TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 0878	TPA CHANGE NOTICE FORM	Date: 12/16/19
Document Number, Title, and Revision: DOE/RL-2014-51, *Sampling and Analysis Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*, Rev. 0		Date Document Last Issued: November, 2015
Approved Change Notices Against this Document: TPA-CN-0720, TPA-CN-0796		
Originator: Mark Byrnes		Phone: 509-373-3996

Description of Change:
DOE/RL-2014-51 is revised to expand the number of perched water extraction wells and to add perched water monitoring.

M. W. Cline (**DOE**) and D. Goswami/C. Cameron (**Lead Regulatory Agency**) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records*, and not Chapter 12.0, *Changes to the Agreement*.

Pages 1-1 and 1-6 are modified to update the project scope and objective.

Tables 2-5 and 2-6 on pages 2-16, 2-17, and 2-20 are modified to add quality control requirements for constituents added to Table 3-1, "Sampling Frequency."

Page 3-1 is modified to update the sampling locations. A new figure 3-1 is added on newly added Page 3-1a, and Figure 3-1 on page 3-2 is renumbered to Figure 3-2.

Table 3-1 on pages 3-4 and 3-5 is modified to update the sampling requirements for perched water constituents and operating parameters in Table 3-1.

Additions are shown using double underline. Deletions are shown using ~~strikeout~~.

Note: Include affected page number(s): Pages 1-1, 1-6, 2-16, 2-17, 2-20, 3-1, 3-1a, 3-2, 3-4, and 3-5.

Justification and Impacts of Change:
Twelve new perched water extraction and monitoring wells are planned for installation over the next two years to enhance the extraction rate and monitoring capability for the perched water in the deep vadose zone of the 200-DV-1 Operable Unit. This sampling and analysis plan is modified to add the new extraction and monitoring wells and update the sampling requirements. The actual schedule for installation, construction, and operation of the extraction and monitoring wells will be determined based on priority of Hanford Site work activities and available funding each FY.

Approvals:

DOE Project Manager	12/16/2019 Date	[X] Approved [ ] Disapproved
EPA Project Manager	12/17/19 Date	[X] Approved [ ] Disapproved
Ecology Project Manager	12/16/19 Date	[X] Approved [ ] Disapproved

1. Introduction

This sampling and analysis plan (SAP) describes the field sampling activities for the 200-DV-1 Operable Unit (OU) to support implementation of a non-time-critical removal action in accordance with DOE/RL-2014-37, *Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water Pumping/ Pore Water Extraction* (hereafter referred to as the removal action work plan [RAWP]). The removal action for remediating perched water was selected in DOE/RL-2014-34, *Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*. The selected remedy consists of pumping/extracting water from the 200-DV-1 OU perched zone underlying the B Tank Farm complex in the 200 East Area and transferring the water by tanker truck (or pipeline) to the 200 West Pump and Treat (P&T), where the water is treated to remove contaminants and then injected into the aquifer beneath the 200 West Area.

This removal action will minimize the release, or the threat of release, of hazardous substances from the 200-DV-1 OU perched water zone to the underlying aquifer in the 200-BP-5 OU. The removal action is designed to recover as much perched water as practical while awaiting issuance of the 200-DV-1 OU Record of Decision (ROD). When the 200-DV-1 OU perched water wells no longer yield sufficient amounts of water for extraction (as agreed to by the U.S. Department of Energy [DOE], the U.S. Environmental Protection Agency [EPA], and the Washington State Department of Ecology [Ecology] [known as the Tri-Parties]), the removal action will be terminated. Additional actions, if needed, will be identified in the 200-DV-1 OU ROD. The removal action is consistent with the overall Hanford Site cleanup initiative and will, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action, as required by 40 CFR 300.415(d), "National Oil and Hazardous Substances Pollution Contingency Plan," "Removal Action."

This SAP consists of six chapters, with the remainder of this chapter addressing the project scope and objective, contamination and geologic background, contaminants of concern (COCs), regulatory history, and data quality objectives (DQOs). Chapter 2 discusses quality assurance (QA) requirements. Chapter 3 provides the field sampling plan, and Chapter 4 addresses the waste management plan. Chapter 5 discusses health and safety requirements, and Chapter 6 provides a reference list of the documents cited in this SAP.

1.1 Project Scope and Objective

The primary objective of this SAP is to collect and analyze perched water samples from ~~three~~ perched water extraction wells ~~(299-E33-344, 299-E33-350, and 299-E33-351)~~, perched water monitoring wells, and an aboveground container at the 200-DV-1 OU perched water site. Data from the perched water zone will also be obtained during the extraction activity. The data will be used to support treatment of the water at the 200 West P&T and to support decisions on adjusting, transitioning, or terminating the extraction system operations at the 200-DV-1 OU perched water zone. The actual schedule for installation, construction, and operation of the extraction and monitoring wells will be determined based on priority of Hanford Site work activities and available funding each FY.

1.2 Background

Contaminated perched water has been encountered in the deep vadose zone in portions of the B Complex area since 1991. During the drilling of groundwater monitoring well 299-E33-344 for the unconfined aquifer in the 200-BP-5 OU, radiological contamination levels found in the perched water were higher than anticipated. As a result, drilling was terminated, and the well was configured as an extraction well for the 200-DV-1 OU perched water (SGW-39626, *Borehole Summary Report for the Installation of*

Seven Groundwater Monitoring Wells at the 200-BP-5 Operable Unit, CY 2008). In August 2011, extraction was begun to collect information on the perched water and reduce contaminant migration to

216-B-8 Crib (Figure 1-2). The major sources of the contaminated water are thought to be the 200-DV-1 OU waste sites (e.g., 216-B-7A&B and 216-B-8 Cribs), which were used for subsurface infiltration of liquid wastes, and single-shell tank 241-BX-102, which released liquid waste to the subsurface when it was inadvertently overfilled (SGW-58147).

1.4 Regulatory History

Perched water extraction was initiated in August 2011 in the first phase of a treatability test. The first phase is referred to as "gravity drain" because recharge of the extraction well occurs naturally. Two additional phases of perched water extraction may also be considered. The second phase of perched water pumping would add a vacuum system to accelerate recharge into the well. Based on the results of the enhanced perched water pumping using the vacuum system, a third phase could be implemented to extract pore water in the perched zone. The treatability test is described in DOE/RL-2011-40, *Field Test Plan for the Perched Water Pumping/Pore Water Extraction Treatability Test*, and DOE/RL-2011-37, *Sampling and Analysis Plan for the Perched Water Pumping/Pore Water Extraction Treatability Test*. As of September 30, 2014, the vacuum-enhanced recovery and the pore water extraction phases of the treatability test plan have not been implemented because the natural recharge rate has been sufficient to maintain pumping from the extraction well.

In January 2014, DOE/RL-2013-37, *Engineering Evaluation/Cost Analysis for Perched Water Pumping/Pore Water Extraction*, was prepared to evaluate alternatives for continued extraction of perched water as a non-time-critical removal action under the *Comprehensive Environmental Response, Compensation, and Liability Act of* 1980 (CERCLA). A 30-day public and Tribal Nations review of the engineering evaluation/cost analysis was held from February 3 through March 3, 2014. The action memorandum (DOE/RL-2014-34) that documents selection of the alternative for extraction and treatment of the perched water as a non-time-critical removal action was issued in December 2014. The removal action is being implemented in accordance with the RAWP (DOE/RL-2014-37). This SAP describes the field activities for the collection of water samples and perched water zone physical and chemical characteristics in support of the RAWP.

1.5 Contaminants

Contaminants identified in the 200-DV-1 OU perched water include both radioactive and chemical hazardous substances. The COCs established for this removal action apply to water removed from the perched water zone for treatment and not to the perched water layer remaining in the deep vadose zone. Table 1-1 lists the COCs and other radioactive and nonradioactive constituents in perched water samples obtained from well 299-E33-344, as identified in Table 1 of the action memorandum (DOE/RL-2014-34). These additional constituents were determined not to pose an impact to the 200 West P&T. The COCs, with the exception of tritium, will be treated at the 200 West P&T to below MCLs to meet the P&T injection criteria. There is no treatment method for tritium, but the resulting combined discharge concentration from the 200 West P&T is expected to be below the MCL for tritium, and for nitrate for the duration of the 200-ZP-1 optimization study plan (DOE/RL-2019-38)

1.6 Data Quality Objectives Summary

The DQO process is a strategic planning approach for defining the criteria that a data collection design should satisfy for the current SAP objectives. The DQO process ensures that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended application. This section presents a summary of the key outputs resulting from the DQO process.

Table 2-4. Project QC Requirements

Sample Type	Frequency	Characteristics Evaluated

a. For portable pumps, one EB is collected for every 10 well trips. Whenever a new type of nondedicated equipment is used, an EB will be collected every time sampling occurs until it can be shown that less frequent collection of EBs is adequate to monitor the decontamination methods for the nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., all Hanford Site groundwater).

c. Unless not required by, or different frequency is called out in, laboratory analysis methods.

DUP = field duplicate
EB = equipment blank
FTB = full trip blank
LCS = laboratory control sample
MB = method blank
MS = matrix spike
MSD = matrix spike duplicate
SPLIT = field split
SUR = surrogate

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
General Chemical Parameters			
Alkalinity Conductivity Hexavalent chromium pH Total inorganic carbon Total organic carbon Total dissolved solids	MB[b]	< MDL <5% sample concentration	Flagged with "C"
	LCS	80 – 120% recovery[c]	Data reviewed[d]
	Laboratory duplicate [g] or MS/MSD [h]	≤20% RPD	Data reviewed[d]
	Post-preparation spike[b]	75 – 125% recovery[c]	Flagged with "N"
	EB	<2 times MDL	Flagged with "Q"
	DUP[g]	≤20% RPD[e]	Flagged with "Q"
Ammonia, Anions, and Cyanide			
Anions by IC	MB	< MDL <5% sample concentration	Flagged with "C"
	LCS	80 – 120% recovery[c]	Data reviewed[d]
	Laboratory duplicate [g] or MS/MSD [h]	≤20% RPD	Data reviewed[d]
	MS [h]	75 – 125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	DUP [g]	≤20% RPD[e]	Flagged with "Q"
Cyanide (Total)/Cyanide (Free)	MB	≤ MDL <5% sample concentration	Flag with "C"
	LCS	80 – 120% recovery	Flag with "o" [g]
	Laboratory duplicate [e] or MS / MSD [h]	≤20% RPD	Review data [d]

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
	MS / MSD [h]	75 – 125% recovery	Flag with "N"
	EB. FTB	< MDL <5% sample concentration	Flag with "Q"
	DUP [e]	≤20% RPD	Review data [d]
Sulfide	MB	< MDL <5% sample concentration	Flag with "C"
	LCS	80 – 120% recovery	Flag with "o" [g]
	Laboratory duplicate [e] or MS / MSD [h]	≤20% RPD	Review data [d]
	MS / MSD [h]	75 – 125% recovery	Flag with "N"
	EB. FTB	< MDL <5% sample concentration	Flag with "Q"
	DUP [e]	≤20% RPD	Review data [d]
Metals			
ICP metals ICP/MS metals Mercury	MB	< RDL <5% sample concentration	Flagged with "C"
	LCS	80 – 120% recovery[c]	Data reviewed[d]
	MS [h]	75 – 125% recovery[c]	Flagged with "N"
	MSD [h]	75 – 125% recovery[c]	Flagged with "N"
	MS/MSD [h]	≤20% RPD	Data reviewed[d]
	EB, FTB	<2 times MDL	Flagged with "Q"
	DUP [e]	≤20% RPD[e]	Flagged with "Q"
Radiochemical Analyses			
Carbon-14 Iodine-129 Technetium-99 Tritium ~~Uranium (total)~~	MB	< MDA <5% sample concentration	Flagged with "B"
	LCS	70 – 130% recovery	Data reviewed[d]
	Laboratory duplicate[e]	≤20% RPD	Data reviewed [d]
	MS[f]	60 – 140% recovery	Flagged with "N"
	Tracer (where applicable)	20 – 105% recovery	Data reviewed[d]
	Carrier (where applicable)	30 – 105% recovery	Data reviewed[d]
	EB, FTB	<2 times MDA	Flagged with "Q"
	DUP [e]	≤20% RPD	Flagged with "Q"

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
AEA (Uranium isotopes)	MB	< MDC <5% sample activity concentration	Flag with "B"
	LCS	80 – 120% recovery or statistically derived limits [c]	Flag with "o" [g]
	Laboratory duplicate [e]	≤20% RPD	Review data [d]
	Tracer	30 – 105% recovery	Review data [d]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	DUP [e]	≤20% RPD	Review data [d]

a. Specific analytes and method for determination are available from the SMR organization.

b. Does not apply to pH, conductivity, total residue, total suspended solids, total dissolved solids, or alkalinity.

c. Determined by the laboratory based on historical data or statistically derived control limits. Limits are reported with the data. Where specific acceptance criteria are listed, those acceptance criteria may be used in place of statistically derived acceptance criteria.

d. After review, corrective actions are determined on a case-by-case basis.

e. ~~Applies only in cases where both results are greater than five times the minimum detectable concentration.~~ Applies when at least one result is greater than the laboratory PQL (chemical analyses) or greater than five times the MDC (radiochemical analyses).

f. Applies only to isotopic technetium-99, total uranium by ICP/MS, and tritium.

g. The reporting laboratory will apply the "o" flag with SMR concurrence.

h. Either a sample duplicate or a MSD is to be analyzed to determine measurement precision (if there is insufficient sample volume, an LCSD is analyzed with the acceptance criteria defaulting to the DUP/MSD criteria)

AEA = alpha energy analysis
DUP = duplicate
EB = equipment blank
FTB = full trip blank
IC = ion chromatography
ICP = inductively coupled plasma
ICP/MS = inductively coupled plasma/mass spectrometry
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
MB = method blank
MDA = minimum detectable activity
MDC = minimum detectable concentration
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PQL = practical quantitation limit
QC = quality control
RPD = relative percent difference
SMR = Sample Management and Reporting

Data flags:

B (organics)/C (inorganics/wetchem) = analyte was detected in both the associated QC blank and the sample

N = all except gas chromatography/mass spectrometry – matrix spike outlier

o = result may be biased; associated LCS result was outside the acceptance limits

Q = associated QC sample is out of limit

Table 2-6. Preservation, Container, and Holding-Time Guidelines

Constituent Parameter	Minimum Volume	Container Type[a]	Preservation[b]	Holding Time
Metals[c]				
ICP/MS (with/without mercury)	500 mL	Narrow-mouth poly or glass	Adjust pH to <2 with nitric acid	28 days/6 months[c]
Dissolved metals (with/without mercury)	500 mL	Narrow-mouth poly or glass	Filter prior to pH adjustment to <2 with nitric acid	28 days/6 months[c]
Inorganic – Miscellaneous				
Hexavalent chromium	60 mL	Amber glass	Store at ≤6°C	24 hours
Anions, General Chemistry Parameters				
Chloride	500 mL	Poly or glass	Store at ≤6°C	28 days
Fluoride	500 mL	Poly or glass	Store at ≤6°C	28 days
Nitrate	500 mL	Poly or glass	Store at ≤6°C	48 hours
Nitrite	500 mL	Poly or glass	Store at ≤6°C	48 hours
Sulfate	500 mL	Poly or glass	Store at ≤6°C	28 days
Cyanide (Total) / Cyanide (Free)	500 mL	Poly or glass	NaOH to pH >= 12 Cool ≤6°C	14 days [d,e,f]
Sulfide	500 mL	Poly or glass	ZnAc+NaOH to pH ≥ 9 Cool ≤6°C	7 days [d,e,f]
Radiochemical Analyses				
Carbon-14	2 × 1 L	Narrow-mouth poly or glass	None	6 months
Iodine-129	2 × 4 L	Narrow-mouth poly or glass	None	6 months
Technetium-99 by liquid scintillation	1 L	Narrow-mouth glass	Adjust pH to <2 with HCl	6 months
Tritium	1 L	Narrow-mouth glass	None	6 months
AEA (Uranium isotopes)	1 L	Narrow-mouth poly or glass	HNO3 to pH < 2	6 months[g]
Other Analyses[d-h]				
Isotopic analysis (O-18/O-16 and H-2/H-1)	1 L	Narrow-mouth poly	Filter	6 months
Major ions	1 L	Poly or glass	Anions – store at ≤6°C Cations – adjust pH to <2 with nitric acid	Anions – 28 days/48 hours Cations – 6 months

Table 2-6. Preservation, Container, and Holding-Time Guidelines

Constituent Parameter	Minimum Volume	Container Type[a]	Preservation[b]	Holding Time

Notes:

The information in this table does not represent EPA requirements but is intended solely for use as guidance.

Selection of containers, preservation techniques, and applicable holding times should be based on the stated project-specific DQOs.

a. Under the "Container" heading, the term "poly" stands for EPA clean polyethylene bottles.

b. For preservation identified as "store at ≤6°C," the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

c. For metals analysis, the 28 days/6 months holding-time defines 28 days for mercury and 6 months for all other metals.

d. 40 CFR 136, Table II.

e. SW-846, Table 3-2.

f. SW-846, Table 2-40(B).

g. DOE/RL-96-68, Vol. 2, Appendix A.

~~d~~h. These analyses will be performed at PNNL and will be conducted in accordance with PNNL procedures, QC standards, and analytical performance requirements.

EPA = U.S. Environmental Protection Agency
ICP/MS = inductively coupled plasma/mass spectrometry
PNNL = Pacific Northwest National Laboratory
QC = quality control

3 Field Sampling Plan

This chapter identifies the locations to be sampled, the sampling frequency, the data to be collected, and the contaminants to be analyzed.

3.1 Sampling Objectives

The main sampling objectives for the perched water removal action are to (1) assess the recovered masses and concentrations of the COCs, (2) measure the volume of extracted water, (3) optimize the extraction system operations, and (4) investigate the perched zone characteristics. These objectives are accomplished by obtaining perched water data at the ~~three~~ extraction and monitoring wells and from the perched water container. The samples will be analyzed for COCs, and hydraulic data for the perched zone will be collected. The data will be used for the treatment of perched water at the 200 West P&T and to support decisions on adjusting, transitioning, or terminating the 200-DV-1 OU perched zone extraction system.

3.2 Sample Location, Frequency, and Constituents to Be Monitored

The following subsections provide details for the sampling activities performed under this SAP. This includes sample locations, sample identification, sampling frequency, sampling methods, and shipping requirements.

3.2.1 Sampling Location

Figure ~~1-2~~3-1 shows the locations of the ~~three~~ extraction and monitoring wells located within the perched water zone. During perched water extraction operations, samples will be drawn from the sampling port located on the pipe that transports water from the extraction wells to the perched water container. Figure ~~3-1~~3-2 shows the operational flow diagram at the wellhead. Samples will also be drawn from the sampling port on the perched water container. Samples will be collected from monitoring wells using a downhole pump. The sample number, well number, and perched water container identification number will be documented (e.g., in the field logbook) for each perched water sample collected.

At the startup of the gravity drain extraction operations under this removal action, perched water samples will be collected from all three initial extraction wells (299-E33-344, 299-E33-350, and 299-E33-351).

3.2.1.1 Sample Identification

The SMR organization will use a sample tracking database to track the perched water samples from collection through the laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. HEIS sample numbers will be issued to the sampling organization for this project. The radiological and physical properties of each sample will be identified and labeled with a unique HEIS sample number. The sample location and corresponding HEIS numbers will be documented in the sampler's field logbook. Each sample container will be labeled with the following information, using a waterproof marker on firmly affixed, water-resistant labels:

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

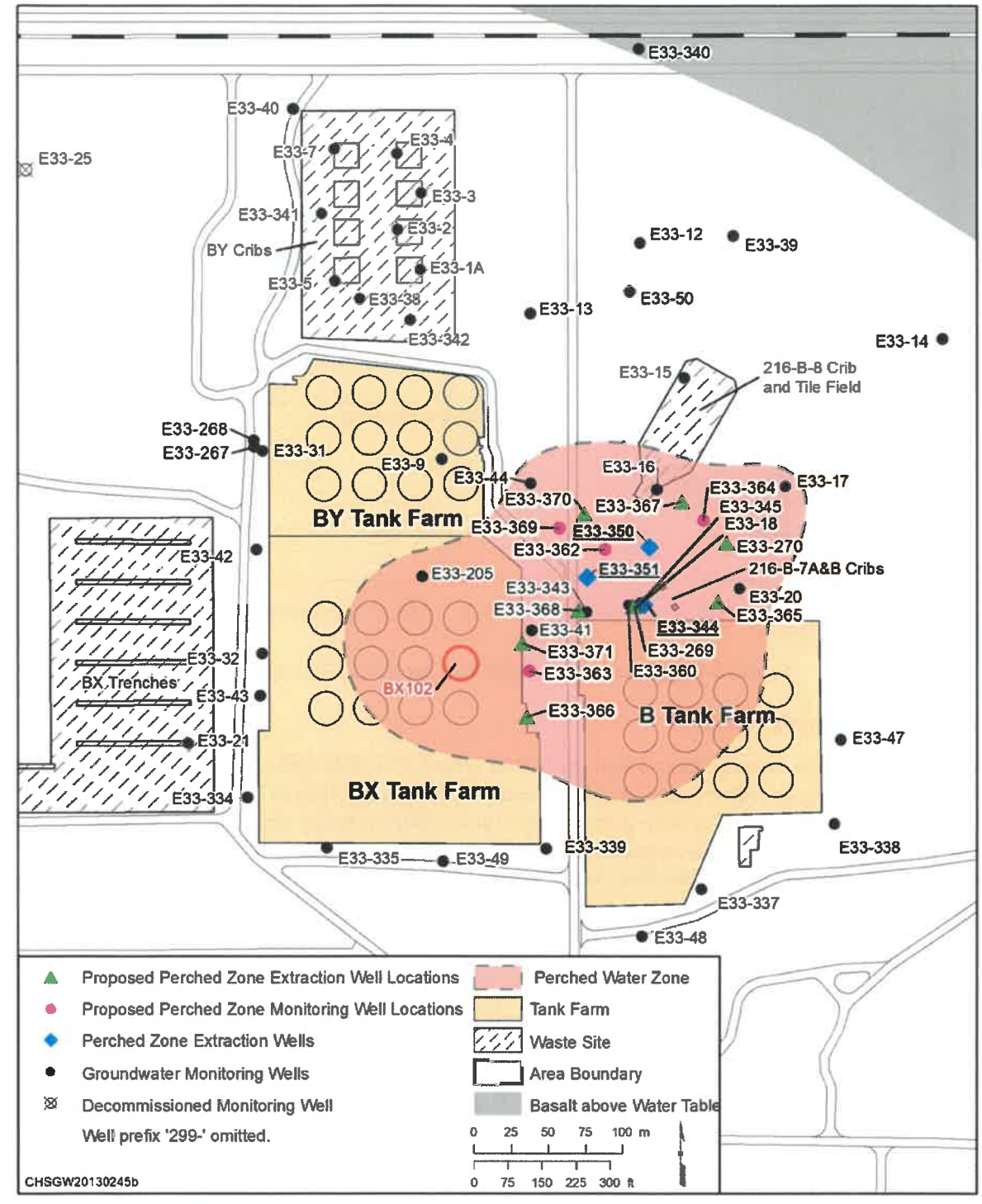
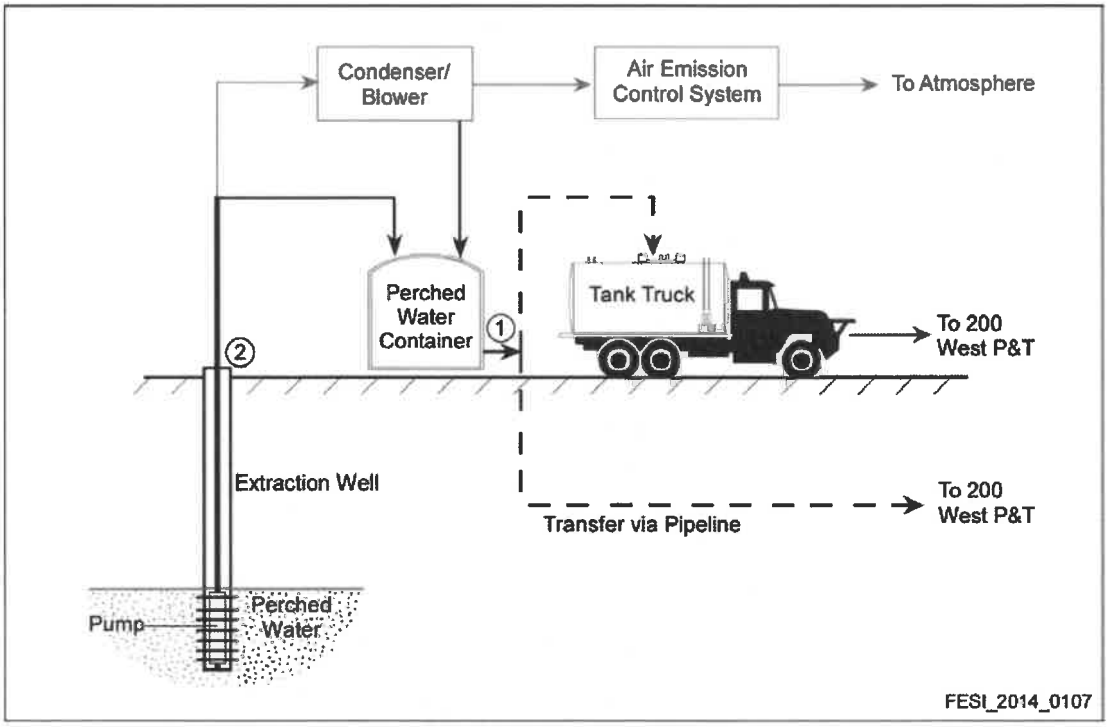


Figure 3-1. Location of Perched Water Extraction and Monitoring Wells.



Note: Sampling location marked as "1" to satisfy DS #1, DS #2, and DS #3; sampling location marked as "2" to satisfy DS #4 and DS #5.

Figure ~~3-1~~3-2. 200-DV-1 OU Well Field Operational Flow Diagram

3.2.1.2 Field Sample Logbook

Information pertinent to sampling and analysis will be recorded on field data forms and in bound logbooks in accordance with existing sample collection protocols specified in HASQARD (DOE/RL-96-68). The sampling team is responsible for recording relevant sampling information. Logbook entries will be dated and signed by the individual making the entry. Program requirements will be followed for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records.

3.2.1.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site sampling protocol. The custody of samples will be maintained from the time that samples are collected until ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to the laboratory. Sample shipping procedures will be followed throughout sample shipping. Each chain-of-custody form will include the HEIS sample identification number, associated well identification number, and remediation system designation.

The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, storage, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility for the custody of the sample changes, the new and previous custodians will sign the record and note the date and time.

and is being sampled on a quarterly basis; arsenic is a non-COC and is being sampled on an annual basis. Cadmium and manganese are not perched water COCs and, therefore, will be monitored during the vacuum-enhanced recovery phase. For radiological contaminants, the unabated potential to emit is considered a minor source; therefore, only periodic confirmatory measurements are required for radiological monitoring.

Table 3-1. Sampling Frequency

Media	Constituent	CAS No.	Sampling Frequency from Perched Water Wells and Container
Perched water	**COCs**		
	Technetium-99	14133-76-7	Once per quarter
	Tritium	10028-17-8	Once per quarter
	Chromium (total) [a]	7440-47-3	Once per quarter
	Hexavalent chromium [a]	18540-29-9	Once per quarter
	Nitrate as N	14797-55-8	Once per quarter
	Uranium [a]	7440-61-1	Once per quarter
	Non-COCs		
	Carbon-14	14762-75-5	Semiannual
	Iodine-129	15046-84-1	Annual
	Uranium-233	103968-55-3	Annual
	Uranium-234	103966-29-5	Annual
	Uranium-235	15117-96-1	Annual
	Uranium-238	U-238	Annual
	Arsenic [a]	7440-38-2	Annual
	Calcium [a]	7440-70-2	Annual
	Cadmium [a, ab]	7440-43-9	Annual
	Chloride	16887-00-6	Annual
	Fluoride	16887-00-6	Annual
	Iron [a]	7439-89-6	Annual
	Magnesium [a]	7439-95-4	Annual
	Manganese [a, ab]	7439-96-5	Annual
	Molybdenum [a]	7439-98-7	Annual
	Nickel [a]	7440-02-0	Annual
	Nitrite as N	14797-65-0	Annual

Table 3-1. Sampling Frequency

Media	Constituent	CAS No.	Sampling Frequency from Perched Water Wells and Container
	Potassium [a]	7440-09-7	Annual
	Sodium [a]	7440-23-5	Annual
	Sulfate	14808-79-8	Annual
	Sulfide	18496-25-8	Annual
	Total inorganic carbon	TINC	Quarterly
	Total organic carbon	TOC	Quarterly
	Total dissolved solids	TDS	Quarterly
	Alkalinity	ALKALINITY	Quarterly
	Bicarbonate alkalinity	HCO3ALKALINITY	Quarterly
	Carbonate alkalinity	CO3ALKALINITY	Quarterly
	Cyanide, free	FREE-CN	Quarterly
	Isotopic analyses (O-18/O-16 and H-2/H-1)[b,c]	—	Once at startup[d]
	Other analyses (magnesium, potassium, bicarbonate alkalinity, carbonate alkalinity, total inorganic carbon, total organic carbon, total dissolved solids)[d]	—	Once at startup[d]
Field/operational parameters	Barometric pressure [c]	—	Continuous
	Extracted flow rate	—	Continuous
	Conductivity	—	Once per quarter
	Dissolved oxygen	—	Once per quarter
	~~Oxidation-reduction potential~~	—	~~Once per quarter~~
	pH	—	Once per quarter
	Temperature	—	Once per quarter
	Turbidity	—	Once per quarter
	Water level (well)	—	Continuous
	Water level (container)	—	Once per shipment

Table 3-1. Sampling Frequency

Media	Constituent	CAS No.	Sampling Frequency from Perched Water Wells and Container

a. Both filtered and unfiltered samples will be collected for all metal constituents except hexavalent chromium (filtered only).

~~a~~b. Sample only when using the vacuum-enhanced recovery extraction technology.

~~b~~c. These analyses will be performed by PNNL and will be conducted in accordance with PNNL procedures, QC standards, and analytical performance requirements.

d. These analytes were specified for the initial startup of the extraction system using wells 299-E33-344, 299-E33-350, and 299-E33-351.

e. Barometric pressure readings will be taken from the nearest in-service Hanford Site barometric station to a well at the approximate time of sampling.

CAS = Chemical Abstracts Service
COC = contaminant of concern
PNNL = Pacific Northwest National Laboratory
QC = quality control

At the startup of the gravity drain extraction operations under this removal action, perched water samples, along with operational and physical parameters, will be collected from all three initial extraction wells. All chemical (except for cadmium and manganese) and radiological parameters will be analyzed for baseline development purposes. For COCs and physical parameters, the sampling activity will be repeated every quarter thereafter. The sampling frequency for the non-COC carbon-14 is semiannual and annual for all other non-COCs.

At the startup of the vacuum-enhanced recovery operations, perched water samples will be obtained from all operational wells. Physical parameters will also be obtained. All chemical (including cadmium and manganese) and radiological parameters will be analyzed for baseline development purposes. For COCs