

TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 0893	TPA CHANGE NOTICE FORM	Date: June 26, 2020
Document Number, Title, and Revision: DOE/RL-2011-104, <i>Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit, Rev. 0</i>		Date Document Last Issued: January, 2012
Approved Change Notices Against this Document: TPA-CN-668, TPA-CN-724, TPA-CN-0748, TPA-CN-0884		
Originator Mark E. Byrnes		Phone: 509-373-3996

Description of Change:

Changes are required to the DOE/RL-2011-104, *Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit*, in order to conduct resampling and discrete analysis of soil samples from waste site 216-S-13.

 M. W. Cline and C. Cameron/D. Goswami agree that the proposed change
DOE **Lead Regulatory Agency**

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*.

Updated Table 2-2 to revise method name and required detection limits for total uranium. Revised required detection limits and methyl isobutyl ketone (MIBK).

Revised Section 2.2.4 to include analytical methods described in DOE/RL-2011-104, Addendum 1, *Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit Addendum 1: Attenuation Process Characterization for use for the new borehole for resampling at 216-S-13*.

Revised Table 3-1 to add the new borehole for resampling at 216-S-13. The borehole will be drilled through the approximate center of the crib and vadose zone soil will be sampled and analyzed for the applicable contaminants of potential concern (COPC) listed in Table 1-2 of DOE/RL-2011-104, Rev 0. In addition, groundwater will be collected from three discrete depths within the top of aquifer and analyzed for MIBK and the 200-UP-1 contaminants of concern (COCs). The 200-UP-1 COCs include carbon tetrachloride, chromium (total and hexavalent), iodine-129, nitrate, technetium-99, tritium, uranium, trichloroethylene, chloroform, strontium-90, and 1,4-dioxane (DOE/RL-2014-27, Revision 2, *Sampling and Analysis Plan for Remediation Wells in the 200-UP-1 Operable Unit*). Information on passive soil gas sampling and pore fluid sampling was also added to Table 3-1.

Made the following revisions to Section 3.1.3.2, 216-S-13 Crib:

- Revised the text in Section 3.1.3.2 to include general information for the new borehole for resampling. In addition added information on passive soil gas sampling and pore fluid sampling
- Added Figure 3-29 showing conceptual layout of the passive soil gas sampling grid
- Revised Figure 3-30 to add the new borehole
- Revised Figure 3-31 to add the new borehole and proposed sampling intervals
- Revised Table 3-17 by adding a new line for the new borehole and updating the sample numbers

Added Section 3.2.9 to provide information on the pore fluid sampling equipment and process.

Added Section 3.2.10 to provide information on the passive soil gas sampling equipment and process.

New pages are added to accommodate additional text.

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

Note: Include affected page number(s): 2-10, 2-11, 2-17, 2-17a, 3-2a, 3-63, 3-63a, 3-63b, 3-64, 3-65, 3-66, 3-66a, 3-79, and 3-79a.

Continued on Page 2

Approvals:

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DOE Project Manager	Date		
_____	_____	<input checked="" type="checkbox"/> Approved <input type="checkbox"/> Disapproved	
EPA Project Manager	Date		
_____	_____	<input checked="" type="checkbox"/> Approved <input type="checkbox"/> Disapproved	
Ecology Project Manager	Date		

Justification and Impacts of Change:

Methyl isobutyl ketone (MIBK), uranium, and hexavalent chromium were insufficiently characterized during the initial field effort at waste site 216-S-13; therefore, resampling is needed. One borehole at waste site 216-S-13 is needed to collect soil samples for characterization and evaluation of applicable radiological, inorganic, and organic constituents. In addition, the borehole will be drilled up to 25 feet below the water table. Groundwater samples will be collected from depths of 5, 10, and 25 feet below the water table and analyzed for MIBK and the 200-UP-1 COCs (DOE/RL-2014-27, Rev 2). The field work is anticipated to take place during FY2021. The actual schedule for installation of this borehole will be determined based on priority of Hanford Site Work activities and available funding each fiscal year.

Table 2-2. Analytical Performance Requirements for Nonradionuclides

COPC	Chemical Abstracts Service No.	Preliminary Action Level ^a (mg/kg)				Hanford Site Background ^e	Name/ Analytical Technology ^h	Required Detection Limits (mg/kg) ^f		Soil ^g (%)		Water ^g (%)	
		Direct Contact, WAC 173-340 ^b (mg/kg)		Groundwater Protection ^c	Ecological Indicator Concentration (mg/kg) ^d			Water (mg/L)	Soil (mg/kg)	Precision	Accuracy	Precision	Accuracy
		Method C Industrial	Method B Unrestricted										
Uranium (total)	7440-61-1	10,500	240	1.32	5	3.21	U total – kinetic phosphorescence analysis or EPA Method 200.8 or EPA Method 6020	0.004 0.001 05	1	≤30	70-130	≤20	80-120
Inorganics													
pH (corrosivity)	pH	--	--	--	--	--	EPA Method 9045 or SM4500 PH or EPA Method 150.1 or EPA Method 9040	0.1 pH unit	0.1 pH unit	≤30	70-130	≤20	80-120
Ammonia/ ammonium	7664-41-7	--	--	--	--	28	EPA Method 350.1 ⁱ or EPA Method 300.7 ^j	0.05	0.5	≤30	70-130	≤20	80-120
Chloride	16887-00-6	--	--	1,000	--	100	EPA Method 300.0	0.2	2	≤30	70-130	≤20	80-120
Cyanide	57-12-5	70,000	1,600	0.80	--	--	EPA Method 9010 or EPA Method 9014 or SM4500E CN	0.005	0.5	≤30	70-130	≤20	80-120
Fluoride	16984-48-8	210,000	4,800	24.1	--	200 (as fluorine)	EPA Method 300.0 ^k – IC	0.5	5	≤30	70-130	≤20	80-120
Nitrate	14797-55-8	Unlimited	128,000	40	--	52	EPA Method 300.0 ^k – IC	0.25	2.5	≤30	70-130	≤20	80-120
Nitrite	14797-65-0	350,000	8,000	4	--	--	EPA Method 300.0 ^k – IC	0.25	2.5	≤30	70-130	≤20	80-120
Phosphate	14265-44-2	N/A	N/A	--	--	0.79	EPA Method 300.0 ^k – IC	0.5	5	≤30	70-130	≤20	80-120
Sulfate	14808-79-8	N/A	N/A	1,030	--	237	EPA Method 300.0 ^k – IC	0.5	5	≤30	70-130	≤20	80-120
Organics													
Acetone	67-64-1	Unlimited	72,000	28.9	--	--	EPA Method 8260 – GC/MS	0.02	0.02	≤30	(q)	≤20	(q)
Benzene	71-43-2	2,390	18.2	0.00483	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
<i>n</i> -Butyl Benzene	104-51-8	140,000	3,200	110	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Carbon Tetrachloride	56-23-5	1,010	7.69	0.031	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Chlorobenzene	108-90-7	70,000	1,600	0.874	40	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Chloroform (trichloromethane)	67-66-3	21,500	164	0.0381	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
1,1-Dichloroethane	75-34-3	350,000	8,000	4.37	--	--	EPA Method 8260 – GC/MS	0.01	0.01	≤30	(q)	≤20	(q)
1,2-Dichloroethane	107-06-2	1,440	11	0.00232 below RDL ⁿ	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
<i>trans</i> -1,2-Dichloro- ethylene	156-60-5	70,000	1,600	0.543	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
<i>cis</i> -1,2-Dichloro- ethylene	156-59-2	35,000	800	0.35	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Ethylbenzene	100-41-4	350,000	8,000	6.1	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)

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COPC	Chemical Abstracts Service No.	Preliminary Action Level ^a (mg/kg)				Hanford Site Background ^e	Name/ Analytical Technology ^h	Required Detection Limits (mg/kg) ^f		Soil ^g (%)		Water ^g (%)	
		Direct Contact, WAC 173-340 ^b (mg/kg)		Groundwater Protection ^c	Ecological Indicator Concentration (mg/kg) ^d			Water (mg/L)	Soil (mg/kg)	Precision	Accuracy	Precision	Accuracy
		Method C Industrial	Method B Unrestricted										
Methyl Ethyl Ketone (MEK; 2-butanone)	78-93-3	Unlimited	48,000	19.6	--	--	EPA Method 8260 – GC/MS	0.01	0.01	≤30	(q)	≤20	(q)
Methyl Isobutyl Ketone (MIBK, hexone, 4-methyl-2-pentanone)	108-10-1	280,000	6,400	2.71	--	--	EPA Method 8260 – GC/MS	0.01 0.0105	0.01 0.02	≤30	(q)	≤20	(q)
Methylene Chloride (dichloromethane)	75-09-2	17,500	133	0.0218	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Phenol	108-95-2	Unlimited	24,000	11	--	--	EPA Method 8270 GC/MS	0.01	0.33	≤30	(q)	≤20	(q)
Polychlorinated biphenyls ^o	1336-36-3	65.6	0.5	0.0165 ⁿ	0.65	--	EPA Method 8082 – GC	0.0005	0.0165	≤30	(q)	≤20	(q)
Tetrachloroethylene	127-18-4	243	1.85	0.00086	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Toluene	108-88-3	28,000	6,400	4.65	200	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Tributyl Phosphate	126-73-8	24,300	185	0.68	--	--	EPA Method 8270 – GC/MS	0.1	3.3	≤30	(q)	≤20	(q)
Trichloroethane; 1,1,1	71-55-6	Unlimited	72,000	1.58	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Trichloroethylene	79-01-6	328	2.5	0.00072	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Xylene (total)	1330-20-7	700,000	16,000	14.6	--	--	EPA Method 8260 – GC/MS	0.005	0.005	≤30	(q)	≤20	(q)
Total petroleum hydrocarbons – diesel to oil range (kerosene)	TPH DIESEL, TPH KEROSENE	2,000 ^l	2,000 ^l	2,000	200	--	NWTPH-D ^p	0.5	5	≤30	(q)	≤30	(q)
Soil Physical Properties													
Bulk Density	N/A	N/A	--	N/A	N/A	--	ASTM D2937-04, <i>Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method</i> ^p	--	Wt %	N/A	N/A	N/A	N/A
Moisture Content	N/A	N/A	--	N/A	N/A	--	ASTM D2216-05, <i>Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass</i> ^p	--	Wt %	N/A	N/A	N/A	N/A
Particle Size Distribution	N/A	N/A	--	N/A	N/A	--	ASTM D422, <i>Sieve Analysis</i> ^p	--	Wt %	N/A	N/A	N/A	N/A

2.2.2 Sampling Methods

Section 3.2 of the SAP describes the sampling methods. The specific information includes the following:

- Field sampling methods
- Corrective actions for sampling activities
- Decontamination of sampling equipment
- Radiological field data

2.2.3 Sample Handling and Custody

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

Laboratory analytical results are entered and maintained in HEIS. 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.

Section 3.5 of the SAP provides the following specific sample handling information:

- Sample packaging
- Container labeling
- Sample custody requirements
- Sample 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 Sample Management and Reporting.

2.2.4 Analytical Methods

Information on analytical methods is provided in Tables 2-1, 2-2, and 2-3. 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 offsite 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 Tables 2-1, 2-2, and 2-3 must be approved by the Sample Management and Reporting organization in consultation with the 200-DV-1 OU Project Manager.

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 the Sample Management and Reporting organization in coordination with the 200-DV-1 OU Project Manager.

For borehole D0211 through the center of the 216-S-13 crib, measurement of physical and chemical parameters to characterize sediment and pore water chemistry and define waste stream effects of subsurface geochemistry will be conducted as described in Section 4, Analytical Methods, of DOE/RL-

2011-104, Addendum 1, Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit Addendum 1: Attenuation Process Characterization, hereinafter called ADD1. Selected tests will be conducted from ADD1 based on the results of the vertical concentration profile in the borehole. If necessary, based on the vertical concentration profile results, additional laboratory investigation of the fate and transport behavior for MIBK, uranium, and/or hexavalent chromium may be conducted as input to estimates of the potential for vadose zone contaminants to migrate to the groundwater. If methods other than those described in this SAP or ADD1 are needed for this fate and transport behavior assessment, a separate laboratory test plan will be developed to guide these efforts.

Table 3-1 . Summary of Vadose Zone Sampling Activities for the 200-DV-1 OU Waste Sites

Waste Site/Group	200-DV-1 OU Characterization	Rationale
216-B-57 Crib	Characterization adequate.	Previous investigation drilled and sampled boreholes at 216-B-57 (DOE/RL-92-70, <i>Phase I Remedial Investigation Report for 200-BP-1 Operable Unit</i>). Prototype Hanford Barrier constructed over 216-B-57 Crib.
T Complex Area		
216-T-3 Reverse Well	One drilled borehole to groundwater, with sampling for contaminants.	Evaluate vertical distribution of contaminants.
216-T-5 Trench	Three direct-push boreholes to refusal, with geophysical logging at two and sampling for contaminants at one.	Evaluate vertical distribution of contaminants.
216-T-6 Crib	Three direct-push boreholes to refusal, with geophysical logging at two and sampling for contaminants at one.	Evaluate vertical distribution of contaminants.
216-T-7 Tile Field/ 200-W-52 Crib (WMA T)	One drilled borehole to groundwater, with sampling for contaminants.	Evaluate vertical distribution of contaminants.
T Trenches (216-T-14, 216-T-15, 216-T-16, 216-T-17)	Three direct-push boreholes to refusal, with geophysical logging at two and sampling for contaminants at one.	Evaluate vertical distribution of contaminants.
216-T-18 Crib	One direct-push borehole to refusal, with sampling for contaminants.	Supplement previous geophysical logging of drive points with samples for laboratory analysis.
216-T-19 Crib and Tile Field	One drilled borehole to groundwater, with sampling for contaminants.	Evaluate vertical distribution of contaminants.
	One drilled borehole 0 to 1.85 m (0 to 6 ft) bgs, with sampling for PCBs and PCB congeners (resampling of shallow zone for borehole drilled to groundwater).	Evaluate vertical distribution of PCBs and PCB congeners.
TX Trenches (216-T-21, 216-T-22, 216-T-23, 216-T-24, 216-T-25)	Three direct-push boreholes to refusal, with geophysical logging at two and sampling for contaminants at one.	Evaluate vertical distribution of contaminants.
216-T-26 Crib	Characterization adequate.	Previous remedial investigation drilled and sampled borehole (C3102) at 216-T-26 Crib.
216-T-32 Crib	Characterization adequate.	Existing boreholes show no contamination below CCU.
S Complex Area		
216-S-9 Crib	One direct-push borehole, with sampling for contaminants.	Evaluate vertical distribution of contaminants.
216-S-13 Crib	One drilled borehole to groundwater, with sampling for contaminants.	Evaluate vertical distribution of contaminants and evaluate uncertainty regarding chromium inventory.

Table 3-1 . Summary of Vadose Zone Sampling Activities for the 200-DV-1 OU Waste Sites

Waste Site/Group	200-DV-1 OU Characterization	Rationale
	<p>One drilled borehole 0 to 4.6 m (0 to 15 ft) bgs, with sampling for PCBs and PCB congeners (resampling of shallow zone for borehole drilled to groundwater).</p> <p><u>One drilled borehole up to 7.7 m (25 ft) below the water table, with soil sampling for COPCs listed in Table 1-2 (DOE/RL-2011-104).</u></p> <p><u>Groundwater will be sampled for MIBK and the 200-UP-1 COCs. The 200-UP-1 COCs include carbon tetrachloride, chromium (total and hexavalent), iodine-129, nitrate, technetium-99, tritium, uranium, trichloroethylene, chloroform, strontium-90, and 1,4-dioxane (DOE/RI-2014-27, Rev 2).</u></p> <p><u>As determined by the project, install passive soil gas sampling grid in area surrounding the 216-S-13 crib.</u></p> <p><u>As determined by the project, install pore fluid sampler in completed borehole.</u></p>	<p>Evaluate vertical distribution of PCBs and PCB congeners.</p> <p><u>Evaluate vertical distribution of applicable radiological, inorganic, and organic constituents in soil to confirm whether contaminants from the 216-S-13 crib reached groundwater and to better determine if they are likely to contaminate groundwater in the future.</u></p> <p><u>Evaluate MIBK and the 200-UP-1 COCs in shallow groundwater.</u></p> <p><u>Evaluate MIBK distribution in shallow vadose zone.</u></p> <p><u>Evaluate contaminant distribution (Table 1-2) in pore fluid near the borehole following sampling.</u></p>
216-S-21 Crib	One direct-push borehole to refusal, with sampling for contaminants.	Evaluate vertical distribution of contaminants.

Note: the 200-UP-1 COCs will be sampled in accordance with the 200-UP-1 Sample and Analysis Plan DOE/RL-2015-27 Rev. 2 for this characterization event and the 200-DV-1 COCs will be sampled in accordance with this SAP.

bgs = below ground surface

CCU = Cold Creek Unit

COC = contaminant of concern

OU = operable unit

3.1.3.2 216-S-13 Crib

The characterization planned for the 216-S-13 Crib includes drilling a borehole to groundwater and collecting samples and geophysical logs using this same borehole. The location of the borehole is shown on Figure 3-30. The location was selected at the influent side of the crib to address the zone of expected highest contamination. Drilling will ensure that the vertical extent of contamination in the subsurface at this location is characterized.

The sampling intervals for the 216-S-13 Crib were selected to reduce the uncertainty associated with the nature and extent of contamination in the shallow vadose zone above 4.6 m (15 ft) bgs that may pose a risk to human health and the environment, and in the deep vadose zone that may be a source to groundwater. The samples also are planned to reduce the uncertainty associated with differences in the chromium inventory between the current Soil Inventory Model (SIM) and historical estimates (e.g., DOE/RL-91-60, *S Plant Aggregate Area Management Study Report*). Samples will be collected at the bottom of the crib and at changes in lithology, as depicted on Figure 3-31. The split-spoon samples will be analyzed for the COPCs presented in Table 1-2, as indicated in the 216-S-13 Crib Sampling Plan (Table 3-17). Selected grab samples may be analyzed for mobile COPCs as determined by the field geologist and technical lead, using characterization data such as geophysical logs, lithology (geologist logs), and split-spoon sample analytical results, consistent with the field sampling strategy (Section 3.2.3). Groundwater samples or other opportunistic samples may be collected if requested to support integration with other Central Plateau activities.

A second borehole will be drilled 0 to 4.6 m (0 to 15 ft) bgs adjacent (within approximately 1.5 m [5 ft] laterally) to the initial borehole. Continuous core samples will be collected at seven discrete intervals from 0 to 4.6 m (0 to 15 ft) bgs as shown in Figure 3-31. The samples will be analyzed for PCBs as noted in Table 2-2, and listed in the 216-S-13 Crib FSP (Table 3-17).

As determined by the project, a passive soil gas sampling grid may be established in the area surrounding the 216-S-13 crib. A conceptual layout of the sampling grid is shown in Figure 3-29. The soil gas sampling equipment and process are described in section 3.2.6, Passive Soil Gas Sampling. The soil gas sampling grid will be installed and sampled in accordance with established procedures.

A borehole will be drilled through the approximate center of the 216-S-13 crib to a depth of up to 7.7 m (25 ft) below the water table (Figure 3-30) to evaluate the applicable radiological, inorganic, and organic COPCs (see Table 1-2, DOE/RL-2011-104). The new borehole proposed for the center of the 216-S-13 crib will be drilled following the same protocols employed during the first phase of 200-DV-1 characterization. These protocols include:

- If possible, collect two soil samples (10-12 ft bgs and 13-15 ft bgs) for risk assessment purposes.
- To maintain worker safety, the borehole will be drilled from ground surface to the base of the high rad risk zone with a drilling method that does not return soil material to the surface (such as Becker Hammer). In the original 216-S-13 borehole the base of the high rad risk zone was 45 ft bgs.
- From the base of the high rad risk zone to TD the borehole will have continuous coring with the sediments preserved within intact 5 ft lexan liners. The 5 ft liners will be cut longitudinally, maintaining the intact nature of the sediments within, and subsampled for inorganic constituents as necessary. The intact cores will be photographed and described by a geologist, guided by the project scientist and/or SME.

- Sub-sample depths will be determined by geophysical log signatures, targeting zones of high gamma and neutron moisture.
- Once a sub-sample is collected to send to the selected analytical laboratory, a second aliquot of sediment at that same depth within the 5 ft core will be saved for potential tier 2 and 3 analyses.
- A borehole log will be written by an onsite geologist describing the sediments within the 5 ft liners according to the geologic logging procedure and guidance from the project scientist and geology SME.
- Three intervals identified for potential tier 2 and 3 analyses require intact 1-ft lexan liners to be sent to Pacific Northwest National Laboratory for storage and analyses once the initial tier 1 results have returned. See Table 3-17 for those interval depths. If a VOA sample depth coincides with a tier 2/3 interval, that 1 ft liner will be sent to the analytical laboratory selected for the VOA analyses and the rest of the 1 ft liners will go to PNNL.
- Sampling for VOAs and SVOAs with short holding times is required at the 216-S-13 crib. Those sampling depths require intact 1 or 2.5 ft lexan liners to be sent to the specified analytical laboratory for analyses rather than wait for geophysical logging results.

Groundwater samples will be collected using low flow methods from three discrete depths (5, 10, and 25 ft below the water table) and analyzed for MIBK and the 200-UP-1 COCs. The 200-UP-1 COCs include carbon tetrachloride, chromium (total and hexavalent), iodine-129, nitrate, technetium-99, tritium, and uranium, trichloroethylene, chloroform, strontium-90, and 1,4-dioxane (DOE/RL-2014-27, Revision 2, *Sampling and Analysis Plan for Remediation Wells in the 200-UP-1 Operable Unit*).

As determined by the project and technology availability, after soil and groundwater sampling is complete a pore fluid sampling apparatus may be inserted into the borehole. The pore fluid sampling equipment and process are described in section 3.2.5, Pore Fluid Sampling. The pore fluid sampler is a sampling technology that will be field tested and, if acceptable, will be used for continued source monitoring. Because it is initially a demonstration technology, an installation and sampling approach will be developed separately as a field test plan.

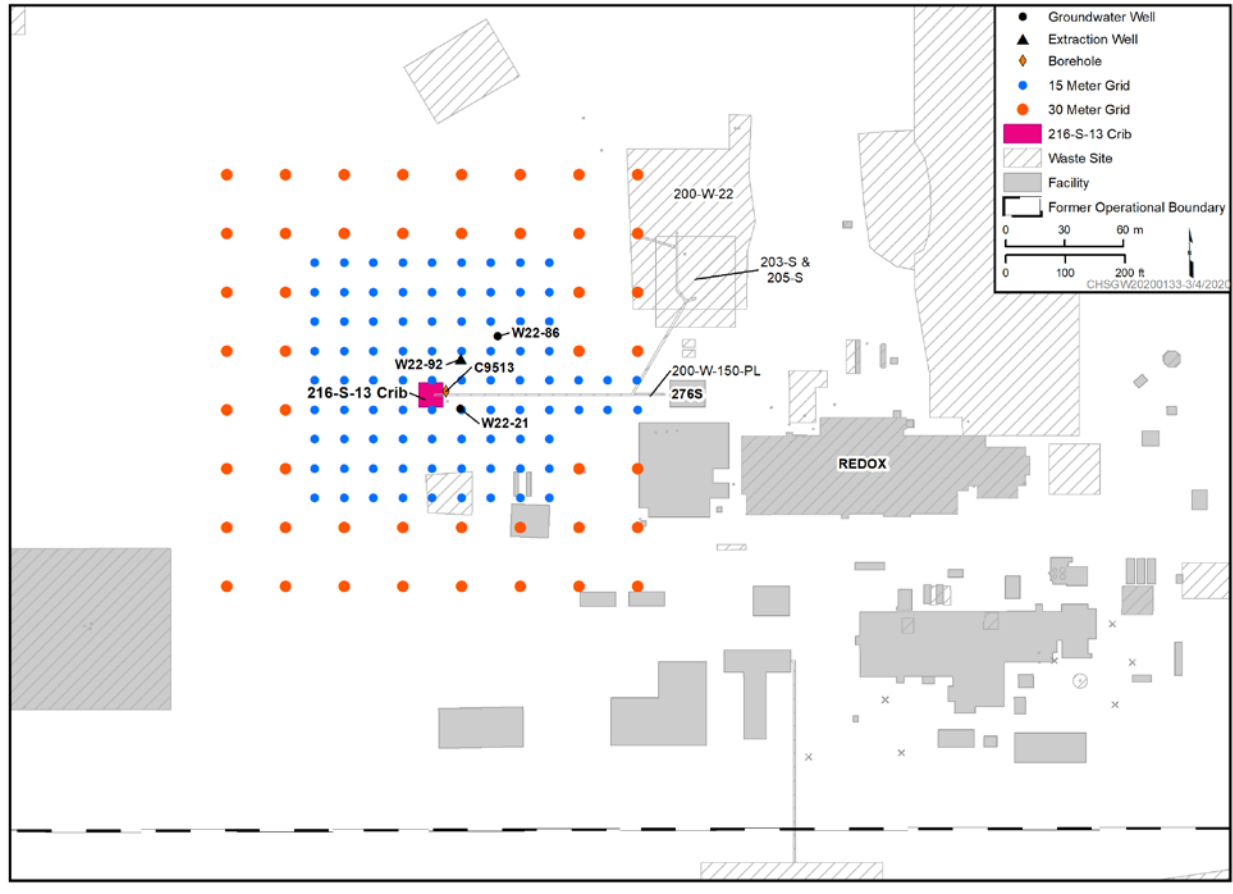
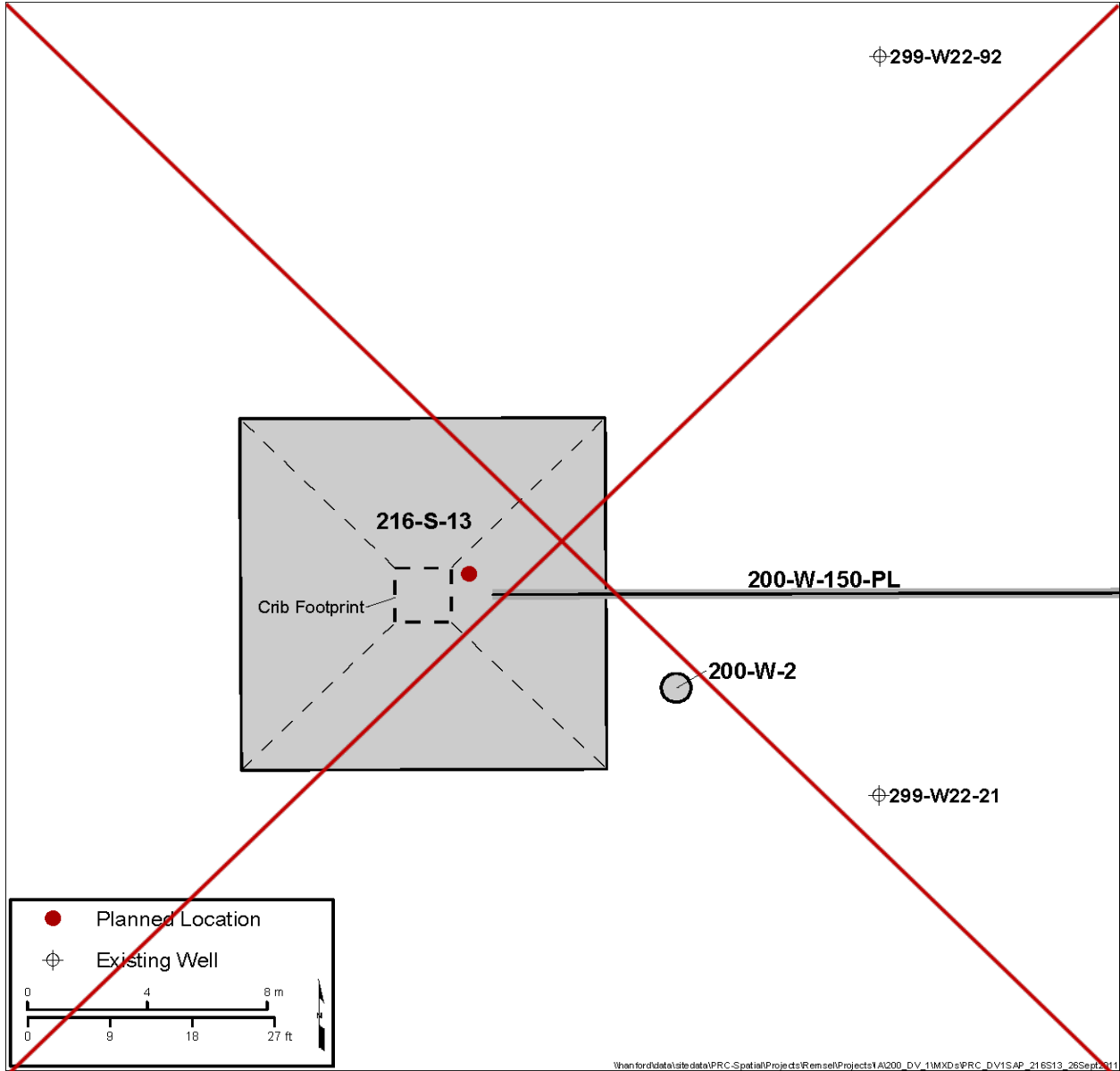


Figure 3-29. Conceptual Passive Soil Gas Sampling Grid for the 216-S-13 Crib



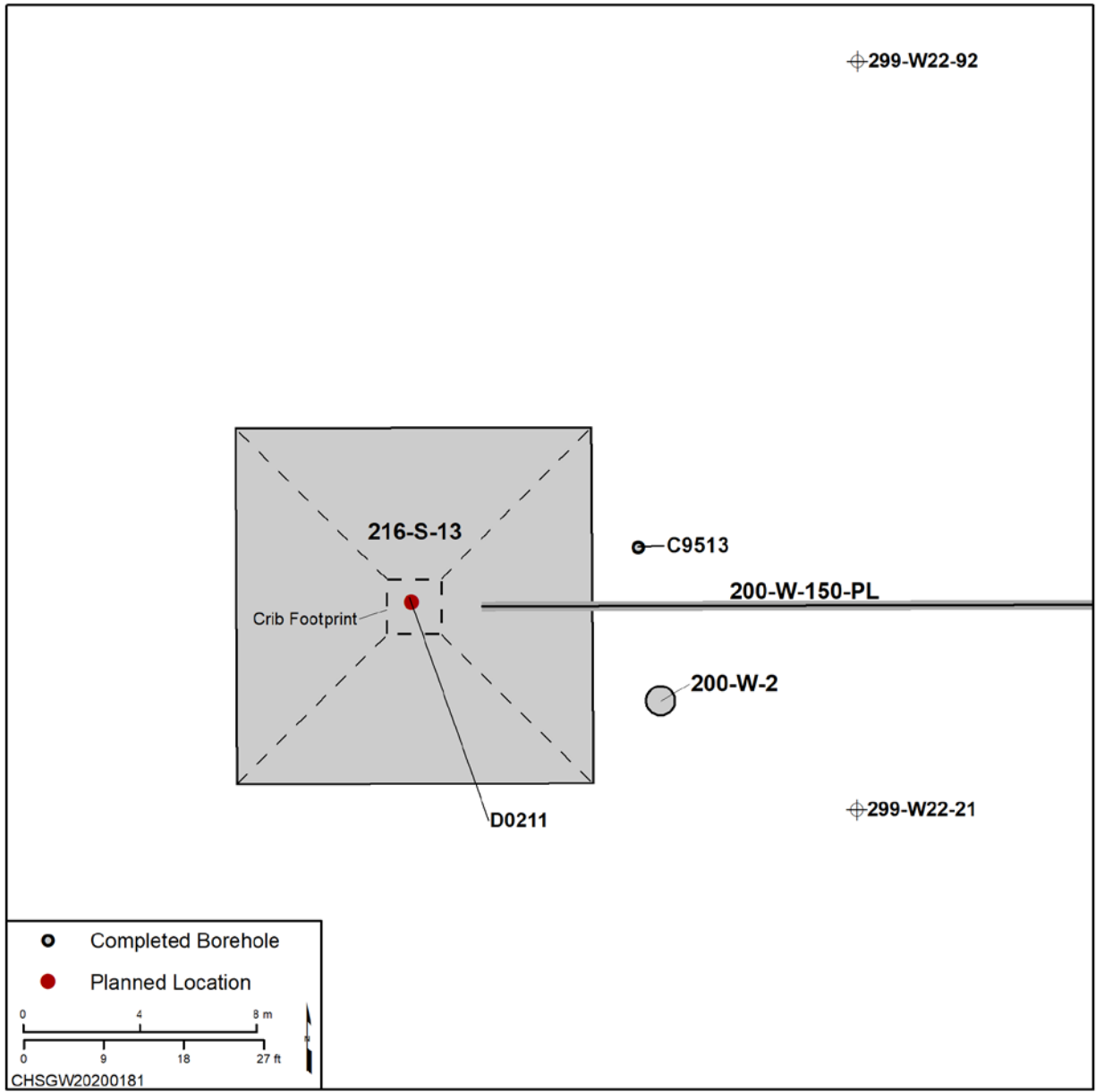
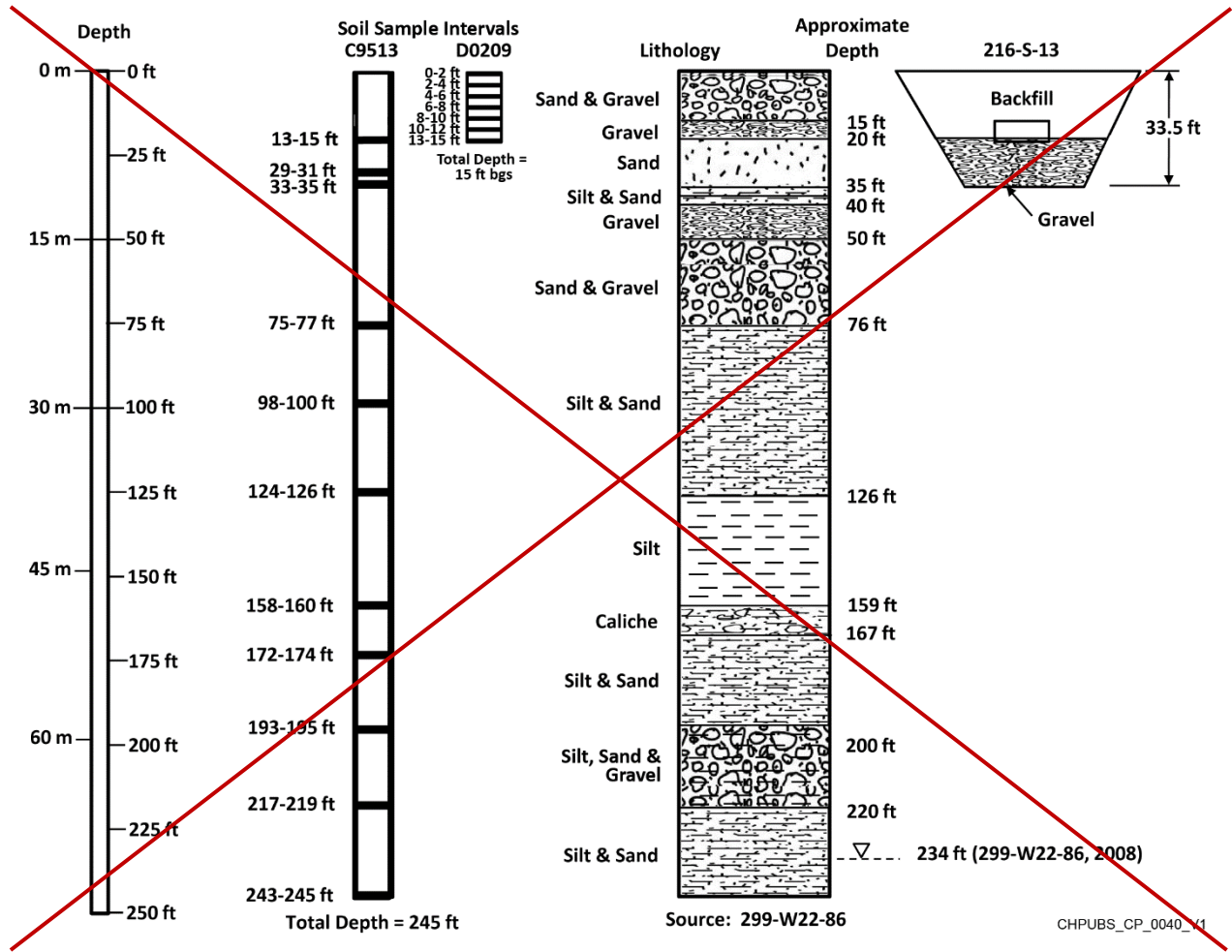
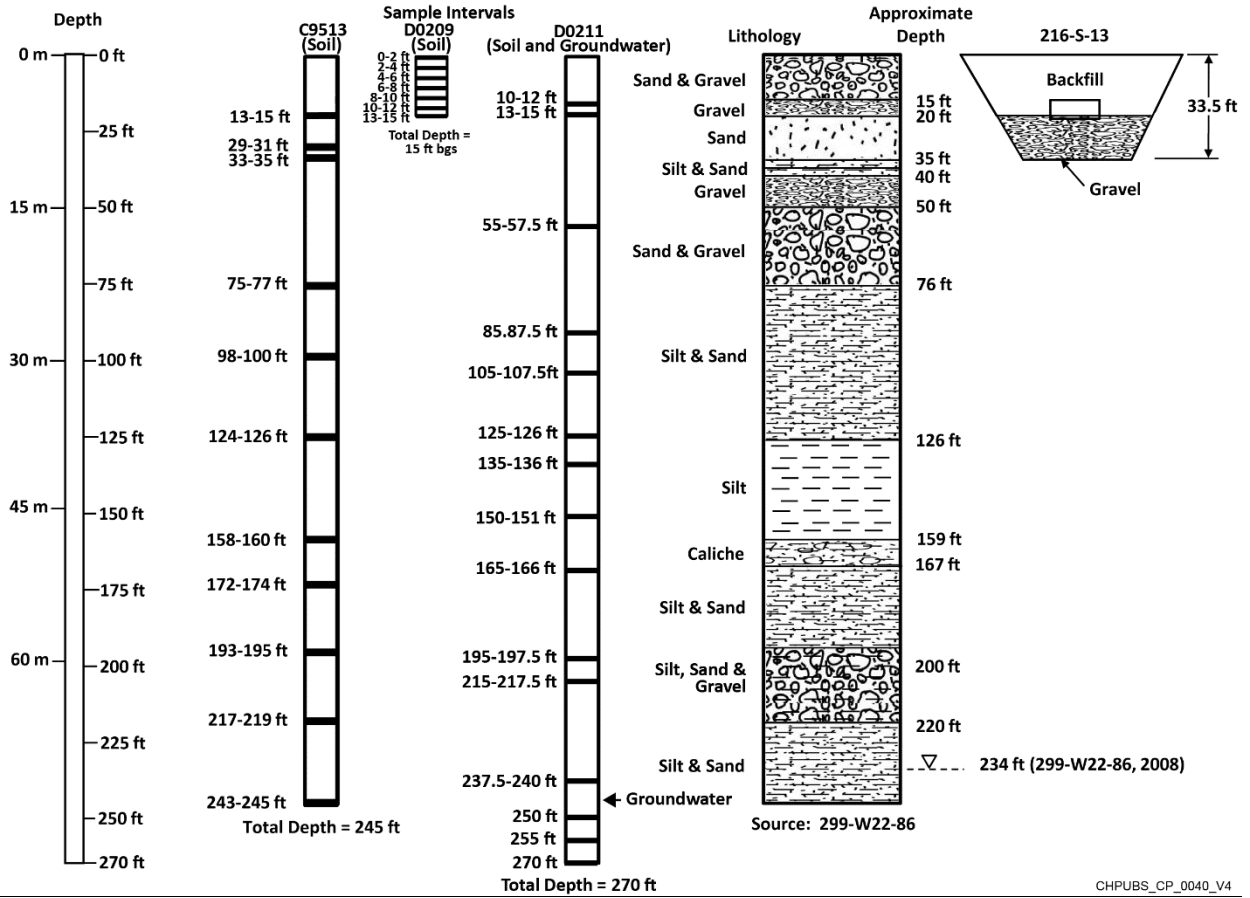


Figure 3-30. 216-S-13 Crib Data-Collection Locations





CHPUBS_CP_0040_V4

Figure 3-31. 216-S-13 Crib Stratigraphy and Sample-Collection Intervals

Table 3-17. 216-S-13 Crib Field Sampling Plan

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) ^{a,d}	Analyte List	Physical Properties	
					Sample Interval	Parameters
Borehole to groundwater with split-spoon samples.	One deep borehole as close as feasible to the crib, but outside of the crib footprint. ^e	To groundwater (approximately 245 ft).	Split-spoon sample at depths: 13 – 15 ft bgs 29 – 31 ft bgs 33 – 35 ft bgs 75 – 77 ft bgs 98 – 100 ft bgs 124 – 126 ft bgs 158 – 160 ft bgs 172 – 174 ft bgs 193 – 195 ft bgs 217 – 219 ft bgs 243 – 245 ft bgs Approximate depths only. Grab samples at 10 ft intervals throughout borehole.	Analytes are presented in Table 1-2.	One sample at each change in lithology or fine-grained interval (same as split-spoon sample intervals below 32 ft bgs), as indicated in Figure 3-31.	pH, bulk density, moisture, particle size distribution.
Borehole to 15 ft bgs with continuous core samples.	One shallow borehole adjacent (within approximately 1.5 m [5 ft] laterally) to the initial borehole.	15 ft	Continuous core sample at depths: 0 – 2 ft bgs 2 – 4 ft bgs 4 – 6 ft bgs 6 – 8 ft bgs 8 – 10 ft bgs 10 – 12 ft bgs 13 – 15 ft bgs Approximate depths only.	PCBs (as noted in Table 2-2).	None	None
<u>Borehole up to 25 ft below groundwater with continuous core samples and groundwater samples.</u>	<u>One deep borehole through the approximate center of the crib.</u>	<u>Up to 25 ft below the water table (approximately 270 ft).</u>	<u>Continuous core sample at depths:</u> <u>10 – 12 ft bgs</u> <u>13 – 15 ft bgs</u> <u>55 – 57.5 ft bgs</u> <u>85 – 87.5 ft bgs</u> <u>95 – 105 ft bgs¹</u> <u>105 – 107.5 ft bgs</u> <u>125 – 126 ft bgs</u> <u>135 – 136 ft bgs</u> <u>150 – 151 ft bgs</u> <u>125 – 165 ft bgs^f</u> <u>165 – 166 ft bgs</u> <u>195 – 197.5 ft bgs</u>	<u>Soil:</u> <u>radiological,</u> <u>inorganic, and</u> <u>organic</u> <u>COPCs (see</u> <u>Table 1-2,</u> <u>DOE/RL-</u> <u>2011-104).</u> <u>Groundwater:</u> <u>MIBK, carbon</u> <u>tetrachloride,</u> <u>chromium</u> <u>(total and</u> <u>hexavalent),</u> <u>iodine-129,</u> <u>nitrate,</u> <u>technetium-</u>	<u>None</u>	<u>None</u>

Table 3-17. 216-S-13 Crib Field Sampling Plan

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) ^{a,d}	Analyte List	Physical Properties	
					Sample Interval	Parameters
			<u>200 – 210 ft bgs^f</u> <u>215 – 217.5 ft bgs</u> <u>237.5 – 240 ft bgs</u> Groundwater sample at depths: <u>250 ft bgs^g</u> <u>255 ft bgs</u> <u>270 ft bgs</u> <u>Approximate depths only.</u>	<u>99, tritium, and uranium.</u>		
Approximate number of samples					4833	
Approximate number of field quality-control samples ^b					3	
Approximate number of physical-property samples					6	
Approximate number of grab samples					24	
Approximate total number of soil samples collected					5466	
Approximate total number of soil samples analyzed ^c					2742	
<u>Approximate number of groundwater samples analyzed</u>					<u>3</u>	
Non-Sample Data Collection				Maximum Depth of Investigation		
Downhole gamma-spectroscopy log and neutron moisture log. Passive neutron log may be collected on a case-by-case basis if gamma-spectroscopy log and/or process history indicates the likely presence of plutonium contamination.				Surface to TD in new borehole (approximately 245 ft bgs)		

a. Actual sampling depths may vary depending on the amount of backfill/overburden used in interim-stabilization activities at the waste site, field screening results, and varying subsurface conditions, consistent with the field sampling strategy (Section 3.2.3).

b. One duplicate, one split (optional), and one equipment blank. Full trip blanks and field transfer blanks will accompany samples collected for volatile organic analysis, as needed.

c. Number of samples analyzed includes ~~eighteen~~ thirty-three samples, three field quality-control samples, and six physical-property samples.

d. To convert feet to meters, multiply by 0.3048.

e. The crib was constructed using wooden timbers and presents a cave-in potential. For safety purposes, the borehole will be outside of the wood construction footprint. The crib was backfilled and no longer represents a subsidence potential.

f. Tier 2 and 3 samples for PNNL (Pacific Northwest National Laboratory).

g. The sample from 5 feet below the water table may need to be collected using a bailer.

bgs = below ground surface

TD = total depth

As appropriate, such deviations or problems will be documented in the field logbook or on nonconformance report forms in accordance with internal corrective action procedures. The 200-DV-1 OU Project Manager, Field Team Lead, or designee, will be responsible for communicating field corrective action requirements and for ensuring immediate corrective actions are applied to field activities.

Changes in sample locations not affecting the DQOs will require notification and approval of the 200-DV-1 OU Project Manager. Changes to sample locations affecting the DQOs will require concurrence from DOE and the lead regulatory agency. Changes to the SAP will be documented as noted in Section 2.1.6.

3.2.9 Pore Fluid Sampling

A system to enable periodic sampling of pore water and soil gas from selected depth intervals in the vadose zone has been developed to provide effective sampling of vadose zone contaminated sites that are a potential source to groundwater. The Deep Vadose Zone Fluid Sampling System has been tested in the laboratory for its ability to obtain multiple samples over time from the same depth interval. For pore water, sampling is accomplished by creating conditions that extract pore water in a way that does not significantly disturb the hydraulic conditions in the vadose zone. Soil gas samples can also be obtained from a discrete depth interval. The sampling system provides a means to measure changes in contaminant concentrations that occur at the same physical location, reducing uncertainties associated with spatial variations that are present in the subsurface. In addition, between sampling events, the system includes use of electrical resistivity tomography (ERT) to monitor subsurface moisture and specific conductivity changes that are indicators of contaminant migration rate.

The system consists of a set of custom flush-thread casing assemblies at designated sampling intervals. Samples are taken by lowering a sampling device that locks into these locations and collects the sample. The sampling device is then extracted from the well to retrieve the sample. In this way, no long sampling lines are needed to access the deep vadose zone. The casing assemblies can be installed at multiple selected depths in a borehole and the sampling "well" is completed in a manner similar to standard well casing, though can be installed in a relatively small diameter borehole.

3.2.10 Passive Soil Gas Sampling

Passive soil gas (PSG) surveys utilize adsorbent samplers that are emplaced in the soil subsurface to adsorb volatile and semivolatile organic compounds (VOCs and SVOCs) in soil gas. PSG samplers are typically placed in a grid pattern to simultaneously sample trace levels of compounds in soil gas that originate from contamination in soil or groundwater. By sampling all grid locations at the same time, the temporal variations in soil-gas concentrations that are known to occur daily and even hourly are normalized. In addition, the spatial variability of contamination can be defined with a PSG survey because the lower sampling and analytical costs of the method allow for more locations to be sampled. PSG methods have been demonstrated to be able to target a broad range of organic compounds from vinyl chloride to polynuclear aromatic hydrocarbons (PAHs) and other SVOCs.

The survey design varies depending on the amount of historical and other site information that is available prior to initiating the PSG survey. Typically an unbiased grid is established across the site with additional biased sample locations to target specific features. The spacing between sample locations is dependent upon the expected depth of the chemicals of concern (COC), the soil types, and the size of the area to be investigated.

The analytical results for a PSG method are presented in units of mass (e.g., nanograms of each individual compound) for comparison between sample locations to identify source areas, identify the potential for

vapor intrusion, to delineate the lateral extent of contamination, including migration pathways, and to monitor remediation programs. When requested, the mass measured (ng) can be converted to a concentration by dividing the mass (ng) by the sampler uptake rate (ml/min) and the sampling period (min), which is then multiplied by a value of 1,000 to convert ng/ml to $\mu\text{g}/\text{m}^3$.

3.3 Documentation of Field Activities

Logbooks or data forms are required for field activities. Requirements for the logbook are provided in Section 2.1.5. 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.

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

- Purpose of activity
- Day, date, time, weather conditions
- Names, titles, organizations of personnel present
- Deviations from the QAPjP or procedures
- All site activities, including field tests
- Materials quality documentation (e.g., certifications)
- Details of samples collected (e.g., preparation, splits, duplicates, matrix spikes, blanks)
- Location 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 any decontamination procedures
- Equipment failures or breakdowns, and descriptions of any corrective actions
- Telephone calls relating to field activities

3.4 Calibration of Field Equipment

The Field Team Lead 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