	1 ppmv	75 - 125	± 25
75-09-2	Methylene Chloride	Soil vapor	Photoacoustic spectroscopy	50 ppmv	1 ppmv	75 - 125	± 25
Laboratory Analysis							
56-23-5	Carbon Tetrachloride	Soil vapor	EPA Method TO-15 ^b	100 ppmv	0.005 ppmv	75 - 125	± 25
75-09-2	Methylene Chloride	Soil vapor	EPA Method TO-15	50 ppmv	0.005 ppmv	75 - 125	± 25

a. Cleanup levels for carbon tetrachloride and methylene chloride are established in Table 35 of the *Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units* (EPA, 2011).

b. EPA/625/R-96/010b, 1988, *Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)*.

CAS – Chemical Abstract Service
 N/A – not applicable
 ppmv – parts per million volume
 RPD – relative percent difference

2.1.5 Special Training/Certification

A graded approach is used to ensure that workers receive a level of training commensurate with responsibilities and complying with applicable DOE orders and government regulations. The Field Work Supervisor (FWS), in coordination with line management, will ensure that special training requirements for field personnel are met.

Typical training requirements or qualifications have been instituted by the primary contractor management team to meet training requirements imposed by the contract, regulations, DOE orders, DOE contractor requirement documents, American National Standards Institute/American Society of Mechanical Engineers, and the *Washington Administrative Code*. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. Field personnel typically have completed the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training and supervised 24-hour hazardous waste site experience
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- Hanford General Employee Radiation Training
- Hanford General Employee Training or equivalent (e.g. CH2M Hill Plateau Remediation Company [CHPRC] General Employee Training)
- Radiological Worker Training

The following project-specific safety training, geared specifically to the project and the day's activity, will be provided:

- Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements.
- Samplers are required to have training and/or experience in the type of sampling that is being performed in the field.
- Training requirements or qualifications needed by field analysis personnel will be in accordance with QA requirements.
- Personnel responsible for calibrating and operating the Brüel & Kjær 1302 are required to have training and experience in the type of analysis that is being performed in the field.
- Qualification requirements for RCTs are established by the Radiation Protection Program; the RCTs assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

Pre-job briefings will be performed to evaluate an activity and associated hazards by considering many factors, including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

Training records are maintained for each individual employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management will be used to confirm that an individual employee's training is appropriate and up-to-date prior to performing any field work.

2.1.6 Documents and Records

The Project Manager is responsible for ensuring that the current version of the SAP is being used and providing any updates to field personnel. Version control is maintained by the administrative document control process. Changes to the SAP affecting the DQOs will be reviewed and approved by DOE and the lead regulatory agency prior to implementation. Table 2-5 defines the types of changes that may be made to the sampling design and the documentation requirements.

Changes to the monitoring program and this monitoring plan are managed based on guidance in the Tri-Party Agreement (Ecology et al., 1989a). Minor field changes can be made by the person in charge of the particular activity in the field to ensure timely and efficient completion of the task. These minor field changes are those that have no effect on the technical adequacy of the job or the work schedule

(TPA Section 12.4). Minor field changes typically result from unexpected conditions encountered at the well or aquifer tube sampling site. Such changes will be documented in the daily log books that are maintained by field sampling personnel. Other minor changes to approved plans which do not qualify as a minor field change can be made through documentation by a letter to project files, the use of a change notice, or a document revision depending upon evaluation by the lead regulatory agency (TPA, Section 9.3). Table 2-5 identifies potential types of changes to the monitoring program or sampling design and the documentation requirements. Change management actions in Table 2-5 are consistent with requirements in the HASQARD, which defines changes as minor, significant, and fundamental.

A revision to this document may be necessary after a certain number (e.g., 5) of TPA (Ecology et al., 1989a) change notices, at a major change in sampling, or at the request of the lead regulatory agency. Changes to this plan will be reviewed and approved by DOE and the lead regulatory agency prior to implementation.

Table 2-5. Monitoring Program Change Control

Duration of Change	Change Type	Action	Documentation
Temporarily (≤ 1 year) adding constituents, wells, or increasing sampling frequency, or substituting an analytical method that meets or exceeds analytical performance requirements.	Minor per TPA Section 9.3, significant per HASQARD	DOE-RL Project Manager approval.	Letter to Project File*, approved TPA Change Notice, or revised monitoring plan.
Adding (>1 year) or eliminating constituents, wells, increasing/decreasing sampling frequency, or a change in analytical method to one that does not meet performance requirements.	Minor or revision necessary per TPA Section 9.3, fundamental per HASQARD	Revise monitoring plan (or TPA Change Notice, if appropriate); obtain DOE and regulatory approval; distribute plan.	Revised monitoring plan (or approved TPA Change Notice)

* If the lead regulatory agency decides that a monitoring plan revision or a TPA change notice is not necessary to document minor changes as defined in Section 9.3 of the TPA, then those changes can be documented by a letter to project files or some equivalent formal means of documentation.

DOE = U.S. Department of Energy

DOE-RL = DOE Richland Operations Office

TPA = Tri-Party Agreement (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*)

The FWS or Buyer's Technical Representative (BTR) is responsible for ensuring that the field instructions are maintained and aligned with any revisions or approved changes to the SAP. The FWS or BTR will ensure that deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action protocols.

The Project Manager, Construction Management Lead, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproofed, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

The Project Manager is responsible for ensuring that a project file is properly maintained. The project file will include the following items, as appropriate:

- Field logbooks or operational records
- Data forms
- Global positioning system data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports
- Laboratory data packages
- Verification and validation reports

The project file will contain the records or references to their storage locations.

The laboratory is responsible for maintaining and having the following items available, upon request:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records. Records required by the TPA (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

2.2 Data Generation and Acquisition

This section addresses aspects of project design and implementation. Implementation of these elements ensure that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and properly documented.

2.2.1 Sampling Process Design

The sampling design is judgmental. In judgmental sampling, the selection of sampling units (i.e., the number and location and/or timing of collecting samples) is based on knowledge of the feature or condition under investigation and on professional judgment. Judgmental sampling is distinguished from probability-based sampling in that inferences are based on professional judgment, not statistical scientific theory. Therefore, conclusions about the target population are limited and depend entirely on the validity and accuracy of professional judgment. Probabilistic statements about parameters are not possible.

The types, numbers, and locations of samples are provided in Chapter 3.

2.2.2 Sampling Methods

Sampling, including the following information, is described in Section 3.6:

- Field sampling methods
- Sample preservation, containers, and holding times
- Corrective actions for sampling activities
- Decontamination of sampling equipment

2.2.3 Sample Handling and Custody

A sampling database is used to track the samples from the point of collection through the laboratory analysis process. Samplers should note any anomaly with a sample (e.g., sample appears unusual or sample is sludge) to prevent laboratory batching across similar matrices. If anomalies are found, the sampler should write “DO NOT BATCH” on the chain-of-custody form and inform SMR.

Laboratory analytical results are entered and maintained in the HEIS database. The HEIS sample numbers are issued to the sampling organization for the project. Each chemical, radiological, and physical properties sample is identified and labeled with a unique HEIS sample number.

The following specific sample handling information is provided in Section 3.7:

- Container requirements
- Container labeling and tracking process
- Sample custody requirements
- Shipping and transportation

Sample custody during laboratory analysis is addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by SMR.

2.2.4 Analytical Methods

Information on analytical methods is provided in Table 2-4 and Section 2.1.4. These analytical methods are controlled in accordance with the laboratory’s QA plan and the requirements of this QAPjP. The primary contractor participates in overseeing off-site analytical laboratories to qualify them for performing Hanford Site analytical work.

If the laboratory uses a nonstandard or unapproved method, then the laboratory must provide method validation data to confirm that the method is adequate for the intended use of the data. This includes information such as determination of detection limits, quantitation limits, typical recoveries, and analytical precision and bias. Deviations from the analytical methods noted in Table 2-4 must be

approved by SMR in consultation with the Project Manager and in consideration of the guidance set forth in the HASQARD.

Laboratories providing analytical services in support of this SAP will have a corrective action program in place that addresses analytical system failures and documents the effectiveness of any corrective actions. Issues that may affect analytical results are to be resolved by SMR in coordination with the Project Manager.

The analytical performance requirements and quality control standards presented here apply to analytical work performed by the analytical laboratory. For this study, primary sample analysis will be performed in the field using the Brüel & Kjær 1302 photoacoustic multi-gas analyzer, in accordance with applicable procedures, quality control standards and analytical performance requirements.

2.2.5 Quality Control

QC protocols must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Field QC sampling will include the collection of field blank and field duplicate samples. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples for sampling and analyses are summarized in Table 2-6.

Table 2-6. Project Quality Control Sampling Summary

QC Sample Type	Purpose	Frequency
Field Quality Control		
Field Blank	Assess contamination from sources other than the sample.	<i>Minimum of one per day.</i>
Field Duplicates	Estimate precision, including sampling and analytical variability.	<i>One per each batch of 20 or fewer samples collected, per day.</i>
Split Sample	Estimate precision, including sampling, analytical, and inter-laboratory variability.	<i>At a minimum, three split samples will be collected in Summa canisters. One will be collected in association with an early sample (possibly the 5th or 6th sample), one will be collected roughly midway through the sampling campaign, and one will be collected near the end of the sampling campaign.</i>
Analytical Quality Control - Brüel & Kjær 1302 Photoacoustic Multi-gas Analyzer		
Quality Control Level 2 (QC-2), in accordance with applicable procedures, quality control standards and analytical performance requirements.		
Analytical Quality Control – Split Sampling for Laboratory Analysis		
Method Blank	Assess response of an entire laboratory analytical system	<i>One per batch, 20 samples maximum or as identified by the method guidance per media sampled.</i>
Matrix Spike	Identify analytical (preparation + analysis) bias; possible matrix affect on the analytical method used	<i>When required by the method guidance, one per batch, 20 samples maximum or as identified by the method guidance per media sampled.</i>
Matrix Duplicate or Matrix Spike Duplicate	Estimate analytical bias and precision	<i>When required by the method guidance, one per batch, 20 samples maximum or as identified by the method guidance per media sampled.</i>

Table 2-6. Project Quality Control Sampling Summary

QC Sample Type	Purpose	Frequency
Laboratory Control Samples	Assess method accuracy	<i>One per batch, 20 samples maximum or as identified by the method guidance per media sampled.</i>
Surrogates	Estimate recovery/yield	<i>When required by the method guidance, as identified by the method guidance.</i>

2.2.5.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance. QC samples and the required frequency, as shown in Table 2-6, are described in this section.

Field Blanks: Field blanks will be collected at a minimum frequency of one per day. For the field blanks, results greater than two times the method detection limit (MDL) or minimum detectable activity (MDA) are identified as suspected contamination. However, for common laboratory contaminants, such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the MDL.

Field Duplicates. Field duplicates are independent samples collected as close as possible to the same time and same location, and are intended to be identical. Field duplicates are two separate samples collected from the same source, placed in separate sample containers, and analyzed independently. Field duplicates generally should be collected from an area expected to have some contamination, so valid comparisons between the samples can be made (i.e., some constituents will likely be greater than MDL).

Field duplicates will be stored and transported together, and analyzed for the same constituents. The field duplicate samples will be used to determine precision for both sampling and laboratory measurements. Evaluation of the results can provide an indication of intra-laboratory variability. Large relative percent differences (RPDs) can be an indication of potential laboratory performance problems and should be investigated.

Field Split Samples. Field split samples are two samples collected as close as possible to the same time and same location and are intended to be identical. Field split samples will be stored in separate containers and analyzed by different laboratories for the same or similar analytes. Split samples are inter-laboratory comparison samples used to evaluate comparability between laboratories. Large RPDs can be an indication of potential laboratory performance problems and should be investigated.

2.2.5.2 Laboratory Quality Control Samples

Laboratory QC samples (e.g., method blanks and laboratory control sample/blank spike) are defined for the four-digit EPA methods (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*) and will be run at the frequency specified in the respective reference unless superseded by agreement.

Laboratory QC checks that fall outside of control limits will be identified during the data validation and DQA processes, as described in Section 2.4.

2.2.5.3 Quality Control Requirements

Table 2-6 lists the field QC requirements for sampling. If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment blank is not required. Field blanks are not required when transferring samples to the field gas chromatograph for analysis.

Field duplicates must agree within 25 percent, as measured by the RPD, to be acceptable. Only those field duplicates with at least one result greater than five times the appropriate detection limit are evaluated. Field duplicate results not satisfying evaluation criteria will be qualified and flagged in HEIS, as appropriate.

For laboratory chemical analyses, the control limits for laboratory duplicate samples, matrix spike samples, matrix spike duplicate samples, surrogate recoveries, and laboratory control samples are typically derived from historical data at the laboratories in accordance with SW-846. Typical control limits are within 25 percent of the expected values, although the limits may vary considerably depending upon the method and analyte. For this SAP, control limits for laboratory QC samples are specified in Table 2-4.

Holding time is the elapsed time period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. If holding times are exceeded, the effects of the holding time exceedance on the results will be evaluated on a case by case basis.

Field analysis: Samples collected in Tedlar® bags for VOC analysis must be delivered for field analysis within 5 hours of collection. Samples collected in Tedlar bags should be analyzed for VOCs within 6 hours of collection.

Laboratory analysis: Samples collected in Tedlar bags for VOC analysis have a holding time of 48 hours following collection. Samples collected in Summa canisters for VOC analysis have a holding time of 14 days following collection.

Additional QC measures include laboratory audits and participation in nationally-based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies. Periodic surveillances and audits of the analytical laboratories are conducted to identify, resolve, and prevent quality problems. Results are used to improve analytical and quality control performance of the laboratories. Summaries of surveillance and audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

Failure of QC will be determined and evaluated during data validation and DQA processes, if performed. Data will be qualified, and flagged in HEIS, as appropriate.

2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Equipment used for collection, measurement, and testing should meet applicable standards (e.g., American Society for Testing and Materials [ASTM]) or should have been evaluated as acceptable and valid in accordance with the methods, requirements, and specifications. The FWS, Field Technical Representative, or equivalent, will ensure that data generated from instructions using a software system are backed up and/or downloaded on a regular basis. Software configuration will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory directly affecting the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and

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calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with three-digit EPA methods (EPA-600/4-79-020) and four-digit EPA methods (SW-846), as amended, or with auditable DOE Hanford Site and contractual requirements. Consumables, supplies, and reagents will be reviewed per SW-846 requirements and will be appropriate for their use.

2.2.7 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in Section 3.4. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan.

2.2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes described in the contractor acquisition system. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with the laboratory's QA plan.

2.2.9 Non-Direct Measurements

Nondirect measurements include data obtained from sources, such as computer databases, programs, literature files, and historical databases. Nondirect measurements associated with this activity are restricted to barometric pressure readings, which will be obtained from the Hanford Meteorological Station.

2.2.10 Data Management

The SMR organization, in coordination with the Project Manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management protocols. 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 Section 9.6 of the TPA Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to SMR on a routine basis. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with contractor protocols. This process is used to document analytical errors and establish their resolution with the Project Manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and for records management.

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 methods. In the event that specific protocols do not exist for a particular work evolution, or if it is determined that additional guidance is needed to complete certain tasks is needed, a work package will be developed for adequate control of the activities, as appropriate. Examples of sampling method requirements include activities associated with the following items:

- Chain of custody/sample analysis requests

- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks
- Checklists
- Sample packaging and shipping

Field activities will be recorded in the field logbook. 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 primary contractor radiological records
- The minimum standards and practices necessary for preparing, performing, and retaining radiological related records
- The indoctrination of personnel on the development and implementation of sample plans
- The requirements associated with preparing and transporting regulated material
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities (data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results)
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities. Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.

2.3 Assessment and Oversight

The elements in assessment and oversight address the activities for assessing 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 Actions

Contractor management, Regulatory Compliance, QA, and/or Health and Safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, and regulatory requirements. The OU Project Manager will determine whether a DQA will be performed for the activities identified in this SAP. The DQA process is discussed in Section 2.4. The results of the DQA will be provided to the Project Manager. No other planned assessments have been identified.

If circumstances arise in the field dictating the need for additional assessment activities, then additional assessments would be performed. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies in accordance with the contractor QA program, the corrective action management program, and associated protocols implementing these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. The contractor oversees offsite analytical laboratories and qualifies the laboratories for performing Hanford Site analytical work.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the SMR organization, which then initiates a sample issue resolution form in accordance with contractor protocols. This process is used to document analytical or sample issues and establish resolution with the 200-PW-1 OU Project Manager.

A DQA report will be prepared to determine whether the type, quality, and quantity of collected data met the quality objectives described in this SAP.

2.4 Data Validation and Usability

The elements in this group address the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether or not the data conform to the specified criteria, thus satisfying the project objectives.

2.4.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review shall include linking sample numbers to specific sampling locations, reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times have been met, and reviewing QC data to determine whether analysis have met the data quality requirements specified in this SAP.

The criteria for verification can include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors.

Errors identified by the laboratories are reported to the SMR organization's project coordinator, who initiates a sample issue resolution form. This process is used to document analytical errors and to establish resolution with the OU Project Manager.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences regarding risk. Physical data and field QA/QC results will be reviewed to ensure that physical property data and/or field screening results are usable.

2.4.2 Data Validation

Data validation is not typically performed on analytical results generated using the Brüel & Kjær 1302 photoacoustic multi-gas analyzer. In addition, due to the small number of split samples (three) generated for laboratory analysis, associated data quality evaluation beyond that performed by laboratory personnel will be addressed through the DQA process.

2.4.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data quality assessment is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. The results of the DQA will be used in interpreting the data and determining if the objectives of this activity have been met.

Step 1. Review Data Quality Objectives and Sampling Design. This step requires a comprehensive review of the sampling and analytical requirements outlined in the project specific DQO summary report and this SAP.

- List any deviations from the planned sampling design
- Determine the potential effect of any deviations

Step 2. Conduct a Preliminary Data Review. Identify, locate, and compile all information related to the sampling and analysis data being assessed including sample summary sheets, logbooks, chain of custody forms, field measurement data, laboratory analysis, field and laboratory QC samples and analysis results, flagged data, laboratory standards results, data validation reports, and various discrepancy or data reviewer reports. Perform basic statistical calculations (percentage of flagged data, percent of various QC parameters not meeting acceptance criteria, percent of non-detects, etc.)

Step 3. Conduct a Data Usability Assessment

Summarize the usability of the data set as a whole and the quality of individual results as appropriate. Describe the usability in terms of the following Data Quality Indicators:

Precision – primarily from field duplicate data, but also from laboratory QC.

Accuracy/Bias – discuss evidence of field contamination, and laboratory QC.

Representativeness – discuss the extent to which the sampling design was accomplished and the representativeness of the samples and the design as a whole. Identify any specific measurements that are not representative of the target condition, explain why they are non-representative, and discuss the impact to the data set.

Comparability – if multiple laboratories were used, or if this data set is intended to be combined with others, discuss the nature of differences which may limit the comparability.

Completeness – discuss the accomplishment of all SAP-required data generating activities. This must include a comparison of samples actually collected versus those identified in the original sampling design. Comment on the impact to data set usability of any planned samples that were not taken. Although the third party data validation report typically includes a completeness metric that relates to the percent of data that is not rejected, the third party data validation report generally relates only to the fraction of the data set which was actually validated. Thus it cannot be the only completeness evaluation of the data set in total.

Sensitivity – discuss any laboratory data which do not meet the SAP required reporting limits and also compare the results to any applicable decision thresholds such as maximum contaminant levels, action levels, etc.

In addition, for radiochemical determinations discuss the magnitude of the total propagated uncertainty to the reported activity value and to applicable decision thresholds. Discuss uses of data where total propagated uncertainty calculations are warranted.

Describe the impacts of any deviations of the Quality Indicators as noted by data flags in terms of limitation of the use of the data set, or individual analytical results, for the specific question to be answered.

Step 4. Formulate Overall Conclusion as to Usability of Data Set.

Based upon the usability assessments in Step 3, develop an overall conclusion as to the usability of the entire data set for their intended purpose.

2.4.4 Corrective Actions

Responses to data quality issues identified will vary and may be data or measurement specific. Some pre-identified corrective actions are included in Section 2.1.4.

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3 Field Sampling Plan

The purpose of the field sampling plan is to define project sampling and analytical requirements. These include defining the number and location of samples, sampling methods, and analyses that will be performed.

3.1 Site Background and Objectives

Soil vapor extraction was initiated at the 200-PW-1 OU in 1992 to mitigate volatile organic compound (VOC) contamination in the vadose zone. SVE was operated continuously through 1997 and then seasonally (typically April through October) from 1998 through October 2012. The SVE system has been shut down since that time.

The objective of the planned sampling and analysis is to assess the rebound of carbon tetrachloride and methylene chloride concentrations in soil vapor, and to assess previously unidentified contaminant source areas above cleanup levels. The data will support decision making regarding attainment of SVE operational goals.

3.2 Documentation of Field Activities

Logbooks or data forms are required for field activities. Requirements for the logbook are provided in Section 2.1.6. Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks. Current practice is to enter data forms into the logbooks.

A summary of information to be recorded in logbooks is as follows:

- Purpose of activity
- Day, date, time, and weather conditions
- Names, titles, and organizations of personnel present
- Deviations from the QAPjP
- All site activities, including field tests
- Materials quality documentation (e.g., certifications)
- Details of samples collected (e.g., preparation, splits, duplicates, matrix spikes, and blanks)
- Locations and types of samples
- Chain-of-custody details and variances relating to chain-of-custody
- Field measurements
- Field calibrations and surveys, and equipment identification numbers, as applicable
- Equipment decontaminated, number of decontaminations, and variations to decontamination methods
- Equipment failures or breakdowns and descriptions of any corrective actions
- Telephone calls relating to field activities

3.3 Sampling Design

The sampling design is judgmental sampling, wherein the selection of sampling units (i.e., the number and location and/or timing of collecting samples) is based on knowledge of the condition under investigation and on professional judgment. Judgmental sampling is distinguished from probability-based sampling in that inferences are based on professional judgment, not statistical scientific theory. Therefore, conclusions about the target population are limited and depend entirely on the validity and accuracy of

professional judgment. Probabilistic statements about parameters are not possible. All soil vapor sampling locations were selected using a judgmental sampling approach by knowledgeable and professionally trained staff. Sample locations are listed in Table 3-1 and are shown in Figure 1-2 and Figure 1-3.

Table 3-1. Sample Locations

Sample Location	Waste Site	Relative to CCU	Sample Depth ^a (ft bgs)	Type	Prior Use
Rebound Sample Locations					
299-W18-10L	Z1A/Z18/Z12	Below	183	Vadose Well	Passive
299-W18-11L	Z1A/Z18/Z12	Below	199	Vadose Well	Passive
299-W18-12	Z1A/Z18/Z12	Below	198	Vadose Well	Passive
299-W18-152	Z1A/Z18/Z12	Above	101	Vadose Well	Active
299-W18-165	Z1A/Z18/Z12	Above	109	Vadose Well	Active
299-W18-167	Z1A/Z18/Z12	Above	106	Vadose Well	Active
299-W18-246L	Z1A/Z18/Z12	Below	170	Vadose Well	Passive
299-W18-247L	Z1A/Z18/Z12	Below	167	Vadose Well	Passive
299-W18-248	Z1A/Z18/Z12	Above	131	Vadose Well	Active
299-W18-249	Z1A/Z18/Z12	Above	130	Vadose Well	Active
299-W18-252L	Z1A/Z18/Z12	Below	175	Vadose Well	Passive
299-W18-6L	Z1A/Z18/Z12	Below	208	Groundwater Well	Passive
299-W18-7	Z1A/Z18/Z12	Below	197	Groundwater Well	Passive
C3872	Z1A/Z18/Z12	Above	63	Vadose Well	Monitoring
CPT-13A	Z1A/Z18/Z12	Above	30	Soil Tube	Monitoring
CPT-1A	Z1A/Z18/Z12	Above	35	Soil Tube	Monitoring
CPT-1A	Z1A/Z18/Z12	Above	68	Soil Tube	Monitoring
CPT-1A	Z1A/Z18/Z12	Above	91	Soil Tube	Monitoring
CPT-30	Z1A/Z18/Z12	Above	48	Soil Tube	Monitoring
CPT-32	Z1A/Z18/Z12	Above	25	Soil Tube	Monitoring
CPT-32	Z1A/Z18/Z12	Above	70	Soil Tube	Monitoring
CPT-34	Z1A/Z18/Z12	Above	40	Soil Tube	Monitoring
CPT-4E	Z1A/Z18/Z12	Above	25	Soil Tube	Monitoring
CPT-4F	Z1A/Z18/Z12	Above	109	Soil Tube	Monitoring
CPT-7A	Z1A/Z18/Z12	Above	32	Soil Tube	Monitoring
299-W15-217	Z9	Above	114	Vadose Well	Active
299-W15-82	Z9	Above	83	Vadose Well	Active
299-W15-8L	Z9	Below	180	Vadose Well	Active
299-W15-8U	Z9	Above	103	Vadose Well	Active
299-W15-95L	Z9	Below	144	Vadose Well	Active
299-W15-9L	Z9	Below	176	Vadose Well	Active
C4937	Z9	Above	64.1	Vadose Well	Active
C4938	Z9	Above	64	Vadose Well	Active
C5340	Z9	Above	64.5	Vadose Well	Active
CPT-16	Z9	Above	25	Soil Tube	Monitoring
CPT-16	Z9	Above	65	Soil Tube	Monitoring
CPT-17	Z9	Above	10	Soil Tube	Monitoring
CPT-18	Z9	Above	35	Soil Tube	Monitoring
CPT-18	Z9	Above	75	Soil Tube	Monitoring

Table 3-1. Sample Locations

Sample Location	Waste Site	Relative to CCU	Sample Depth ^a (ft bgs)	Type	Prior Use
CPT-21A	Z9	Above	65	Soil Tube	Monitoring
CPT-21A	Z9	Above	86	Soil Tube	Monitoring
CPT-24	Z9	Above	118	Soil Tube	Monitoring
CPT-27	Z9	Above	33	Soil Tube	Monitoring
CPT-28	Z9	Above	40	Soil Tube	Monitoring
CPT-28	Z9	Above	87	Soil Tube	Monitoring
CPT-9A ^b	Z9	Above	50	Soil Tube	Monitoring
CPT-9A	Z9	Above	60	Soil Tube	Monitoring
CPT-9A ^b	Z9	Above	64	Soil Tube	Monitoring
Perimeter Sample Locations					
299-W18-1	Z1A/Z18/Z12	Below	211	Groundwater Well	N/A
CPT-13A	Z1A/Z18/Z12	Above	70	Soil Tube	N/A
CPT-2	Z1A/Z18/Z12	Above	40	Soil Tube	N/A
CPT-30	Z1A/Z18/Z12	Above	68	Soil Tube	N/A
CPT-31	Z1A/Z18/Z12	Above	76	Soil Tube	N/A
CPT-33	Z1A/Z18/Z12	Above	80	Soil Tube	N/A
299-W15-216U	Z9	Above	75	Vadose Well	N/A
299-W15-216L	Z9	Below	180	Vadose Well	N/A
299-W15-218U	Z9	Above	106	Vadose Well	N/A
299-W15-218L	Z9	Below	188	Vadose Well	N/A
299-W15-219U	Z9	Above	95	Vadose Well	N/A
299-W15-219L	Z9	Below	175	Vadose Well	N/A
299-W15-220U	Z9	Above	88	Vadose Well	N/A
299-W15-220L	Z9	Below	163	Vadose Well	N/A
299-W15-84	Z9	Below	180	Vadose Well	N/A
299-W15-86	Z9	Below	122	Vadose Well	N/A
CPT-29	Z9	Above	46	Soil Tube	N/A

- a. Soil tubes (CPTs) and wells configured with stainless steel rods employ in-place color-coded sample tubing for sample collection. Contact the project technical lead as necessary for current correlation between tubing color and sample depth.
- b. May correlate to an actual sample depth of 70 ft bgs or 91 ft bgs; sample tubing at CPT-9A was cut by construction workers, leaving some doubt as to which tubing correlates with which depth.

CCU - Cold Creek unit Z18 - 216-Z-18 Crib
 ft bgs - feet below ground surface Z1A - 216-Z-1A Tile Field
 N/A - not applicable Z9 - 216-Z-9 Trench
 Z12 - 216-Z-12 Crib

3.4 Calibration of Field Equipment

Construction Management, the BTR, or the FWS is responsible for ensuring that field equipment is calibrated appropriately. Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. The results from all instrument calibration activities are recorded in logbooks and/or work packages. Either hard copy or electronic calibration activity records are acceptable.

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 by Mission Support Alliance, as specified in their program documentation.
- Daily calibration checks will be performed and documented for each instrument used to characterize areas under investigation. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to nationally or internationally recognized standard agency source or measurement system, if available.

The following field equipment requires calibration:

- The Brüel & Kjær 1302 photoacoustic multi-gas analyzer.

3.5 Sample Location and Frequency

The planned sample locations are shown on Figure 1-2 and Figure 1-3. Note that some locations are sampled at more than one depth. The sample locations and sample depths are listed in Table 3-1. Any deviations from the planned sample locations and depths must be documented, as discussed in Section 3.6.1. The current plan is to sample each location once.

3.6 Sampling Methods

Soil vapor sampling will be conducted in accordance with applicable procedures following "nonroutine" protocols. Split sampling will be conducted for quality assurance purposes.

Soil vapor monitoring will be conducted using sampling methods similar to those developed for the rebound study in 1997 (BHI-01105, *Rebound Study Report for the Carbon Tetrachloride Soil Vapor Extraction Site, Fiscal Year 1997*). A low-flow (0.8 L/min [0.2 gal/min]) sampling pump will be used to draw soil vapor samples from wells and probes into a 1 L (0.3 gal) Tedlar bag for analysis using a Brüel & Kjær multi-gas analyzer. At wells, a tube will be lowered to the target depth where the casing is perforated to minimize the volume of air to be purged. A metal filter attached to the end of the tube also serves as a weight. Some of the wells included in this sampling campaign are already configured with tubing and metal filter, and are sealed at the well head in a manner that will allow sampling. To the extent practicable, the remainder of the sampling locations should be configured in a similar manner. Passive wells, if still configured as passive wells, will be sampled as they have been historically.

Sample preservation, containers, and holding times are presented in Table 3-2.

Table 3-2. Sample Preservation, Container, and Holding Time

CAS Number	Analyte	Matrix	Sampler Container		Preservation	Holding Time
			Number	Type		
56-23-5	Carbon Tetrachloride	Soil Vapor	65 + 3 field duplicates	1 L Tedlar Bag	Immediately place in cooler	Analyze within 6 hours of collection
75-09-2	Methylene Chloride					
56-23-5	Carbon Tetrachloride	Soil Vapor	3 as split samples	6 L Summa Canister	None	Analyze within 14 days of collection
75-09-2	Methylene Chloride					

CAS - Chemical Abstract Service
 L - liter

3.6.1 Corrective Actions and Deviations for Sampling Activities

The Project Manager, FWS, BTR, or designee must document deviations from protocols, problems pertaining to sample collection, chain-of-custody, target analytes, contaminants of potential concern (COPCs), sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions, changes in sample locations because of physical obstructions, or additions of sample depth(s).

As appropriate, such deviations or problems will be documented in the field logbook or on nonconformance report forms in accordance with internal corrective action protocols. The Project Manager, FWS, BTR, or designee will be responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Changes in sample locations not affecting the DQOs will require notification and approval of the Project Manager. Changes to sample locations affecting the DQOs will require concurrence from DOE and lead regulatory agency. Changes to the SAP will be documented, as noted, in Section 2.1.6.

3.6.2 Decontamination of Sampling Equipment

Any non-dedicated sampling equipment will be decontaminated in accordance with the sampling equipment decontamination protocols. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample containers by setting them on or near potential contamination sources (e.g., uncovered ground)
- Handling sample containers or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

3.7 Sampling Handling

Sample packaging, custody, and transportation and container labeling are described in the following subsections.

3.7.1 Packaging

All primary soil vapor samples will be collected in clean Tedlar bags. Three split samples, collected to corroborate in-field Brüel & Kjær 1302 analytical results, will be collected in Summa canisters. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. The Radiological Engineering organization will measure both the contamination levels and dose rates associated with the sample containers. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory’s acceptance criteria. If the dose rate on the outside of a sample container or the curie content exceeds levels acceptable by the laboratory, the FWS (in consultation with SMR) can send smaller volumes to the laboratory. Preliminary container types and volumes are identified in Table 3-3.

Table 3-3. Sample Container Criteria

Sample Type	Container Type	Container Volume
Primary Soil Vapor Sample	Clean Tedlar Bag	1 liter
Field Duplicate Soil Vapor Samples	Clean Tedlar Bag	1 liter
Splits for laboratory analysis	Summa Canister	6 liter

3.7.2 Container Labeling

The sample location, depth, and corresponding HEIS numbers are documented in the sampler’s field logbook. Each sample container will be labeled with the following information on firmly affixed, water resistant labels:

- Sampling authorization form number
- HEIS number
- Sample collection date and time
- Analysis required
- Preservation method (if applicable)

In addition, sample records must include the following information:

- Analysis required
- Source of sample
- Matrix (soil vapor)
- Field data (moisture content)

Custody seals are NOT required for samples collected in Tedlar bags, as sampling personnel deliver samples directly to the analytical facility, so there is no intermediate transfer of custody. Custody seals will be applied to Summa canisters in accordance with applicable procedures.

3.7.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples transported to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. 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 sample shipment and will transmit the copy to SMR within 48 hours of shipping.

The following information is required on a completed chain-of-custody form:

- Project name
- Signature of sampler
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Signatures of individual involved in sample transfer
- Requested analyses (or reference thereto)

3.7.4 Sample Transportation

All Tedlar bag samples will be transported to an in-field location for analysis. Samples collected in Summa canisters will be transported or shipped to the selected analytical laboratory for analysis. Transportation will be in compliance with the applicable procedures and guidance for packaging, marking, and labeling, as well as applicable program-specific implementing protocols.

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4 Management of Waste

All waste (including unexpected waste) generated by sampling and field analysis activities will be managed in accordance with DOE/RL-2000-40, *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-1 and 200-PW-1 Operable Units*. No offsite sample analysis is planned.

If offsite analytical laboratories are used, those laboratories are responsible for the disposal of unused sample quantities. On a monthly basis, the laboratory will coordinate sample disposal and status with SMR by providing a list of samples more than 90 days post-data delivery for which disposal is requested in the following month. The laboratory will also provide on a monthly basis a list of samples disposed in the preceding month that includes disposal date and method or other relevant information. Signed chain-of-custody forms indicating sample disposal will be retained in laboratory case files pending return of case files to the contractor.

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5 Health and Safety

Field operations will be performed in accordance with 10 CFR 851, "Worker Safety and Health Program," health and safety requirements and appropriate Soil and Groundwater Remediation Project requirements. Additionally, work control documents will be prepared to provide further control of site operations. Safety documentation will include an activity hazard analysis and, as applicable, radiological work permits. The sampling and associated activities will implement ALARA practices to minimize the radiation exposure to the sampling team and possible release of radiological contamination, consistent with the requirements defined in 10 CFR 835, "Occupational Radiation Protection."

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6 References

- 10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*. Available at: <http://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part835.xml>.
- 10 CFR 851, "Worker Safety and Health Program," *Code of Federal Regulations*. Available at: <http://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part851.xml>.
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Table 1-1. Decision Statements and Decision Rules

No.	Decision Statement	Decision Rule	Are Additional Data Needed?
	Source References: See references for Decision Statement #3, and EPA, 2011, <i>Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units</i> , U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/region10/pdf/sites/hanford/200/hanford_200_rod.pdf		

CERCLA – *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
 EPA – U.S. Environmental Protection Agency
 ppmv – parts per million by volume
 SVE – soil vapor extraction

Decision rules 3, 4 and 5 do not drive sampling and analysis activities, but do support interpretation of the rebound study results, supporting decision making with respect to attainment of soil vapor extraction goals.

1.9 Contaminants of Potential Concern/Target Analytes

Carbon tetrachloride and methylene chloride are the target analytes. These are the only two contaminants identified in the 200-PW-1 ROD that have soil vapor cleanup levels.

1.10 Sampling Design

The sampling design for the SVE wells/probes is judgmental. In judgmental sampling, selection of the sampling units (i.e., the number and location of sample intervals) is based on knowledge of the feature or condition under investigation and on professional judgment. The sampling locations and depths were selected to provide a current understanding of the concentration of carbon tetrachloride and methylene chloride in the soil vapor in the vadose zone around the 216-Z-9, 216-Z-1A, 216-Z-18, and 216-Z-12 waste sites, both above and below the CCU. Wells/probes at the perimeter of these disposal sites were selected for sampling to support assessment of unidentified contaminant source areas above cleanup levels. Sampling design is addressed in Section 3.3; sample location and frequency are addressed in Section 3.5.

1.11 Project Schedule

The project schedule is presented in Figure 1-4.

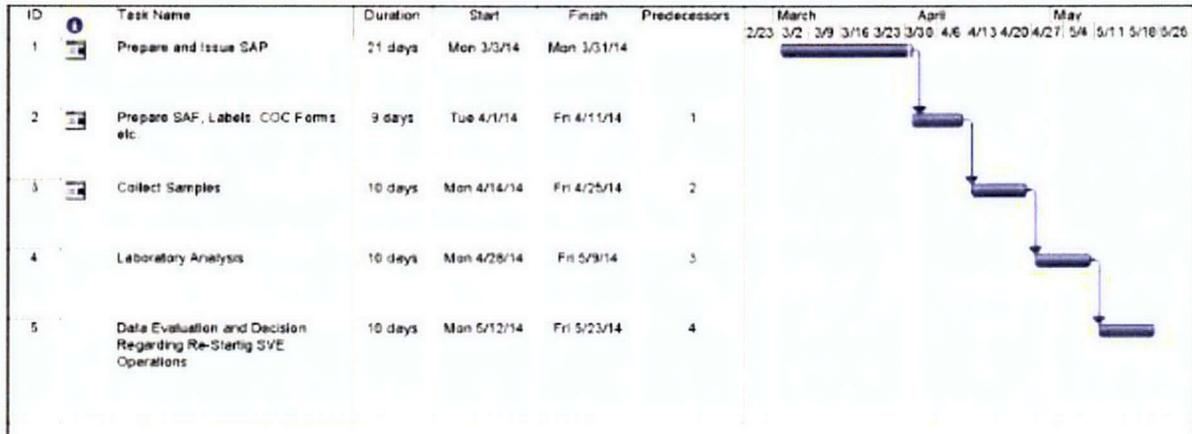


Figure 1-4. Project Schedule

1 Introduction

This sampling and analysis plan (SAP) provides the quality assurance project plan (QAPjP) and field sampling requirements for soil vapor rebound sampling to be conducted using existing soil vapor sampling locations in the 200-PW-1 Operable Unit (OU) in the 200 West Area of the Hanford Site (Figure 1-1). Soil vapor extraction (SVE) has been used to remove carbon tetrachloride and its degradation products (e.g., methylene chloride) from the vadose zone at the 200-PW-1 OU since 1992. The active SVE systems were last shut down in October 2012. Passive SVE wells were taken out of service permanently in March 2013.

Analytical results from this rebound sampling event will support decision making regarding attainment of active SVE remediation goals. Additionally, results will be assessed for evidence of unidentified contaminant source areas above cleanup levels.

1.1 Background

From the time the Z Plant complex (now referred to as the Plutonium Finishing Plant [PFP] Complex) came online in 1949, it generated large volumes of waste effluent. From 1949 until May 1973, effluents from chemical processes and plutonium finishing activities that, under normal operating conditions, contained low levels of plutonium and other contaminants were discharged to the soil column at subsurface engineered waste sites. These engineered waste sites were designed to provide effective disposal of effluent to the soil column, but were operated in a manner intended to limit adverse impacts to groundwater. Three of these waste sites (216-Z-9 Trench, 216-Z-1A Tile Field, and 216-Z-18 Crib) primarily received waste streams from solvent extraction systems. In addition to radiological and inorganic contaminants, these waste streams included significant volumes of organics, principally carbon tetrachloride, tributyl phosphate, and lard oil. The organics were discharged in dissolved phase as part of the aqueous waste streams and as nonaqueous phase liquids (batch discharges of spent solvent). The three sites were operated sequentially from April 1955 until May 1973, being replaced when conditions warranted. A fourth waste site (216-Z-12 Crib) is estimated to have received a small volume of organics including carbon tetrachloride.

In 1992, an expedited response action was initiated at the 200-PW-1 OU to mitigate ongoing impacts to groundwater associated with residual carbon tetrachloride in the vadose zone at these three waste sites. Three SVE systems were used for continuous full-scale operations at each of the three sites from 1992 through 1997. From 1998 through 2008, due to substantial reductions in accessible vapor phase carbon tetrachloride, two of the extraction systems were taken out of service, and the third system was operated seasonally (typically from April through September), and alternated between the 216-Z-9 well field and the combined 216-Z-1A/216-Z-18 well field. From 2009 through 2012, two new SVE systems were operated seasonally, one at the 216-Z-9 well field and one at the combined 216-Z-1A/216-Z-18 well field. Between April 1991 (when the pilot test was conducted) and December 2012, approximately 80,107 kg (176,604 lb) of carbon tetrachloride were removed from the vadose zone using the SVE systems (SGW-54566, *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Calendar Year 2012*).

Passive SVE systems were installed on eight wells in the 216-Z-1A/216-Z-18/216-Z-12 well field in FY 1999. Passive SVE is a natural process driven by barometric pressure fluctuations and often is referred to as "barometric pumping." Between October 1999 and March 2013, when they were taken out of service, the passive SVE wells removed approximately 110 kg (253 lb) of carbon tetrachloride from the vadose zone of the 200-PW-1 OU (SGW-54566).

Carbon tetrachloride concentrations in the extracted soil vapor have decreased significantly at the 216-Z-9 and 216-Z-1A/216-Z-18/216-Z-12 well fields since SVE operations began. Carbon tetrachloride concentrations in soil vapor extracted from the 216-Z-9 well field using the active SVE systems declined from approximately 30,000 ppmv at startup in 1993 to a maximum of 14 ppmv in 2012. Carbon tetrachloride concentrations in soil vapor extracted from the 216-Z-1A/216-Z-18/216-Z-12 well field using the SVE systems declined from approximately 1,500 ppmv at startup in 1992 to a maximum of 11 ppmv in 2012. In the most recent discussion of the conceptual site model (PNNL-21326, *Treatability Test Report: Characterization of Vadose Zone Carbon Tetrachloride Source Strength Using Tomographic Methods at the 216-Z-9 Site*), the remaining carbon tetrachloride mass is likely held in fine-grained layers in the vadose zone, where it is less easily removed using SVE.

The reduction of carbon tetrachloride vapor concentrations in the area remediated using SVE has reduced the threat to human health and to groundwater. However, as carbon tetrachloride concentrations in both groundwater and the vadose zone change, the direction of contaminant movement between these media may change based on the carbon tetrachloride concentration gradients (SGW-37111, *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Fiscal Year 2007*).

The *Record of Decision Hanford 200 Area Superfund Site 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units* (EPA, 2011), hereinafter called the 200-PW-1 ROD, identified both carbon tetrachloride and methylene chloride as contaminants of concern. Table 35 of the 200-PW-1 ROD identifies carbon tetrachloride and methylene chloride as subject to Washington Administrative Code 173-340, *Model Toxics Control Act Cleanup Regulation*, specifying final cleanup levels in soil vapor as 100 ppmv and 50 ppmv, respectively, for protection of groundwater. Analytical results from the most recent soil vapor sampling (March 2013) showed carbon tetrachloride and methylene chloride concentrations were below these cleanup levels in all sampled wells/probes except CPT-28, located roughly 90 m (300 ft) south-southwest of 216-Z-9, where results slightly exceeded the soil vapor cleanup level for carbon tetrachloride.

1.2 Regulatory History

Between February 1992 and October 2011, SVE was operated as an interim action in accordance with “Action Memorandum: Expedited Response Action Proposal for 200 West Area Carbon Tetrachloride Plume” (Smith and Stanley, 1992). In 2012, SVE was operated in accordance with the 200-PW-1 ROD (EPA, 2011), which selected SVE as the final remedial action for vadose zone carbon tetrachloride contamination at these waste sites and the associated vadose zone that received carbon tetrachloride waste liquids. The 200-PW-1 ROD (EPA, 2011) specifies that SVE will continue to be implemented in accordance with the expedited response action until the remedial design/remedial action work plan (RD/RAWP) is approved. The RD/RAWP is to be submitted to the U.S. Environmental Protection Agency (EPA) for review by September 30, 2015 (Section 12.4 of the 200-PW-1 ROD [EPA, 2011]).

1.3 Purpose

The purpose of this SAP is to define sampling and analytical requirements for a soil vapor rebound sampling event in the 200-PW-1 OU. The SAP guides evaluation of the new data in conjunction with previous soil vapor data collected since active SVE systems were put on standby in October 2012, to assess rebound of carbon tetrachloride and methylene chloride in soil vapor. Both the magnitude and trending of rebound will be assessed, to support decision making regarding attainment of active SVE remediation goals. The proposed sampling locations are shown in Figure 1-2 and Figure 1-3.