U.S. Department of Energy
Hanford Site

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OPPORTUNISTIC SAMPLING PROGRAM, SAMPLING AND ANALYSIS INSTRUCTION DURING INSTALLATION OF RESOURCE CONSERVATION AND RECOVERY ACT MONITORING WELL 299-E17-58, SGW-65592, REVISION 0

This letter transmits the Opportunistic Sampling Program, Sampling and Analysis Instruction During Installation of Resource Conservation and Recovery Act Monitoring Well 299-E17-58, at the 216-A-36B Crib, SGW-65592, Revision 0 to the Washington State Department of Ecology and the U.S. Environmental Protection Agency for information.

If there are any questions, please contact me, or your staff may contact Doug Hildebrand, Senior Technical Advisor, Soil and Groundwater Division, on (509) 373-9626.

Sincerely,

Michael W. Cline Digitally signed by Michael W. Cline
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SGD:KLH

Attachment
SGW-65592- Rev 0

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Environmental Portal

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Attachment
21-SGD-001929

Opportunistic Sampling Program, Sampling and Analysis Instruction During Installation of RCRA Monitoring Well 299-E17-58 at the 216-A-36B Crib

SGW-65592, Revision 0

106 pages including cover sheet

SGW-65592
Revision 0

Opportunistic Sampling Program, Sampling and Analysis Instruction during Installation of RCRA Monitoring Well 299-E17-58 at the 216-A-36B Crib

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

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

P.O. Box 1464
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

Opportunistic Sampling Program, Sampling and Analysis Instruction during Installation of RCRA Monitoring Well 299-E17-58 at the 216-A-36B Crib

Date Published
May 2021

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

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

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Terms

bgs	below ground surface
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DoD	Department of Defense
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
DQA	data quality assessment
DQI	data quality indicator
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FSO	Field Sample Operations
FTB	full trip blank
FWS	field work supervisor
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
HEIS	Hanford Environmental Information System
Hf1	Hanford formation unit 1
Hf2	Hanford formation unit 2
Hf3	Hanford formation unit 3
IATA	International Air Transportation Association
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
NTU	nephelometric turbidity unit
OU	operable unit
PUREX	Plutonium-Uranium Extraction (Plant)
QA	quality assurance
QAPjP	quality assurance project plan

QC	quality control
QSM	Quality Systems Manual
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
Rlm	Ringold Formation member of Wooded Island – lower mud unit
Rtf	Ringold Formation member of Taylor Flat
Rwia	Ringold Formation member of Wooded Island – unit A
Rwie	Ringold Formation member of Wooded Island – unit E
SAI	sampling and analysis instruction
SME	subject matter expert
SMR	Sample Management and Reporting
SPLIT	field split
SUR	surrogate
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*

1 Introduction

At the Hanford Site in southeastern Washington State, the installation of Milestone M-24-00 groundwater monitoring wells is negotiated annually by the Washington State Department of Ecology (Ecology), U.S. Department of Energy (DOE), and U.S. Environmental Protection Agency (EPA) pursuant to Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (hereinafter referred to as the Tri-Party Agreement). The Tri-Party Agreement is a comprehensive cleanup and compliance agreement applicable to *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) waste sites and *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and disposal units on the Hanford Site.

This sampling and analysis instruction (SAI) describes opportunistic sampling planned during and after installation of one Milestone M-24-00 groundwater monitoring well, 299-E17-58, to replace well 299-E17-1 upgradient of the 216-A-36B Crib (Figures 1-1, 1-2, and 1-3). The borehole will be advanced to the Ringold Formation member of Wooded Island – lower mud unit (Rlm), approximately 118 m (386 ft) below ground surface (bgs), and then backfilled to well completion depth about 6.1 m (20 ft) below the water table. The well is being installed to support RCRA groundwater monitoring as described in SGW-60595, *Engineering Evaluation Report for the 216-A-36B Crib Groundwater Monitoring*. The engineering evaluation report provides background information justifying the well location in support of the final status groundwater monitoring network.

RCRA groundwater monitoring at the 216-A-36B Crib is conducted in accordance with DOE/RL-2010-93, *Interim Status Groundwater Monitoring Plan for the 216-A-36B PUREX Plant Crib*, as modified by RCRA-CN-01_DOE/RL-2010-93_R2, *Interim Status Change Number 1: Interim Status Groundwater Monitoring Plan for the 216-A-36B PUREX Plant Crib*. Prior to completion of the new well, DOE/RL-2010-93 will be updated to include the well and specify the initial and continuing sampling and analysis necessary to support final status groundwater monitoring for RCRA at the 216-A-36B Crib. The RCRA required well sampling program and analytical constituents are identified in DOE/RL-2010-93 and are not part of this SAI.

Although improvement of the RCRA groundwater monitoring network is the driver for well installation at the 216-A-36B Crib (as discussed in SGW-60595), opportunistic sampling and analysis of soil and groundwater, geologic characterization, and aquifer testing are planned at the well location to support subsurface data needs for the CERCLA operable units (OUs) 200-PO-1 and 200-EA-1. Soil will be sampled during drilling to evaluate the nature and extent of contamination in the vadose zone. Groundwater will be sampled during and after drilling to better define the vertical extent of contamination within the unconfined aquifer at this location. Aquifer testing will be performed after drilling to determine the hydraulic properties in the upper unconfined aquifer at this location.

The various data needs are integrated into this opportunistic SAI to create efficiencies and reduce costs. Efficiencies are achieved by exploiting the subsurface access opportunities associated with drilling the Milestone M-24-00 well for RCRA. The data quality objectives for opportunistic sampling and analysis are presented in Appendix A.

Figure 1-1 shows the location of the Hanford Site, the 200 East Area, and the 216-A-36B Crib. Figure 1-2 shows additional features within the 200 East Area near the 216-A-36B Crib. Figure 1-3 shows the locations of the existing groundwater monitoring wells and the proposed replacement well for the 216-A-36B Crib.

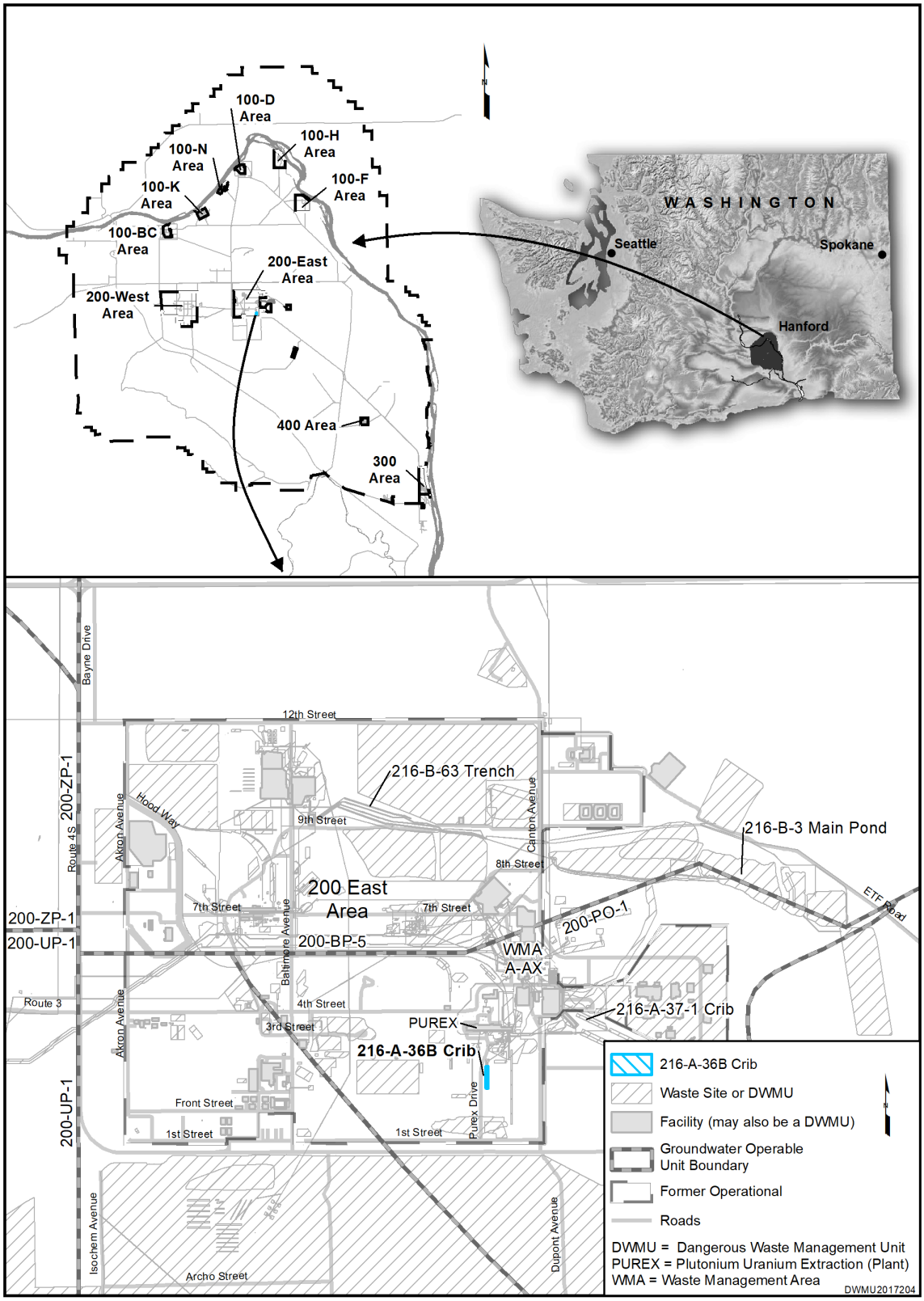


Figure 1-1. Hanford Site, 200 East Area, and 216-A-36B Crib Locations

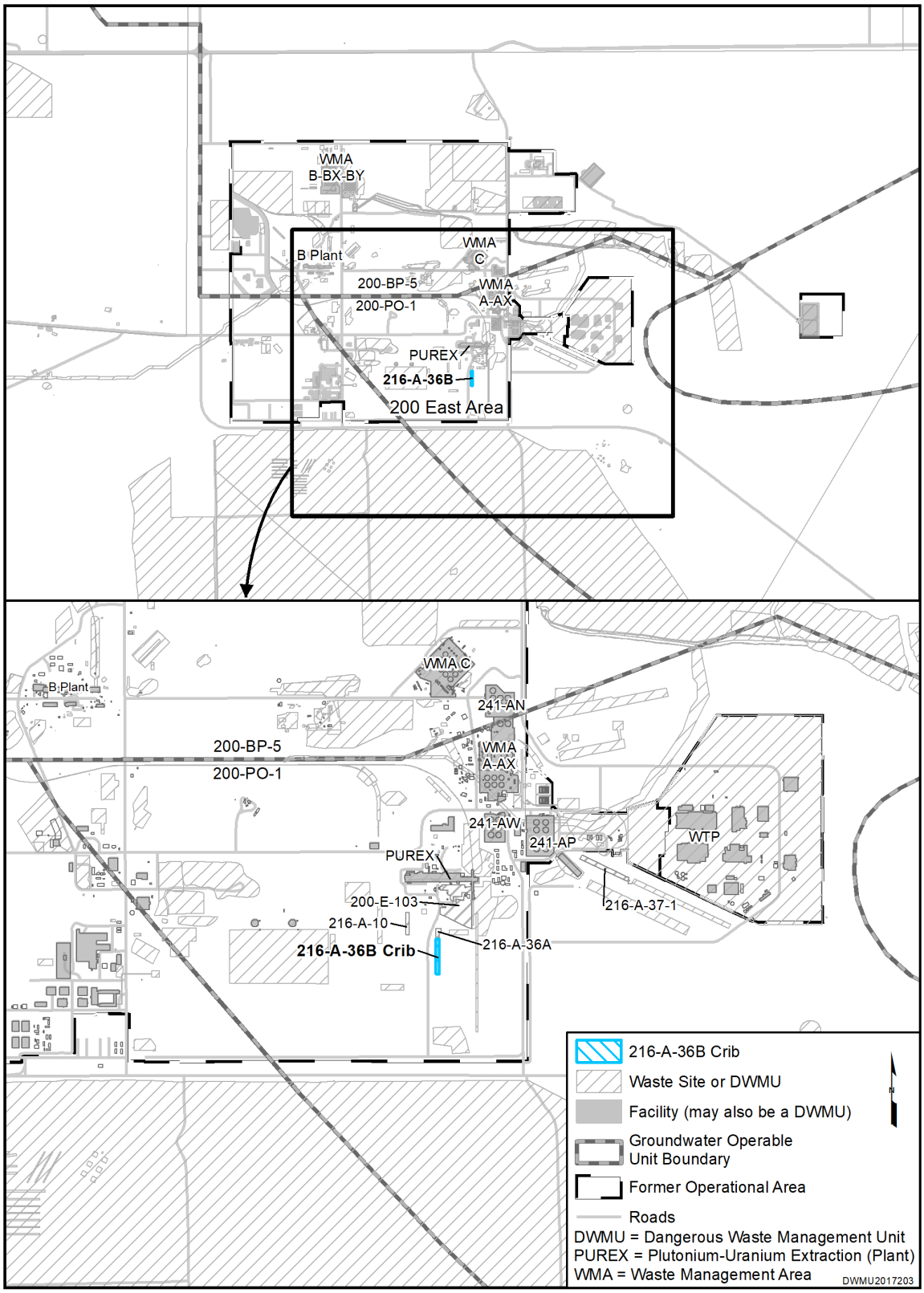


Figure 1-2. Location of the 216-A-36B Crib in the 200 East Area

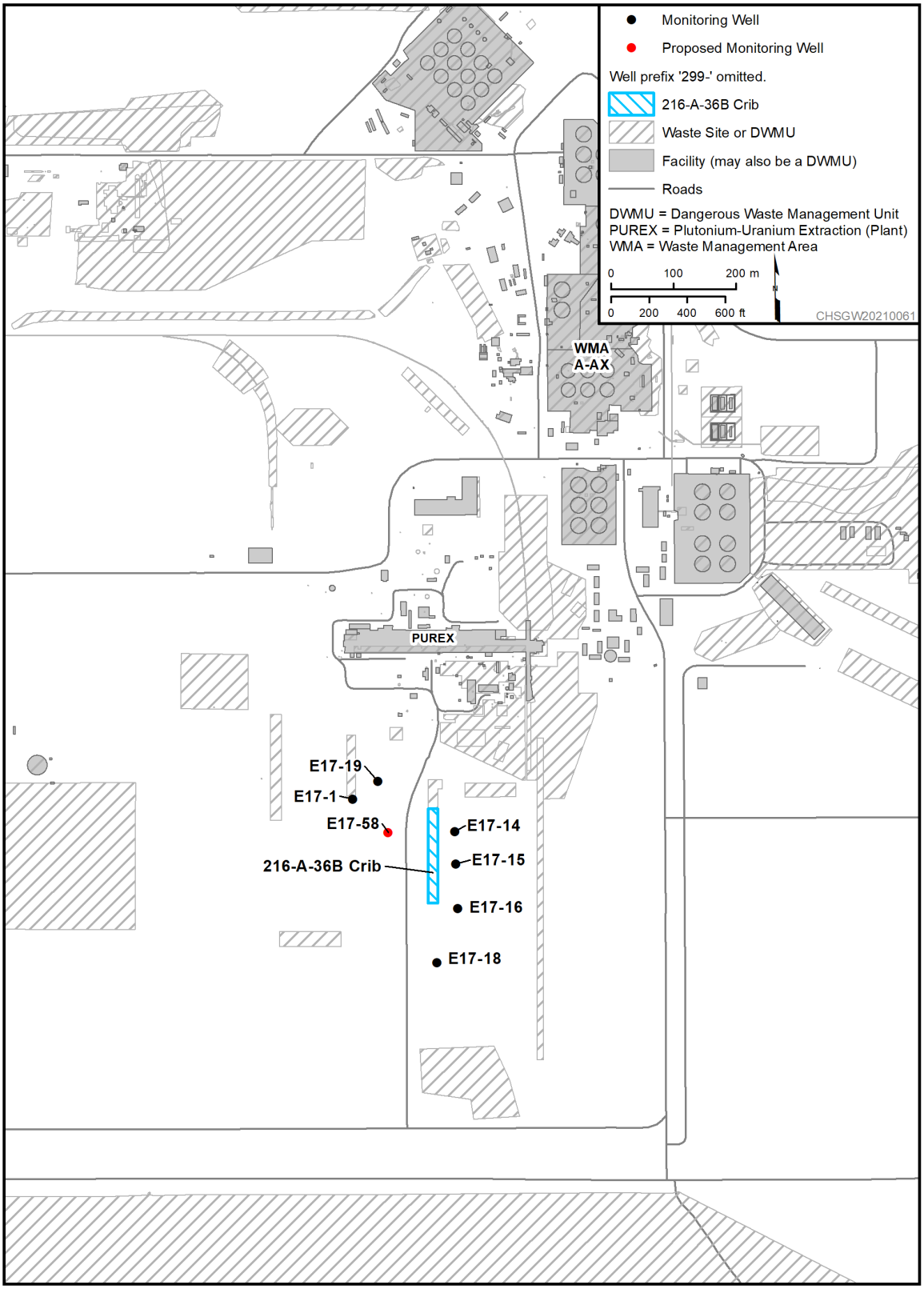


Figure 1-3. Groundwater Monitoring Well Locations for the 216-A-36B Crib

1.1 Project Scope and Objectives

This SAI describes the characterization activities planned during and after installation of one Milestone M-24-00 groundwater monitoring well, 299-E17-58, at the 216-A-36B Crib. Drilling and well construction will be performed to provide access to the subsurface environment and to evaluate potential releases of hazardous waste to the unconfined aquifer. The scope of activities includes sampling and analysis of soil and groundwater. Geologic logging, geophysical logging, well development, and aquifer testing are within the scope of this SAI. The objectives of this SAI are to describe data collection activities to provide additional information for the following:

- Determine the depths and lithologic character of stratigraphic units at each drilling location (through geologic and geophysical logging) to refine the conceptual site model in the 216-A-36B Crib vicinity.
- Determine the nature and vertical extent of soil contamination at the well location in the upper portion of fine-grained sediments within the Cold Creek unit (CCU) and immediately above groundwater for the 200-EA-1 OU.
- Determine the nature and vertical distribution of groundwater contamination across the saturated thickness of the unconfined aquifer at the well location for the 200-PO-1 OU.
- Determine the baseline contaminant concentrations in the shallow unconfined aquifer in the completed well for the 200-PO-1 OU.
- Determine hydraulic properties (aquifer testing) within the upper unconfined aquifer. The data will provide input to various models (e.g., geoframework and groundwater model updates) being developed in the 200 Areas.

1.2 Facility Description and History

This section provides a description and history of the 216-A-36B Crib. Additional information relevant to drilling and well construction is provided in SGW-60595, including geologic conditions and groundwater contamination near the planned well.

1.2.1 216-A-36B Crib Waste Site Description and History

The 216-A-36B Crib is an inactive crib that is located approximately 360 m (1,200 ft) south of the Plutonium-Uranium Extraction (PUREX) Plant in the southeastern corner of the 200 East Area (Figures 1-1, 1-2, and 1-3). The 216-A-36B Crib comprises the southern 152 m (500 ft) portion of the original 216-A-36 Crib. The bottom of the crib is approximately 7.3 m (24 ft) below grade. During construction, a 15 cm (6 in.) diameter perforated stainless-steel distribution pipe was placed horizontally at 7 m (23 ft) below grade. Crib construction also included approximately 7 m (23 ft) of clean backfill soil that became naturally revegetated with native grasses over time. An herbicide treatment program has controlled deep-rooting plants.

Beginning in September 1965, the 216-A-36 Crib received ammonia scrubber distillate effluent wastewater from the PUREX Plant. In March 1966, the 216-A-36 Crib was divided into two sections: 216-A-36A and 216-A-36B. The northern section of the 216-A-36A Crib was removed from service due to the rapid buildup of fission products within the first 30 m (100 ft) of the crib. In 1966, a vertical grout barrier was placed 30 m (100 ft) from the north end of the crib to isolate the heavily contaminated northern portion, thus subdividing the crib into the 216-A-36A (northern) portion and the 216-A-36B (southern) portion. After the grout barrier was placed in 1966, the 216-A-36B Crib continued to receive wastewater until it was temporarily removed from service in October 1972. The 216-A-36B Crib was

returned to service in 1982 due to the restart of the PUREX Plant and received ammonia scrubber distillate effluent wastewater through 1987. Between 1966 and 1987, the 216-A-36B Crib received approximately 315 million L (83 million gal) of ammonia scrubber distillate effluent wastewater.

1.2.2 Geology

The geology discussion in this section is based on the following documents:

- Bjornstad, 2006, *On the Trail of the Ice Age Floods: A Geological Field Guide to the Mid-Columbia Basin*
- CP-60925, *Model Package Report: Central Plateau Vadose Zone Geoframework Version 1.0*
- DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin*
- ECF-HANFORD-13-0029, *Development of the Hanford South Geologic Framework Model, Hanford Site, Washington*
- Lindsey, 1996, *The Miocene to Pliocene Ringold Formation and Associated Deposits of the Ancestral Columbia River System, South-central Washington and North-central Oregon*
- PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*
- PNNL-14753, *Groundwater Data Package for Hanford Assessments*
- WHC-MR-0391, *Field Trip Guide to the Hanford Site*

Sedimentary deposits of the Hanford Site (in descending order) include Holocene eolian sand, the Hanford formation, the CCU, and the Ringold Formation. These strata overlie basalt of the Columbia River Basalt Group. Figure 1-4 shows the stratigraphy and hydrostratigraphic units of the Hanford Site.

Holocene eolian sand is present at the surface over much of the Hanford Site, which consists of very fine- to medium-grained sand to occasionally silty sand. Near the 216-A-36B Crib, Holocene eolian sand is anticipated to extend from the surface to a depth of approximately 2.1 m (7 ft).

The Hanford formation consists of uncemented gravel, sands, and silts deposited by cataclysmic floodwaters 13,000 to 1,000,000 years ago. These basalt-rich glaciofluvial deposits are divided into three sequences: gravel-, sand-, and silt-dominated (although the silt-dominated sequence is not known to be present near the 216-A-36B Crib). The gravel-dominated sequence consists of cross-stratified, coarse-grained sands and granule- to boulder-size gravel that contain minor intercalated silts. The gravels are uncemented and matrix poor. Near the 216-A-36B Crib, the gravel-dominated sequence is present within two units: Hanford formation unit 1 (Hf1) and Hanford formation unit 3 (Hf3). The sand-dominated sequence is present within Hanford formation unit 2 (Hf2) and consists of well-stratified, fine- to coarse-grained sand, and granule gravel; silt in this sequence is variable and may be interbedded with the sand.

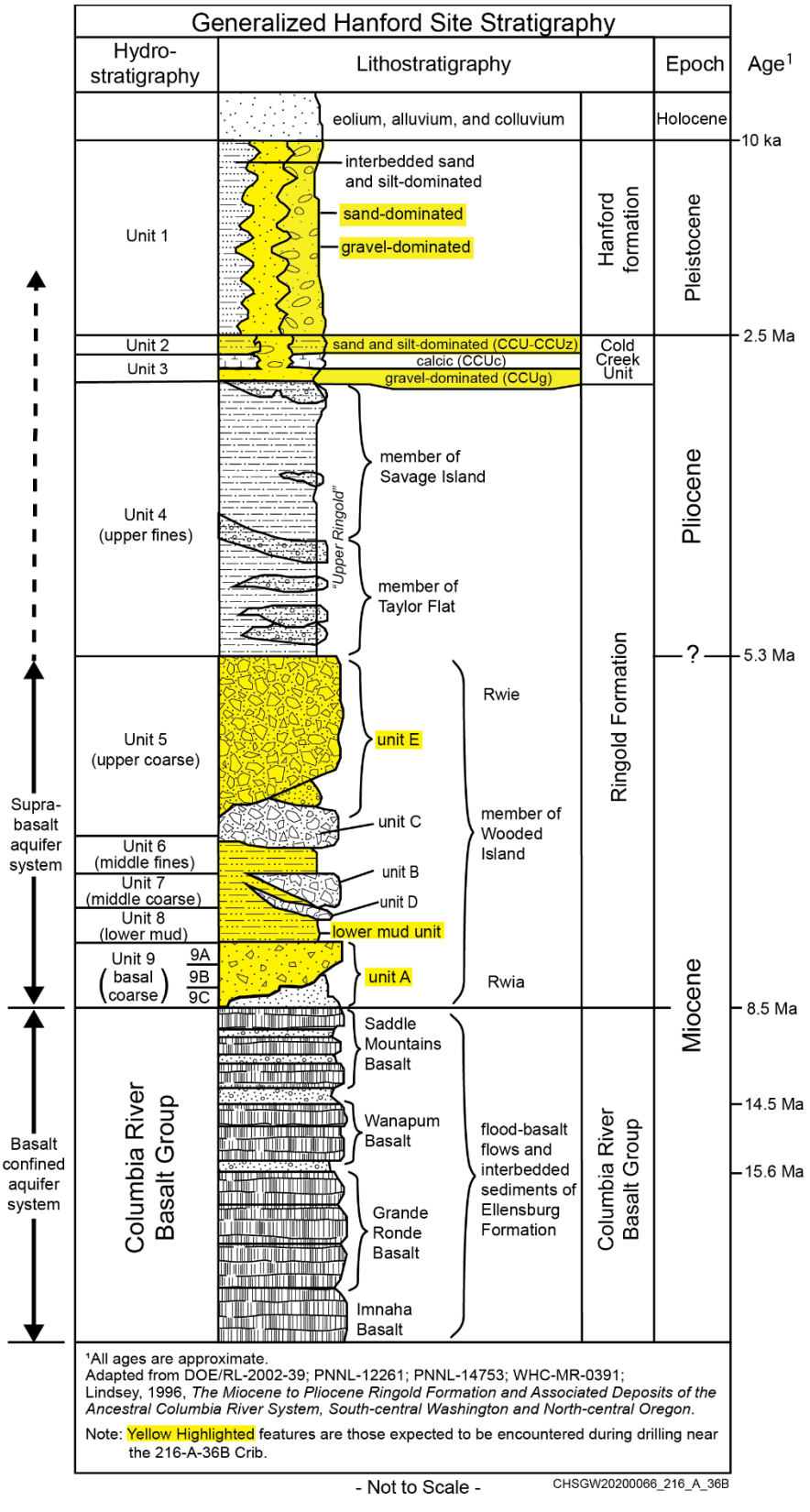


Figure 1-4. Stratigraphy of the Hanford Site

The CCU underlies the Hanford formation and was deposited 1 to 3.9 million years ago. The CCU consists of windblown, unconsolidated, muddy fine sand to fine sandy mud and indurated sediment that formed during soil development from evaporation of calcium-bearing meteoric water. This calcrete facies (locally referred to as the CCU caliche) is a major impediment to vertical migration of water. Near the 216-A-36B Crib, this caliche layer likely will not be encountered because it has not been observed in the 200 East Area; however, silty CCU sediments are anticipated to be encountered, which are also an impediment to vertical migration of water. The CCU gravel-dominated sequence underlies the silty CCU sediments near the 216-A-36B Crib.

The Ringold Formation underlies the CCU. The Ringold Formation is an interstratified sequence of unconsolidated clay, silt, sand, pebble-to-cobble gravel deposited by the ancestral Columbia River 3.9 to 10 million years ago. The Ringold Formation at the Hanford Site consists mainly of the following (in descending order):

- Silt, clay, and sand of the Ringold Formation member of Taylor Flat (Rtf)
- Gravel, sand, and silt of the Ringold Formation member of Wooded Island – unit E (Rwie)
- Silt and clay of the Rlm
- Gravel, sand, and silt of the Ringold Formation member of Wooded Island – unit A (Rwia)

The Rtf consists of overbank-dominated deposits of silt, clay, and sand; the Rtf is absent in the 216-A-36B Crib area. The Rwie and Rwia consist mostly of semiconsolidated, coarse-grained gravel and sand deposited in a high-energy fluvial environment. Gravels consisting of quartzite and porphyritic basalt, mixed with quartz-feldspathic sands and mud, typically characterize the Rwie and Rwia. The Rlm is composed of fluvial overbank deposits, paleosol, and lacustrine silt and clay, with minor sand and gravel.

The Elephant Mountain Member of the Saddle Mountains Basalt Formation (within the Columbia River Basalt Group) is the uppermost basalt bedrock unit beneath the 200 East Area. The Elephant Mountain Member is dated about 10.5 million years before present.

The current water table is anticipated to be encountered at a depth of approximately 97.9 m (321 ft) within the Rwie. Table 1-1 shows the estimated stratigraphic contact depths during drilling of well 299-E17-58, which is to be advanced into the top of the Rlm.

Table 1-1. Estimated Upper Geologic Contacts and Depth to Water

Well Name	Depth to Water Estimate (ft bgs)	Historically Elevated (1988) Depth to Water Estimate (ft bgs)	Hanford formation* (ft bgs)			CCU Silt/Gravel (ft bgs)	Rwie (ft bgs)	Rlm (ft bgs)
			Hf1	Hf2	Hf3			
299-E17-58	321	310	7	18	257	278 / 296	308	386

*Holocene eolian sand may be present at the surface.

bgs = below ground surface
CCU = Cold Creek unit
Hf1 = Hanford formation unit 1
Hf2 = Hanford formation unit 2
Hf3 = Hanford formation unit3
Rlm = Ringold Formation member of Wooded Island – lower mud unit
Rwie = Ringold Formation member of Wooded Island – unit E

A geologic cross section for the 216-A-36B Crib area is shown Figure 1-5, which was prepared as documented in SGW-60595. Where proposed well 299-E17-58 is to be drilled, the vadose zone is anticipated to be encountered within the Hanford formation (Hf1, Hf2, and Hf3) and the CCU. Groundwater is anticipated to be unconfined within the Rwie to the Rlm.

1.2.3 Groundwater Contamination

The groundwater beneath the 216-A-36B Crib area is contaminated. The primary contaminants of potential concern for CERCLA attributable to wastewater discharge at the crib are nitrate, strontium-90, and tritium, which currently occur at concentrations above drinking water standards. Additional information regarding groundwater conditions beneath the 216-A-36B Crib area is provided in Chapter 10 of DOE/RL-2019-66, *Hanford Site Groundwater Monitoring Report for 2019*.

1.3 Opportunistic Sampling and Analysis of Soil and Groundwater

During drilling of the planned well 299-E17-58 at the 216-A-36B Crib, opportunistic sampling and analysis of soil and groundwater will be performed to support CERCLA data needs. Soil sampling and analysis will be focused on the CCU (where the greatest potential contamination is expected) and immediately above the water table. To determine the vertical distribution of contamination across the saturated thickness of the unconfined aquifer (and the actual depth to the bottom of the unconfined aquifer at the Rlm), well 299-E17-58 will be drilled beyond its completion depths to the Rlm for collection and analysis of groundwater samples. A baseline groundwater sample will also be collected following well completion and acceptance. Chapter 3 presents details of the sampling and analysis approach.

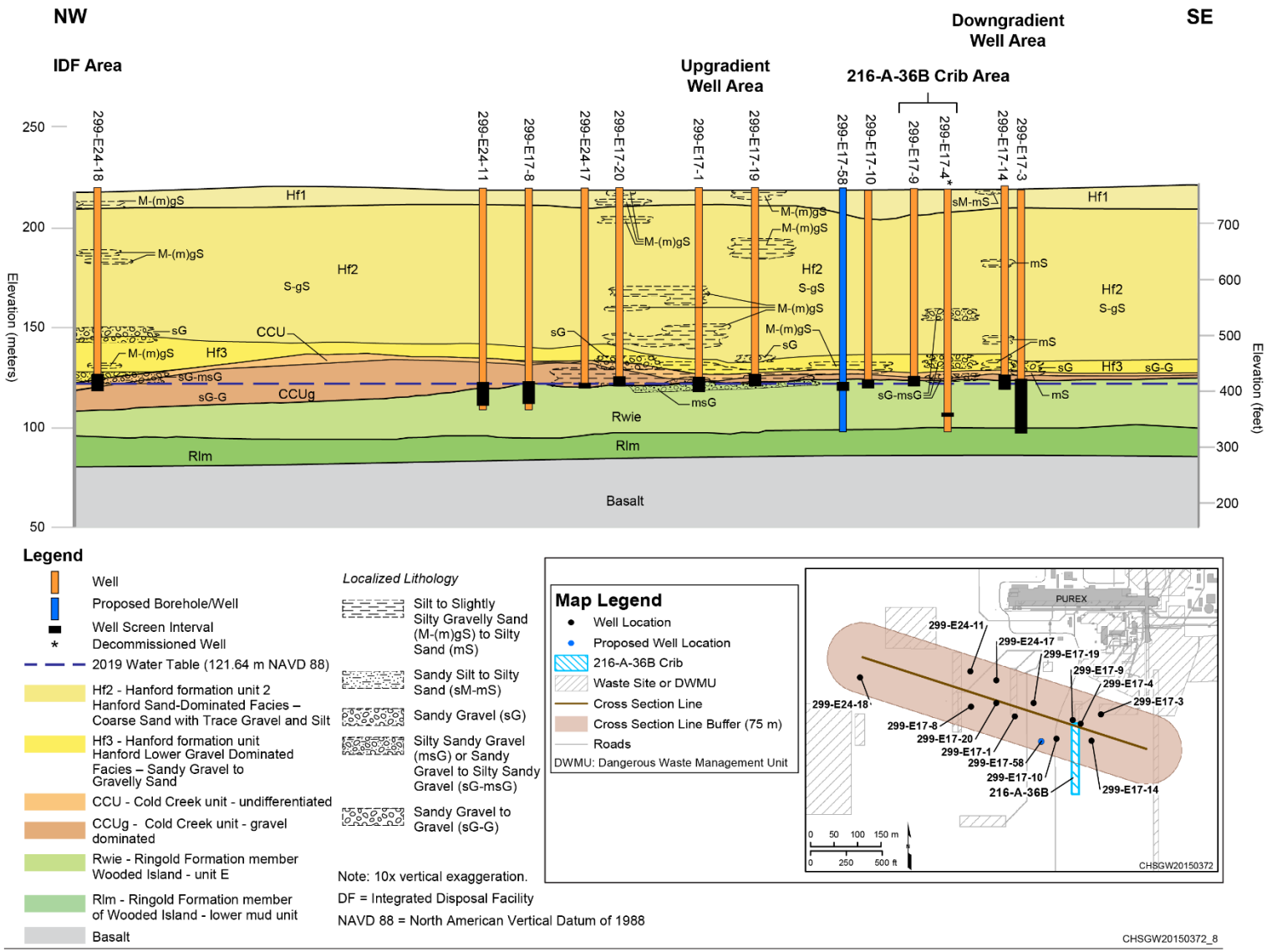
For proposed well 299-E17-58, the target analytes for soil are based on DOE/RL-2016-58, Draft A, *200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Work Plan*, and the target analytes for groundwater are based on DOE/RL-2009-85-ADD1, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit Addendum 1*. The target analytes for soil and groundwater are listed in Tables 1-2 and 1-3, respectively.

The RCRA required analytes are identified in DOE/RL-2010-93 and are not included in this SAI. Following installation and acceptance of the well identified in this SAI, baseline groundwater sampling will be conducted for CERCLA (for the parameters listed in Table 1-3) and for RCRA (as specified in DOE/RL-2010-93). Future routine sampling for RCRA will be conducted in accordance with DOE/RL-2010-93.

1.4 Well Drilling and Construction, Logging, and Aquifer Testing

Well drilling and construction will be performed in accordance with WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells.” Drilling methods that enable observation of stratigraphy in drill cuttings are preferred to facilitate identification of transitions between hydrostratigraphic units.

Well 299-E17-58 is to be drilled to a depth of approximately 119 m (391 ft) bgs, which includes drilling approximately 1.5 m (5 ft) within the Rlm. The lower portion of the borehole will then be backfilled with grout or bentonite to the well completion depth within the upper unconfined aquifer. Grout backfill is preferred; however, if grout backfill is not suitable for some drilled intervals (e.g., open-framework gravel), bentonite chips may be used. The well will be constructed as a 10 cm (4 in.) diameter monitoring well with stainless-steel casing and screens. The screened interval is anticipated to be no more than 7.6 m (25 ft) long and set no more than 1.5 m (5 ft) above the water table. The actual screened interval will be based on conditions encountered during drilling and will meet the intent of RCRA monitoring as specified in DOE/RL-2010-93.



Note: Modified from SGW-60595, *Engineering Evaluation Report for the 216-A-36B Crib Groundwater Monitoring*.

Figure 1-5. Geologic Cross Section Showing the Stratigraphy Near the 216-A-36B Crib and the Proposed Borehole/Well

Table 1-2. Target Soil Analytes

Anions and Others	Metals	
Ammonia	Antimony	Lead
Chloride	Arsenic	Manganese
Cyanide (free and total)	Barium	Mercury
Fluoride	Beryllium	Nickel
Nitrate	Cadmium	Selenium
Nitrite	Chromium (total)	Silver
pH	Chromium (VI)	Uranium (total)
Phosphate	Cobalt	Vanadium
Sulfate	Copper	Zinc
Volatile Organics		
1,1,1-Trichloroethane	Benzene	n-Butylbenzene
1,1,2-Trichloroethane	Carbon tetrachloride	Hexane
1,1-Dichloroethane	Chlorobenzene	Tetrachloroethene
1,2-Dichloroethane	Chloroform	Toluene
2-Butanone (methyl ethyl ketone)	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene
2-Hexanone	Cyclohexane	Trichloroethene
4-Methyl-2-pentanone (hexone, methyl isobutyl ketone)	Ethylbenzene	Vinyl chloride
Acetone	Methylene chloride (dichloromethane)	Xylenes (total)
Acetonitrile	n-Butanol (butyl alcohol)	
Semivolatile Organics		
Acenaphthene	Benzo(k)fluoranthene	Naphthalene
Acenaphthylene	Chrysene	Petroleum hydrocarbons (diesel to kerosene range)
Anthracene	Dibenz[a,h]anthracene	Phenanthrene
Benzo(a)anthracene	Dibenzofuran	Phenol
Benzo(a)pyrene	Fluoranthene	Pyrene
Benzo(b)fluoranthene	Fluorene	Tributyl phosphate
Benzo(ghi)perylene	Indeno[1,2,3-cd]pyrene	
Other Organics		
4,4’-Dichlorodiphenyl dichloroethane	alpha-BHC (alpha-HCH)	Dieldrin
4,4’-Dichlorodiphenyl dichloroethylene	Aroclor 1254*	Endrin
4,4’-Dichlorodiphenyl trichloroethane	Aroclor 1260*	gamma-BHC (gamma-HCH, Lindane)
Aldrin	beta-BHC (beta-HCH)	Total polychlorinated biphenyls
	Chlordane	

Table 1-2. Target Soil Analytes

Radionuclides		
Americium-241	Hydrogen-3 (tritium)	Strontium-90
Carbon-14	Iodine-129	Technetium-99
Cesium-137	Neptunium-237	Thorium-232
Cobalt-60	Nickel-63	Uranium-233
Europium-152	Plutonium-238	Uranium-234
Europium-154	Plutonium-239	Uranium-235
Europium-155	Plutonium-240	Uranium-238

Note: The soil analyte list presented in this table is based on DOE/RL-2016-58, Draft A, *200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Work Plan*.

*This analyte is a polychlorinated biphenyl.

Table 1-3. Target Groundwater Analytes

Anions	Metals	Radionuclides
Nitrate*	Chromium (total)*	Gross alpha
Sulfate*	Chromium (VI)	Hydrogen-3 (tritium)
	Uranium	Iodine-129
		Strontium-90
		Technetium-99

Note: The groundwater analyte list presented in this table is based on DOE/RL-2009-85-ADD1, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit Addendum 1*, and input from the operable unit technical leads.

*Groundwater analyte included in DOE/RL-2010-93, *Interim Status Groundwater Monitoring Plan for the 216-A-36B PUREX Plant Crib*.

Figure 1-6 shows the generic well design of a shallow groundwater monitoring well, and Table 1-4 shows preliminary construction information for well 299-E17-58. The well location will be staked prior to drilling.

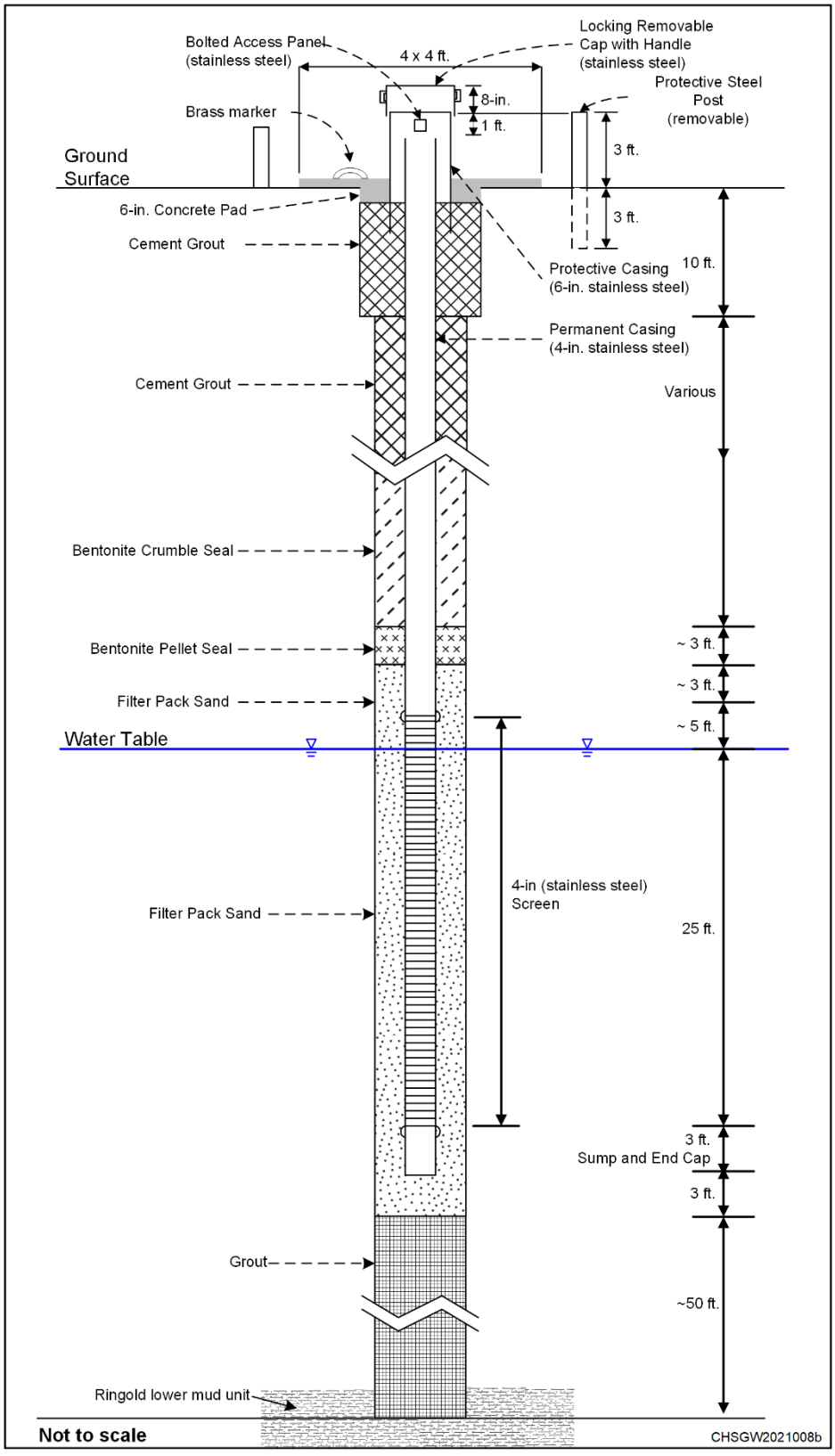


Figure 1-6. Preliminary Generic Design of a Shallow Groundwater Monitoring Well with Borehole Drilled to the Rlm

Table 1-4. Preliminary Well Construction Information

Well Name	Northing (m)	Easting (m)	Surface Elevation (m)	Depth to Water (ft bgs)	Well Diameter (in.)	Screen Interval (ft bgs)[a]	Sump and End Cap Interval (ft bgs)	Total Borehole Depth (ft bgs)[b]
299-E17-58	135332.5	575033.4	219.6	321	4	316–341 (25 ft with ~20 ft saturated)	341–344	391

Note: The borehole will be backfilled to the well completion depth with grout or bentonite. Grout backfill is preferred; however, if grout backfill is not suitable for some drilled intervals (e.g., open-framework gravel), bentonite chips may be used.

a. Actual screened intervals will be based on conditions encountered during drilling and will meet the intent of *Resource Conservation and Recovery Act of 1976* monitoring as specified in DOE/RL-2010-93, *Interim Status Groundwater Monitoring Plan for the 216-A-36B PUREX Plant Crib*.

b. Actual total depth will be based on drilling approximately 5 ft into the Ringold Formation member of Wooded Island – lower mud unit.

bgs = below ground surface

1.4.1 Geologic Logging

Geologic logging is a system of documenting the stratigraphic relationships of geologic materials encountered during borehole drilling. Soil samples from drill cuttings, split-spoon samplers, or sonic cores will be logged throughout the borehole. Changes in drilling rate will be documented by the field geologist in accordance with contractor procedures. The field geologist will collect drill cuttings every 1.5 m (5 ft) and at changes in stratigraphy from the surface to the total drilling depth, and the samples will be archived. Archive samples will be collected in pint-sized glass jars, and representative interval samples will be collected in chip trays and photographed. The log will be reviewed and approved by a geologist who did not complete the log. If representative samples cannot be collected, notes describing the condition of the samples will be entered into the field geologist's logbook. Archive samples will not be collected if contamination is encountered. Archived samples will be transported to the geologic sample library and stored. Records generated during geologic logging will be managed in accordance with contractor procedures.

Sieve analyses will be performed on samples collected across the well's planned submerged screen length (e.g., from 0 to 6.1 m [0 to 20 ft] below the water table), and adjacent samples with similar texture may be composited. The sieve analysis results will be used to select the well screen slot size and filter pack material.

1.4.2 Radiological and Industrial Hygiene Field Screening

Field screening for radiological hazards and industrial hygiene will be performed by a radiological control technician (RCT), industrial hygiene technician, and other qualified personnel in accordance with approved methods and procedures. The RCT and industrial hygiene technician will record field measurements, noting the depth of the sample and the instrument reading. Field measurements will be communicated to the field geologist, who may collect additional samples as discussed in Section 3.2.1.

1.4.3 Geophysical Logging

The borehole will be logged using a spectral gamma logging system and a neutron moisture logging system to determine the vertical distribution and the concentration of gamma-emitting radionuclides, soil moisture variations, and borehole lithology changes, which will be used along with sieve analysis results to inform the well design. Neutron data will be converted from counts to volumetric moisture to provide quantitative moisture data for the vadose zone. The borehole will be logged before downsizing each temporary casing string and/or once the total drill depth is reached.

After well construction is complete, neutron moisture logging will be used for research purposes and to potentially evaluate annular well seal integrity in the future. For this evaluation, only the vadose zone (surface to groundwater) section of the well will be logged after well completion.

1.4.4 Well Development

The objectives of well development are to settle the filter pack, prevent uncontrolled infiltration of fines, and improve communication of the well with the surrounding formation. Well development will be conducted during well construction and after well completion. Initial development will be performed during well construction in conjunction with placement of the filter pack using a dual surge block. The purpose of the dual surge block method is to settle the filter pack, remove loose particulates generated during construction activities, and develop communication across the borehole wall. Fine-grained sediment and filter pack sand drawn into the well during surging are typically removed with a bailer or sand pump.

After well completion, final development will be performed using the mechanical pumping (over-pumping) method with a submersible pump. If the saturated screened interval is >6.1 m (20 ft) in length, the development pump intake will be placed at two equally spaced intervals along the length of the screen to adequately develop the screened interval. The upper and lower intervals can be pumped at up to 132 L/min (35 gal/min). However, sustained pumping during well development is likely to be approximately 57 L/min (15 gal/min) based on the pumping rates estimated for aquifer testing.

Water samples will be collected for analysis of turbidity, temperature, pH, and specific conductance using field instruments (Table 1-5). Development will continue until the well produces clear water (<5 nephelometric turbidity units [NTUs]) and the temperature, pH, and conductivity have stabilized (as indicated in Section 3.2.2) with no more than 20% drawdown. The buyer's technical representative (with information from the field geologist) will determine when development is complete.

1.4.5 Aquifer Testing

Single-well aquifer pumping and recovery tests (aquifer testing) are planned following construction and development of well 299-E17-58. Aquifer testing is accomplished by applying a known stress to the aquifer of known or assumed dimensions and then observing the water-level response over time. Hydraulic characteristics of the aquifer can then be determined by measuring the water-level drawdown and water discharge rates. When pumping is complete, a recovery test is performed as part of testing to refine the hydraulic properties within the aquifer. Testing will be conducted to determine the transmissivity and hydraulic conductivity within the unconfined aquifer and the specific capacity of the completed well. The data will provide input to various models (e.g., geoframework and groundwater model updates) being developed for the 200 Areas. Section 3.4 provides details on aquifer testing.

Table 1-5. Water Sampling Field Measurements

Analyte	Matrix	Analytical Method*
pH	Water	150.1, 9040, Standard Method 4500 H+
Temperature (°C)	Water	170.1
Specific conductance (µS/cm)	Water	120.1, 9050, Standard Method 2520 B-97
Turbidity	Water	180.1, Standard Method 2130 B

*For EPA Method 180.1, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For EPA Methods 120.1, 150.1, 170.1, and 360.1, see EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (current update). For standard methods, see APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater* (current revision).

EPA = U.S. Environmental Protection Agency

2 Quality Assurance Project Plan

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (QA) elements in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5); and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (hereinafter referred to as HASQARD). DoD/DOE, 2019, *Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (hereinafter referred to as DoD/DOE QSM), is also discussed. Section 7.8 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (hereinafter referred to as the Tri-Party Agreement Action Plan) requires the QA/quality control (QC) and sampling and analysis activities to specify the QA requirements for past-practice processes. This QAPjP also describes applicable requirements and controls based on guidance in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*; and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP supplements the contractor's environmental QA program plan.

The QAPjP includes the following sections, which describe the quality requirements and controls applicable to Hanford Site sampling activities:

- Section 2.1, "Project Management"
- Section 2.2, "Data Generation and Acquisition"
- Section 2.3, "Assessment and Oversight"
- Section 2.4, "Data Review and Usability"

2.1 Project Management

This section includes project organization and goals, planned approaches, and planned output documentation.

2.1.1 Project/Task Organization

The project organization is described in the following sections and is illustrated in Figure 2-1.

2.1.1.1 Regulatory Agencies

Ecology is the lead regulatory agency for the 216-A-36B Crib, 200-EA-1 OU, and 200-PO-1 OU and is responsible for regulatory oversight of cleanup projects and activities.

2.1.1.2 DOE-RL Manager

Hanford Site cleanup at the 216-A-36B Crib is the responsibility of the U.S. Department of Energy, Richland Operations Office (DOE-RL). The DOE-RL manager is responsible for authorizing the contractor to perform activities at the Hanford Site under CERCLA, RCRA, the *Atomic Energy Act of 1954*, and the Tri-Party Agreement (Ecology et al., 1989a).

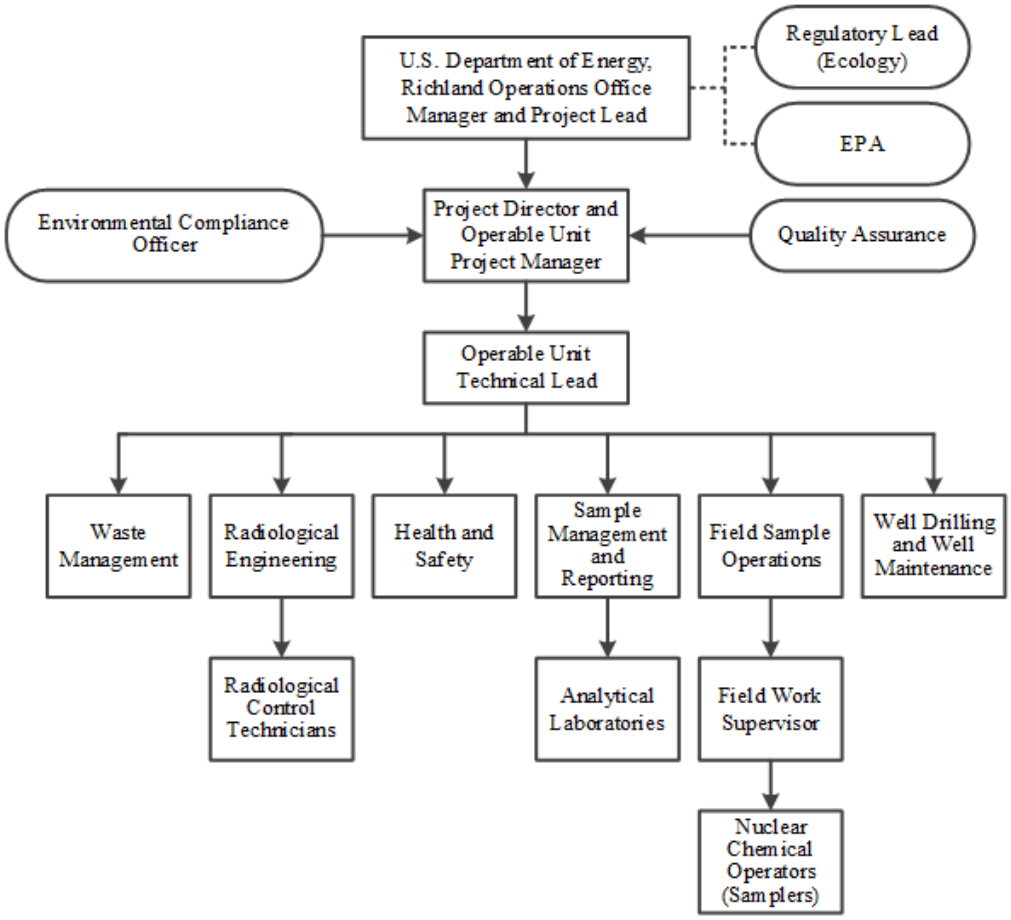


Figure 2-1. Project Organization

2.1.1.3 DOE-RL Project Lead

The DOE-RL project lead is responsible for providing day-to-day oversight of the contractor's performance of the workscope, working with the contractor to identify and work through issues, and providing technical input to DOE-RL management.

2.1.1.4 Regulatory Strategy and Integration Regulatory Document Delivery Manager

The Regulatory Strategy and Integration Regulatory Document Delivery Manager (Project Manager in Figure 2-1) provides oversight and coordinates with DOE-RL and primary contractor management in support of sampling and reporting activities. The Regulatory Strategy and Integration Regulatory Document Delivery Manager also provides support to the OU Project Manager to ensure that work is performed safely and cost effectively.

2.1.1.5 Operable Unit Project Manager

The OU project manager (or designee) is responsible and accountable for project-related activities, including coordinating with DOE-RL, the regulatory agencies, and contactor management in support of sampling activities to ensure that work is performed safely and cost effectively. In addition, the OU project manager (or designee) is also responsible for managing sampling documents and requirements, field activities, and subcontracted tasks, as well as ensuring that the project file is properly maintained.

2.1.1.6 Operable Unit Technical Lead

The OU technical lead is responsible for developing specific sampling design, analytical requirements, and QC requirements, either independently or as defined through a systematic planning process. The OU technical lead ensures that sampling and analysis activities (as delegated by the OU project manager) are carried out in accordance with this SAI and works closely with the environmental compliance officer, the QA and the Health and Safety organizations, the field work supervisor (FWS), well drilling and planning, and Sample Management and Reporting (SMR) to integrate these and other technical disciplines in planning and implementing the workscope.

2.1.1.7 Sample Management and Reporting

SMR oversees offsite analytical laboratories, coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this SAI and verifies that laboratories are qualified to perform Hanford Site analytical work. SMR generates field sampling documents, labels, and instructions for field sampling personnel and develops the sample authorization form, which provides information and instructions to the analytical laboratories. SMR ensures that field sampling documents are revised to reflect approved changes. SMR receives analytical data from the laboratories, ensures that the data are appropriately reviewed, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation and recordkeeping. SMR is responsible for resolving sample documentation deficiencies or issues associated with Field Sample Operations (FSO), laboratories, or other entities. SMR is responsible for informing the OU project manager of any issues reported by the analytical laboratories.

2.1.1.8 Field Sample Operations

FSO is responsible for planning and coordinating field sampling resources. The FWS directs the nuclear chemical operators (samplers) who collect samples in accordance with this SAI and corresponding standard methods and procedures. The FWS ensures that deviations from field sampling documents or issues encountered in the field are appropriately documented (e.g., in the field logbook). The FWS ensures that samplers are appropriately trained and available. Samplers collect samples in accordance with sampling requirements. Samplers also complete field logbooks, data forms, and chain-of-custody forms (including any shipping paperwork) and enable delivery of samples to the analytical laboratory.

Pre-job briefings are conducted by FSO in accordance with work management and work release requirements to evaluate activities and associated hazards by considering the following factors:

- 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

2.1.1.9 Quality Assurance

The QA point of contact provides independent oversight, is responsible for addressing QA issues on the project, and oversees implementation of the project QA requirements. Responsibilities include reviewing project documents (including the QAPjP) and participating in QA assessments on sample collection and analysis activities, as appropriate.

2.1.1.10 Environmental Compliance Officer

The environmental compliance officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work and develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

2.1.1.11 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 regulations or internal primary contractor work requirements.

2.1.1.12 Radiological Engineering

Radiological Engineering is responsible for the following:

- Providing radiological engineering and project health physics support
- Conducting as low as reasonably achievable reviews, exposure and release modeling, and radiological controls optimization
- Identifying radiological hazards and ensuring that appropriate controls are implemented to maintain worker exposures to hazards at as low as reasonably achievable levels
- Interfacing with the project Health and Safety representative and other appropriate personnel as needed to plan and direct project RCT support

2.1.1.13 Waste Management

Waste Management is responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance and for interpreting data to determine waste designations and profiles. Waste Management communicates policies and practices and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner.

2.1.1.14 Analytical Laboratories

The analytical laboratories accept, manage, prepare, and analyze samples in accordance with established methods and the requirements of their subcontract, as well as provide necessary data packages containing analytical and QC results. Laboratories provide explanations of results to support data review and in response to resolution of analytical issues. Laboratory quality requirements are consistent with HASQARD requirements (DOE/RL-98-68). The laboratories are evaluated under the DOE Consolidated Audit–Accreditation Program (or its successor programs) to DoD/DOE QSM (DoD/DOE, 2019) requirements. HASQARD requirements (beyond those in the DoD/DOE QSM) are also evaluated under the DOE Consolidated Audit–Accreditation Program. Laboratories are accredited by Ecology for the analyses performed under this SAI.

2.1.1.15 Well Drilling and Well Maintenance

The well drilling and maintenance and well coordination planning managers are responsible for the following:

- Planning, coordinating, and executing drilling construction
- Coordinating well maintenance activities

- Coordinating with the OU technical lead regarding field constraints that could affect sampling design
- Coordinating well decommissioning with DOE-RL and Ecology approval, as appropriate, in accordance with WAC 173-160

2.1.2 Quality Objectives and Criteria

The QA objective of this SAI is to ensure that the generation of analytical data of known and appropriate quality that are acceptable and useful in order to meet the evaluation requirements stated in the sampling plan. Data descriptors known as data quality indicators (DQIs) help determine the acceptability and usefulness of data to the user. The principal DQIs (precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity) are defined for the purposes of this document in Table 2-1.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. Applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. The DQIs are evaluated during a process to assess data usability (Section 2.4.3).

Table 2-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Precision (field duplicates, laboratory sample duplicates, and matrix spike duplicates)	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/ replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or remeasurement. • Qualify the data before use.
Accuracy (laboratory control samples, matrix spikes, surrogates, tracers)	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. The QC analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	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).	If recovery does not meet objective: • Qualify the data before use. • Request reanalysis or remeasurement.

Table 2-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Representativeness (field duplicates)	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the approved plans were followed during sampling and analysis.	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.	• If results are not representative of the system sampled: • Identify the reason for the results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent. • If data are not usable, flag as appropriate. • Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.
Comparability (field duplicate, field splits, laboratory control samples, matrix spikes, and matrix spike duplicates)	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	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 reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.

Table 2-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Completeness (no QC element; addressed in assessment of data usability)	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	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).	If data set does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future completeness.
Bias (equipment blanks, full trip blanks, field transfer blanks, laboratory control samples, matrix spikes, and method blanks)	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling practices to limit preferential selection or loss of sample media. • Use sample handling practices, including proper sample preservation, that limit the loss or gain of constituents to the sample media. • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other laboratories for analysis.

Table 2-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Sensitivity (method detection limit, practical quantitation limit, and relative percent difference)	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation[b] is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or remeasurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (current update).

a. Acceptance criteria for QC elements are provided in Table 2-5.

b. For purposes of this sampling and analysis instruction, the lower limit of quantitation is interchangeable with the practical quantitation limit.

QC = quality control

2.1.3 Method-Based Analysis

Laboratory testing and reporting for the analytes described in Section 2.2.1 may include nontarget analytes that are part of the analytical method (i.e., method-based reporting). The nontarget analyte results reported by the laboratory as part of the method will be considered with those for the target analyte lists (Tables 1-2 and 1-3) and will be used to supplement expected future data collection activities. Analytical performance requirements will be applicable to all analytes resulting from the method-based analysis process, including nondetects flagged as such by the laboratory.

2.1.4 Sample Volume

If sample volume is insufficient to analyze for all analytes listed for a given sample interval, additional sample material will be collected.

2.1.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility for collecting and transporting samples and that is compliant with applicable DOE orders and government regulations. The FWS (in coordination with line management) will ensure that special training requirements for field personnel are met.

Training has been instituted by the contractor management team to meet training and qualification programs that satisfy multiple training drivers imposed by applicable DOE, *Code of Federal Regulations*, and *Washington Administrative Code* requirements.

Training records are maintained for each employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management confirms that an employee's training is appropriate and up to date prior to performing fieldwork.

2.1.6 Documentation and Records

The OU project manager (or designee) is responsible for ensuring that the current version of this SAI is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Table 2-2 defines the types of changes that may impact the sampling and the associated approvals, notifications, and documentation requirements.

Table 2-2. Change Control for Sampling Projects

Type of Change*	Action	Documentation
Minor field change: A change that has no adverse effect on the technical adequacy of the sampling activity or the work schedule.	The field personnel recognizing the need for a field change will consult with the OU project manager (or designee) prior to implementing the field change.	Minor field changes will be documented in the field logbook. The logbook entry will include the field change, the reason for the field change, and the names and titles of those approving the field change.
Minor change: A change to an approved sampling document that does not affect the overall intent of the document or associated schedule.	The OU project manager will inform DOE-RL and the lead regulatory agency of the change. The lead regulatory agency determines if there is a need to revise the document.	For minor changes, concurrence of DOE-RL and the lead regulatory agency will be documented in unit managers' meeting minutes or comparable forum.
Revision necessary: Lead regulatory agency determines that the change requires the approved sampling document to be updated.	The OU project manager will inform DOE-RL and the lead regulatory agency of the change, and the sampling document is updated.	Formal revision of the sampling document.

References:

DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*.

Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*.

Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*.

*Consistent with DOE/RL-96-68 and Sections 9.3 and 12.4 in Ecology et al., 1989b.

DOE-RL = U.S. Department of Energy, Richland Operations Office

OU = operable unit

Regarding minor field changes, the OU technical lead (in coordination with the soil and groundwater subject matter expert [SME]) will approve deviations from this SAI that do not have an adverse effect on the technical integrity or adequacy of the sampling activity. The following are examples of minor field changes:

- During groundwater sampling, most groundwater samples will be pumped, although use of another method may be authorized by the OU technical lead.
- The sample depths provided in this SAI are estimated based on known characterization data and geology collected from nearby wells. Therefore, adjustments to the sample depths are anticipated. The sample depths may be altered during drilling in consultation with the OU technical lead.
- During sampling, if insufficient material is recovered or a split-spoon sampler is overdriven, then (when feasible) additional sample material will be collected (as needed) prior to advancing the borehole. If it is not possible to collect sufficient sample volume and perform all of the analyses, then DOE-RL will be consulted to concur on a path forward.

- Groundwater samples may not be collected before a minimum of three well casing volumes have been purged, water chemistry (e.g., temperature, pH, and conductivity) has stabilized, and turbidity is <5 NTUs (as indicated in Section 3.2.2) over three consecutive measurements unless approved by the OU technical lead. Note that one borehole volume is acceptable if water chemistry has stabilized over three consecutive measurements for depth-discrete groundwater samples collected during drilling. For low-flow sampling in a completed well, field parameter stabilization is also required, but there are no minimum purge volume requirements.

Regarding minor changes, the OU technical lead (in coordination with the soil and groundwater SME) will consult with DOE-RL and the lead regulatory agency when deviations from this SAI do not affect the overall intent of the plan. The following are examples of minor changes:

- Changing the type of sample being collected (e.g., collecting continuous grab samples instead of continuous cores)
- Selecting a different well construction material and/or well design

The OU technical lead (in coordination with the soil and groundwater SME) will inform DOE-RL and the lead regulatory agency in a timely manner of deviations from this SAI that affect the overall intent and schedule and may require revision to the approved plan.

Logbooks are required for sampling field activities. The logbook must be identified with a unique project name and number. Only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes. Data forms are also required for field activities and will be controlled in accordance with internal work requirements and processes.

The FWS and SMR are responsible for ensuring that the field instructions are maintained and aligned with any revisions or approved changes to this SAI. SMR will ensure that any deviations from this SAI are reflected in revised field sampling documents for the samplers and the analytical laboratory. The FWS will ensure that deviations from this SAI or problems encountered in the field are documented appropriately (e.g., in the field logbook).

The OU project manager, FWS, or designee is responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities. The OU project manager is also responsible for ensuring that project files are appropriately set up and maintained. The project files will contain project records or references to their storage locations. Project files may include the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to SMR)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Photographs

The following records are managed and maintained by SMR:

- Completed field sampling logbooks
- Field and analytical data
- Completed chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by the offsite analytical laboratories

Convenience copies of laboratory analytical results are maintained in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hardcopy format (e.g., DOE Records Holding Area). Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement (Ecology et al., 1989a) will be managed in accordance with the requirements listed therein.

2.2 Data Generation and Acquisition

This section addresses data generation and acquisition to ensure that the project's methods for sampling measurement and analysis, data collection and generation, data handling, and QA/QC activities are appropriate and documented. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

2.2.1 Analytical Methods Requirements

Table 2-3 provides information regarding analytical method requirements for samples collected. Updated EPA methods and nationally recognized standard methods may be substituted for the analytical methods identified in Table 2-3 in order to follow changed requirements in the method update. The new method must achieve project data quality objectives as well as or better than the replaced method.

2.2.2 Field Analytical Methods

Field screening and survey data will be measured in accordance with HASQARD requirements (DOE/RL-96-68). Field analytical methods are performed in accordance with manufacturers' manuals and contractor procedures. Table 2-3 provides the parameters for field measurements.

Table 2-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
General Chemistry Parameters				
pH	PH	150.1	N/A	N/A
Chloride	16887-00-6	300 or 9056	—	55,000
Fluoride	16984-48-8	300 or 9056	—	25,000
Nitrate	14797-55-8	300 or 9056	525	12,500
Nitrite	14797-65-0	300 or 9056	—	12,500
Phosphate	14265-44-2	300 or 9056	—	5,000
Sulfate	14808-79-8	300 or 9056	1,050	27,500
Ammonia	7664-41-7	350.1	—	500
Cyanide	57-12-5	9012 or 335.4 or 4500-CN	—	1,000
Metals				
Antimony	7440-36-0	6020	—	500
Arsenic	7440-38-2	6020	—	1,000
Barium	7440-39-3	6020	—	2,000
Beryllium	7440-41-7	6020	—	200
Cadmium	7440-43-9	6020	—	200
Chromium	7440-47-3	6020	10.5	1,000
Cobalt	7440-48-4	6020	—	400
Copper	7440-50-8	6020	—	1,000
Lead	7439-92-1	6020	—	300
Manganese	7439-96-5	6020	—	1,000
Nickel	7440-02-0	6020	—	500
Selenium	7782-49-2	6020	—	500
Silver	7440-22-4	6020	—	200
Uranium	7440-61-1	6020	1.05	150
Vanadium	7440-62-2	6010	—	5,000
Zinc	7440-66-6	6010	—	5,000
Hexavalent chromium	18540-29-0	7196	10.5	500
Mercury	7439-97-6	7471	—	200

Table 2-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
Volatile Organics				
1,1,1-Trichloroethane	71-55-6	8260	—	5
1,1,2-Trichloroethane	79-00-5	8260	—	5
1,1-Dichloroethane	75-34-3	8260	—	10
1,2-Dichloroethane	107-06-2	8260	—	5
2-Butanone	78-93-3	8260	—	20
2-Hexanone	591-78-6	8260	—	20
4-Methyl-2-pentanone	108-10-1	8260	—	20
Acetone	67-64-1	8260	—	20
Acetonitrile	75-05-8	8260	—	100
Benzene	71-43-2	8260	—	5
Carbon tetrachloride	56-23-5	8260	—	5
Chlorobenzene	108-90-7	8260	—	5
Chloroform	67-66-3	8260	—	5
cis-1,2-Dichloroethylene	156-59-2	8260	—	5
Cyclohexane	110-82-7	8260	—	10
Ethylbenzene	100-41-4	8260	—	5
Hexane	110-54-3	8260	—	10
Methylene chloride	75-09-2	8260	—	5
n-Butyl alcohol	71-36-3	8260	—	250
n-Butylbenzene	104-51-8	8260	—	5
Tetrachloroethene	127-18-4	8260	—	5
Toluene	108-88-3	8260	—	5
trans-1,2-Dichloroethylene	156-60-5	8260	—	5
Trichloroethene	79-01-6	8260	—	5
Vinyl chloride	75-01-4	8260	—	10
Xylenes (total)	1330-20-7	8260	—	10
Semivolatile Organics and Other Organics				
Acenaphthene[c]	83-32-9	8270	—	333
Acenaphthylene[c]	208-96-8	8270	—	333
Anthracene[c]	120-12-7	8270	—	333
Benzo(a)anthracene[c]	56-55-3	8270	—	333

Table 2-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
Benzo(a)pyrene[c]	50-32-8	8270	—	333
Benzo(b)fluoranthene[c]	205-99-2	8270	—	333
Benzo(ghi)perylene[c]	191-24-2	8270	—	333
Benzo(k)fluoranthene[c]	207-08-9	8270	—	333
Chrysene[c]	218-01-9	8270	—	333
Dibenzo(a,h)anthracene[c]	53-70-3	8270	—	333
Dibenzofuran	132-64-9	8270	—	333
Fluoranthene[c]	206-44-0	8270	—	333
Fluorene[c]	86-73-7	8270	—	333
Indeno(1,2,3-cd)pyrene[c]	193-39-5	8270	—	333
Naphthalene[c]	91-20-3	8270	—	333
Phenanthrene[c]	85-01-8	8270	—	333
Phenol	108-95-2	8270	—	333
Pyrene[c]	129-00-0	8270	—	330
Tributyl phosphate	126-73-8	8270	—	333
4,4'-DDD	72-54-8	8081	—	3.3
4,4'-DDE	72-55-9	8081	—	3.3
4,4'-DDT	50-29-3	8081	—	3.3
Aldrin	309-00-2	8081	—	1.7
alpha-BHC	319-84-6	8081	—	1.7
beta-BHC	319-85-7	8081	—	1.7
Chlordane	57-74-9	8081	—	16.5
Dieldrin	60-57-1	8081	—	1.7
Endrin	72-20-8	8081	—	1.7
gamma-BHC (Lindane)	58-89-9	8081	—	1.7
Aroclor 1254	11097-69-1	8082	—	33
Aroclor 1260	11096-82-5	8082	—	33
Total polychlorinated biphenyls	PCBTOT	8082	—	N/A
TPH - diesel range organics	TPHDIESEL	WTPH	—	25,000
TPH - kerosene	TPHKEROSENE	WTPH	—	25,000

Table 2-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
Radionuclides				
Am-241	14596-10-2	Alpha energy analysis	—	1 pCi/g
C-14	14762-75-5	Liquid scintillation counting	—	5 pCi/g
Cs-137	10045-97-3	Gamma energy analysis	—	0.1 pCi/g
Co-60	10198-40-0	Gamma energy analysis	—	0.1 pCi/g
Eu-152	14683-23-9	Gamma energy analysis	—	0.1 pCi/g
Eu-154	15585-10-1	Gamma energy analysis	—	0.1 pCi/g
Eu-155	14391-16-3	Gamma energy analysis	—	0.1 pCi/g
I-129	15046-84-1	Low-energy gamma spectroscopy or liquid scintillation counter	1 pCi/L	2 pCi/g
Ni-63	13981-37-8	Liquid scintillation counting	—	10 pCi/g
Np-237	13994-20-2	Alpha energy analysis	—	1 pCi/g
Pu-238	13981-16-3	Alpha energy analysis	—	1 pCi/g
Pu-239/240	PU-239/240	Alpha energy analysis	—	1 pCi/g
Sr-90	10098-97-2	Gas proportional counting	2 pCi/L	2 pCi/g
Gross alpha	12587-46-1	Gas proportional counting	3 pCi/L	N/A
Tc-99	14133-76-7	Liquid scintillation counting	50 pCi/L	5 pCi/g
Th-232	TH-232	Alpha energy analysis	—	1 pCi/g
Tritium	10028-17-8	Liquid scintillation counting	700 pCi/L	30 pCi/g
U-233/234	U-233/234	Alpha energy analysis	—	1 pCi/g
U-235	15117-96-1	Alpha energy analysis	—	1 pCi/g
U-238	U-238	Alpha energy analysis	—	1 pCi/g
Field Screening				
Radiological screening by radiological control technician	N/A	Field measurement instrument/meter	N/A	N/A
pH	N/A	Field measurement instrument/meter	N/A	N/A
Specific conductance	N/A	Field measurement instrument/meter	N/A	N/A
Temperature	N/A	Field measurement instrument/meter	N/A	N/A
Turbidity	N/A	Field measurement instrument/meter	N/A	N/A

Table 2-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)

Note: Analytical methods and PQLs provided in this table do not represent EPA requirements but are intended solely as guidance.

a. For EPA Method 300.0 and 335.4, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For EPA Methods 150.1, 310.1, and 350.1, see EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (current update). For standard methods, see APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater* (current revision). Equivalent methods may be substituted.

b. PQLs are listed only for groundwater analytes for which analysis is required.

c. Method 8270 (selected ion monitoring) will be used to determine concentrations for polynuclear aromatic hydrocarbons.

d. For field measurement analytical methods, see Table 1-5.

CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
N/A = not applicable
PQL = practical quantitation limit
TPH = total petroleum hydrocarbons

2.2.3 Quality Control Requirements

The QC requirements specified in this SAI must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Table 2-4 summarizes the field and laboratory QC samples. Table 2-5 shows acceptance criteria for field and laboratory QC. Data will be qualified and flagged in the HEIS database, as appropriate.

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. Audit results are used to improve performance.

Table 2-4. QC Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Field QC		
Equipment blank	Contamination from nondedicated sampling equipment	As needed[a, b]
Full trip blank	Contamination from containers, preservative reagents, storage, or transportation	One per 20 samples
Field transfer blank	Contamination from sampling site	One each day VOCs are sampled; additional field transfer blanks are collected if VOC samples are acquired on the same day for multiple laboratories (wells or other media samples)

Table 2-4. QC Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Field duplicate samples	Reproducibility/sampling precision	One in 20 samples
Field split samples	Interlaboratory comparability	As needed
Laboratory Batch QC[c]		
Carrier	Recovery/yield	Added to each sample and quality control sample[d]
Method blanks	Laboratory contamination	One per analytical batch[d]
Laboratory sample duplicate	Laboratory reproducibility and precision	One per analytical batch[d]
Matrix spikes	Matrix effect/laboratory accuracy	One per analytical batch[d]
Matrix spike duplicate	Laboratory reproducibility, and method accuracy and precision	One per analytical batch[d]
Surrogates	Recovery/yield for organic compounds	Added to each sample and quality control
Tracers	Recovery/yield	Added to each sample and quality control
Laboratory control	Method accuracy	One per analytical batch[d]

Note: The information in this table does not represent U.S. Environmental Protection Agency or Washington State Department of Ecology requirements; it is intended solely as guidance.

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

b. Vendor-provided borehole equipment is considered dedicated equipment, and equipment blanks are not typically acquired in this instance.

c. A batch is a group of up to 20 samples that behave similarly with respect to the sampling or testing procedures being used and are processed as a unit. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater).

d. Unless not required by, or different frequency is called out in, laboratory analysis method.

QC = quality control

VOC = volatile organic compound

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

Analytes	QC Element	Acceptance Criteria		Corrective Action
		Water	Soil	
Ammonia and Anions				
Ammonia	MB	< MDL <5% sample concentration		Flag with "C"
	LCS	80% – 120% recovery		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤35% RPD	Review data[d]
	MS/MSD[c]	75% – 125% recovery		Flag with "N"
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Anions by IC	MB	< MDL <5% sample concentration		Flag with "C"
	LCS	80% – 120% recovery		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤35% RPD	Review data[d]
	MS/MSD[c]	75% – 125% recovery		Flag with "N"
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Cyanide (total)	MB	< MDL <5% sample concentration		Flag with "C"
	LCS	80% – 120% recovery		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤35% RPD	Review data[d]
	MS/MSD[c]	75% – 125% recovery		Flag with "N"
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Metals				
ICP/AES and ICP/MS metals	MB	< MDL <5% sample concentration		Flag with "C"
	LCS	80% – 120% recovery		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤35% RPD	Review data[d]
	MS/MSD[c]	75% – 125% recovery		Flag with "N"
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]

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

Analytes	QC Element	Acceptance Criteria		Corrective Action
		Water	Soil	
Hexavalent chromium	MB	< MDL <5% sample concentration		<MDL <5% sample concentration
	LCS	80% – 120% recovery		80%-120% recovery
	DUP[b] or MS/MSD[c]	≤20% RPD	≤35% RPD	Review data[e]
	MS/MSD[c]	75% – 125% recovery		75%-125% recovery
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Mercury by cold vapor atomic absorption	MB	< MDL <5% sample concentration		Flag with "C"
	LCS	80% – 120% recovery		Flag with "o" [a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤35% RPD	Review data[d]
	MS/MSD[c]	75% – 125% recovery		Flag with "N"
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Volatile Organic Compounds				
Volatile organics by GC/MS	MB	< MDL[f] <5% sample concentration		Flag with "B"
	LCS	70% – 130% recovery or % recovery statistically derived[g]		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD		Review data[d]
	MS/MSD[c]	70% – 130% recovery		Flag with "T"
	SUR	70% – 130% recovery	% recovery statistically derived[g]	Review data[d]
	EB, FTB, FXR	< MDL[f] <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]

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

Analytes	QC Element	Acceptance Criteria		Corrective Action
		Water	Soil	
Semivolatile Organic Compounds and Total Petroleum Hydrocarbons				
Semivolatile organics by GC/MS	MB	< MDL[f] <5% sample concentration		Flag with "B"
	LCS	70% – 130% recovery or % recovery statistically derived[g]		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤30% RPD	Review data[d]
	MS/MSD[c]	% recovery statistically derived[g]		Flag with "T"
	SUR	% recovery statistically derived[g]	% recovery statistically derived[g]	Review data[d]
	EB, FTB	< MDL[f] <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Total petroleum hydrocarbons – diesel or kerosene by GC	MB	< MDL <5% sample concentration		Flag with "B"
	LCS	70% – 130% recovery or % recovery statistically derived[g]		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	Review data[d]	Review data [d]
	MS/MSD[c]	70% – 130% recovery		Flag with "N"
	SUR	60% – 140 % recovery		Review data[d]
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data [d]
Total Polychlorinated Biphenyls				
Polychlorinated biphenyls by GC	MB	< MDL <5% sample concentration		Flag with "B"
	LCS	70% – 130% recovery or % recovery statistically derived[g]		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤30% RPD	Review data [d]
	MS/MSD[c]	% recovery statistically derived[g]		Flag with "N"
	SUR	% recovery statistically derived[g]		Review data[d]
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]

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

Analytes	QC Element	Acceptance Criteria		Corrective Action
		Water	Soil	
Pesticides				
Pesticides by GC	MB	< MDL <5% sample concentration		Flag with "B"
	LCS	70% – 130% recovery or % recovery statistically derived[g]		Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	≤30% RPD	Review data [d]
	MS/MSD[c]	% recovery statistically derived[g]		Flag with "N"
	SUR	% recovery statistically derived[g]		Review data[d]
	EB, FTB	< MDL <5% sample concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Radiological Parameters				
AEA (neptunium, thorium, uranium, plutonium, americium)	MB	< MDC <5% sample activity concentration		Flag with "B"
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with "o"[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	Tracer	30% – 105% recovery		Review data[d]
	EB, FTB	< MDC <5% sample activity concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
C-14	MB	< MDC <5% sample activity concentration		Flag with "B"
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with "o"[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	MS	75% – 125% recovery		Flag with "N"
	EB, FTB	< MDC <5% sample activity concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]

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

Analytes	QC Element	Acceptance Criteria		Corrective Action
		Water	Soil	
GEA (cesium, cobalt, europium isotopics)	MB	< MDC <5% sample activity concentration		Flag with "B"
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with "o"[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	EB, FTB	< MDC <5% sample activity concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
I-129	MB	< MDC <5% sample activity concentration		Flag with "B"
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with "o"[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	Carrier	40% – 110% recovery		Review data[d]
	EB, FTB	< MDC <5% sample activity concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Ni-63	MB	< MDC <5% sample activity concentration		Flag with "B"
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with "o"[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	MS	75% – 125% recovery		Review data[d]
	Carrier	40% – 110% recovery		Review data[d]
	EB, FTB	< MDC <5% sample activity concentration		Flag with "Q"
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Gross alpha	MB	< MDC < 5% sample activity concentration		Flag with "B"
	LCS	80% – 120% recovery or % recovery statistically derived[g]		Flag with "o"a
	DUP[b]	≤20% RPD	≤30% RPD	Review Data[d]

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

Analytes	QC Element	Acceptance Criteria		Corrective Action
		Water	Soil	
Sr-90	MB	< MDC <5% sample activity concentration		Flag with “B”
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with “o”[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	Tracer	30% – 105% recovery		Review data[d]
	Carrier	40% – 110% recovery		Review data[d]
	EB, FTB	< MDC <5% sample activity concentration		Flag with “Q”
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Tc-99	MB	< MDC <5% sample activity concentration		Flag with “B”
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with ”o”[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	MS	75% – 125% recovery		Flag with “N”
	EB, FTB	< MDC <5% sample activity concentration		Flag with “Q”
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]
Tritium	MB	< MDC <5% sample activity concentration		Flag with “B”
	LCS	80% – 120% recovery or statistically derived limits[g]		Flag with ”o”[a]
	DUP[b]	≤20% RPD	≤30% RPD	Review data[d]
	MS	75% – 125% recovery		Flag with “N”
	EB, FTB	< MDC <5% sample activity concentration		Flag with “Q”
	Field duplicate[b]	≤20% RPD	—[e]	Review data[d]

Notes:

The information in this table does not represent U.S. Environmental Protection Agency requirements and is intended solely as guidance.

Table 2-3 provides a list of the constituent and analytical methods.

a. The reporting laboratory will apply the “o” flag with SMR concurrence.

b. Applies when at least one result is greater than the laboratory practical quantitation limit (chemical analyses) or greater than five times the MDC (radiochemical analyses).

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

Analytes	QC Element	Acceptance Criteria		Corrective Action
		Water	Soil	

c. Either a DUP or MS/MSD is to be analyzed to determine measurement precision (if there is insufficient sample volume, an LCS duplicate is analyzed with the acceptance criteria defaulting to the <20% RPD criteria [water] or <30% RPD criteria [soil]).

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data.

e. A field duplicate RPD for soils is not recommended because of possible soil matrix heterogeneity effects.

f. For the common laboratory contaminants acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criterion is less than five times the MDL.

g. Laboratory-determined, statistically derived control limits based on historical data are used here. Control limits are reported with the data.

AEA = alpha energy analysis
DUP = laboratory sample duplicate
EB = equipment blank
FTB = full trip blank
FXR = field transfer blank
GC = gas chromatography
GC/MS = gas chromatograph/mass spectrometry
GEA = gamma energy analysis
IC = ion chromatography
ICP/AES = inductively coupled plasma/atomic emission spectroscopy
ICP/MS = inductively coupled plasma/ mass spectrometry
LCS = laboratory control sample
MB = method blank
MDC = minimum detectable concentration
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
QC = quality control
RPD = relative percent difference
SMR = Sample Management and Reporting
SUR = surrogate

Data flags:

B, C = Possible laboratory contamination; analyte was detected in the associated MB (laboratory-applied). The “B” flag is used for organic analytes. The “C” flag is used for general chemical and inorganic analytes.
N = Result may be biased; associated MS result was outside the acceptance limits (except GC/MS) (laboratory-applied).
o = Result may be biased; associated LCS result was outside the acceptance limits (laboratory-applied).
T = Result may be biased; associated MS result was outside the acceptance limits (GC/MS only) (laboratory-applied).
Q = Problem with associated field QC blank; results were out of limits (SMR review).

2.2.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and three types of field blanks (e.g., equipment blanks, full trip blanks [FTBs], and field transfer blanks [FXRs]). High-purity deionized water[1] is the preferred blank matrix when water-based samples are collected, and silica sand is typically used for the field blank when soil or other solid samples are acquired. The QC sample definitions and their required frequency for collection are described as follows:

- **Field duplicates:** Independent samples collected as close as possible to the same time and same location as the schedule sample and intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.
- **Field splits (SPLITs):** Two samples collected as close as possible to the same time and same location and intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.
- **Equipment blanks:** High-purity water or silica sand (as appropriate) is passed through or poured over decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the sample authorization form. Equipment blank sample bottles are placed in the storage containers with samples from the associated sampling event and are analyzed for the same constituents as samples from the sampling event. Equipment blanks are used to evaluate decontamination process effectiveness; these samples are not required for disposable sampling equipment.
- **Full trip blanks (FTBs):** Bottles prepared by the sampling team before travel to the sampling site. The preserved bottle set is either for volatile organic analysis only or identical to the set that will be collected in the field. It is filled with high-purity water or silica sand (as appropriate), and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential sample contamination from the sample bottles, preservative, handling, storage, and transportation.
- **Field transfer blanks (FXRs):** FXRs are used to document possible contamination during field acquisition of volatile organic compound samples. FXRs are sample bottles (already containing any required sample preservative) filled at the sample collection site with high-purity deionized water or silica sand (as appropriate). The blank is sealed at the sampling site and becomes part of the sample set sent to the laboratory.

[1] Reagent water is high-purity water that is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

2.2.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project. Laboratory QA includes a comprehensive QC program that includes the use of laboratory control samples, laboratory sample duplicates, matrix spikes (MSs), matrix spike duplicates (MSDs), and method blanks (MBs). The QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* [current update]) and will be run at the frequency specified in the respective references unless superseded by agreement. The QC checks outside of control limits are documented in analytical laboratory reports during data usability assessments (if performed). Table 2-4 lists the laboratory QC checks and their typical frequencies. Table 2-5 shows the acceptance criteria. Descriptions of the various types of laboratory QC samples are as follows:

- **Carrier:** A known quantity of nonradioactive isotope that is expected to behave similarly and is added to an aliquot of sample. Sample results are generally corrected based on carrier recovery.
- **Laboratory control sample:** A control matrix (e.g., reagent water) spiked with analytes representing the target analytes or certified reference material used to evaluate laboratory accuracy.
- **Laboratory sample duplicate:** An intralaboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.
- **Matrix spike (MS):** An aliquot of a sample spiked with a known concentration of target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.
- **Matrix spike duplicate (MSD):** A replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.
- **Method blank (MB):** An analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the sample preparation and analytical procedure and is used to quantify contamination resulting from the analytical process.
- **Surrogate (SUR):** A compound added to every sample in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined, but they are not normally encountered. SURs are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because SURs are added to every standard, sample, and QC sample, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.
- **Tracer:** A known quantity of a radioactive isotope that is different from that of the isotope of interest but is expected to behave similarly and is generally added to an aliquot of sample prior to the sample preparation step. A tracer does not chemically interfere with the target radioisotope during radiochemical preparation, separation, and counting. Sample results are generally corrected based on tracer recovery.

Laboratories are required to analyze samples within the holding times specified in Table 2-6. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or by other chemical changes. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an “H.”

Table 2-6. Holding-Time and Preservation Guidelines for Laboratory Analytes

Constituent/ Parameter[a]	Preservation[b]		Holding Time	
	Water	Soil	Water	Soil
Anions and Metals				
Chloride, fluoride, and sulfate	Store ≤6°C	None	28 days	28 days before extraction/ 28 days after extraction
Nitrate, nitrite, and phosphate	Store ≤6°C	None	48 hours	28 days before extraction/ 48 hours after extraction
Metals	HNO_3 to pH <2	None	6 months	6 months
Hexavalent chromium	Store ≤6°C	Store ≤6°C	24 hours	30 days before extraction/24 hours after extraction
Mercury	HNO_3 to pH <2	None	28 days	28 days
Cyanide	Store ≤ 6°C, adjust pH to >12 with 50% NaOH. If oxidizing agents present, add 5 mL 0.1 N $NaAsO_2$/L or 0.06 g ascorbic acid/L.	Store ≤6°C	14 days	14 days before/14 days after extraction
Organics				
Volatile organics	HCl or H_2SO_4 to pH <2; ≤6°C	Frozen	14 days	14 days
Semivolatile organics	Store ≤6°C	Store ≤6°C	7 days before extraction/ 40 days after extraction	14 days before extraction/ 40 days after extraction
Total petroleum hydrocarbons (diesel, motor oil, kerosene)	HCl to pH <2; Store ≤6°C	Store ≤6°C	14 days/40 days after extraction	14 days/40 days after extraction
Polychlorinated biphenyls	Store ≤6°C	Store ≤6°C	None	None
Pesticides	Store ≤6°C	Store ≤6°C	7 days before extraction/ 40 days after extraction	14 days before extraction/ 40 days after extraction
Radionuclides				
Am-241	HNO_3 to pH <2	None	6 months	6 months
C-14	None	None	6 months	6 months

Table 2-6. Holding-Time and Preservation Guidelines for Laboratory Analytes

Constituent/ Parameter[a]	Preservation[b]		Holding Time	
	Water	Soil	Water	Soil
Cs-137	HNO_3 to pH <2	None	6 months	6 months
Co-60	HNO_3 to pH <2	None	6 months	6 months
Eu-152	HNO_3 to pH <2	None	6 months	6 months
Eu-154	HNO_3 to pH <2	None	6 months	6 months
Eu-155	HNO_3 to pH <2	None	6 months	6 months
I-129	None	None	6 months	6 months
Ni-63	HNO_3 to pH <2	None	6 months	6 months
Np-237	HNO_3 to pH <2	None	6 months	6 months
Pu-238	HNO_3 to pH <2	None	6 months	6 months
Pu-239/240	HNO_3 to pH <2	None	6 months	6 months
Sr-90	HNO_3 to pH <2	None	6 months	6 months
Gross alpha	HNO_3 to pH <2	None	6 months	6 months
Tc-99	HNO_3 to pH <2	None	6 months	6 months
Th-232	HNO_3 to pH <2	None	6 months	6 months
Tritium	None	None	6 months	6 months
U-233/234	HNO_3 to pH <2	None	6 months	6 months
U-235	HNO_3 to pH <2	None	6 months	6 months
U-238	HNO_3 to pH <2	None	6 months	6 months

Notes:

Holding times and preservation methods are dependent on the constituents and are consistent with EPA guidance and approved analytical methods.

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

a. Table 2-3 provides a list of constituents and analytical methods.

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

EPA = U.S. Environmental Protection Agency

2.2.4 Measurement Equipment

Each measuring equipment user is responsible for ensuring that the equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with the manufacturer's specifications and other approved methods.

2.2.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International [formerly the American Society for Testing and Materials]) or have been evaluated as acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to minimize downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and the onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with HASQARD requirements (DOE/RL-98-68).

2.2.6 Instrument/Equipment Calibration and Frequency

Section 3.6 discusses field equipment calibration. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

2.2.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. 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 that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

2.2.8 Nondirect Measurements

Data obtained from sources such as computer databases, programs, literature files, and historical databases will be technically reviewed to the same extent as data generated as part of any sampling and analysis QA/QC effort. Data used in evaluations will be identified by data source.

2.2.9 Data Management

SMR (in coordination with the OU project manager) is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements governing data management methods.

Electronic analytical data will be accessed through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hardcopies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to SMR through an established process. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and to establish their resolution with the OU project manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and for records management.

2.3 Assessment and Oversight

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

2.3.1 Assessments and Response Action

Management assessments and/or independent assessments may be performed to verify compliance with the requirements outlined in this SAI, project field instructions, the QAPjP, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project line management chain coordinates the corrective actions/ deficiency resolutions in accordance with the QA program, the corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the OU project manager (or designee). An assessment of data usability will be performed for the identified SAI activities, and the results of the assessment will be provided to the OU project manager. No other planned assessments have been identified. If circumstances arise in the field dictating the need for additional assessments, then additional assessments will be performed.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. SMR oversees offsite analytical laboratories and verifies that the laboratories are qualified to perform Hanford Site analytical work.

2.3.2 Reports to Management

Program and project management (as appropriate) will be made aware of deficiencies identified by assessment and oversight. Issues reported by the laboratories are communicated to SMR, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and to establish resolution with the OU project manager. If an assessment finding results in sampling issues that affect a regulatory requirement, DOE will be informed and the matter will be discussed with the lead regulatory agency.

2.4 Data Review and Usability

This section addresses QA activities that occur after data collection. Implementation of these activities determines whether 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 includes linking sample numbers to specific sampling locations, as well as reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times (if any) have been met. Furthermore, review of QC data is used to determine whether analyses have met the data quality requirements specified in this SAI.

The criteria for verification include, but are not limited to, review for contractual compliance (i.e., 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. Field QA/QC results will be reviewed to ensure that the results are usable.

The OU technical lead performs data reviews to help determine if observed changes reflect potential data errors, which may result in submitting a request for data review on questionable data. The laboratory may be asked to check calculations or reanalyze the sample. In extreme cases, another sample may be

collected. Results of the request for data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

2.4.2 Data Validation

Data validation is an independent assessment to ensure data reliability. Analytical data validation provides a level of assurance that an analyte is present or absent. Validation may also include the following:

- Verification of instrument calibrations
- Evaluation of analytical results based on MBs
- Recovery of various internal standards
- Correctness of uncertainty calculations
- Correctness of identification and quantification of analytes
- The effect of quality deficiencies on data reliability

The contractor follows the data validation process described in EPA-540-R-2017-001, *National Functional Guidelines for Inorganic Superfund Methods Data Review*; and EPA-540-R-2017-002, *National Functional Guidelines for Organic Superfund Methods Data Review*, adjusted for use with SW-846, HASQARD (DOE/RL-96-68), and radiochemistry methods. The criteria for data validation are based on a graded approach using five levels of validation (Levels A through E). Level A is the lowest level and is the same as verification. Level E is a 100% review of all data (e.g., calibration data and calculations of representative samples from the data set). Data validation may be performed to Level C, which is a review of the QC data. Level C validation consists of a review of the QC data and specifically requires verification of deliverables; requested versus reported analytes; and qualification of the results based on evaluation of analytical holding times, MB results, MS/MSD results, SUR recoveries, and duplicate sample results. Level C data validation is generally equivalent to Level 2A in EPA 540-R-08-005, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (OSWER 9200.1-85). Level C data validation will be performed on at least 5% of the data by matrix and analyte group under the direction of SMR. Analyte group refers to categories such as radionuclides, volatile chemicals, semivolatiles, metals, and anions. The goal is to include each of the various analyte groups and matrices during the data validation process. The DOE-RL project lead or OU project manager may specify a higher percentage of data to be validated or that data validation be performed at higher levels.

2.4.3 Reconciliation with User Requirements

The purpose of reconciliation with user requirements is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project data needs. The data quality assessment (DQA) process is the scientific and statistical evaluation of previously verified and validated data to determine if information obtained from environmental data operations are of the right type, quality, and quantity to support their intended use (usability). The DQA process uses the entirety of the collected data to determine usability for decision making. If a statistical sampling design was used during field sampling activities, then the DQA will be performed following guidance in EPA/240/B-06/003, *Data Quality Assessment: Statistical Methods for Practitioners* (EPA QA/G-9S). When judgmental (focused) sampling designs are implemented in the field, DQIs such as precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity for the specific data sets (i.e., individual data packages) will be evaluated in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation* (EPA QA/G-8). Data verification and data validation are integral to the statistical DQA data evaluation process and the DQI evaluation process. Results of the DQA or DQI processes will be used by the contractor OU project manager to interpret the data.

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3 Field Sampling Plan

This field sampling plan describes the sampling and analysis of soil and groundwater for Milestone M-24-00 groundwater monitoring well 299-E17-58, located near the 216-A-36B Crib. This field sampling plan also includes a description of single-well aquifer testing that will be performed following construction of the well. This work is planned to support environmental needs applicable to CERCLA for conceptual site model development (e.g., geoframework and groundwater model updates) for the 200 Areas.

The 299-E17-58 borehole will be advanced into the upper Rlm to a depth of approximately 119.2 m (391 ft) bgs and then backfilled with grout or bentonite to the shallower completion depth of the well. Grout backfill is preferred; however, if grout backfill is not suitable for some drilled intervals (e.g., open-framework gravel), bentonite chips may be used.

The well is being constructed to support RCRA groundwater monitoring as described in the engineering evaluation report (SGW-60595), which provides background information justifying the well location in support of the final status groundwater monitoring network.

3.1 Sampling Objectives/Design

Drilling and well construction will be performed to provide access to the subsurface for the purpose of monitoring potential releases of hazardous waste to the vadose zone and the unconfined aquifer. The scope of activities includes sampling and analysis of soil, sampling and analysis of groundwater, and aquifer testing. Geologic logging, geophysical logging, and well development are also within the scope of planned activities. The objectives of this field sampling plan are to describe data collection activities for the following:

- Determine the depths and lithologic character of stratigraphic units at the well location (through geologic and geophysical logging) to refine the conceptual site model in the 216-A-36B Crib vicinity.
- Determine the nature and vertical extent of soil contamination at the well location in the upper portion of fine-grained sediments within the CCU and immediately above groundwater.
- Determine the nature and vertical distribution of groundwater contamination across the saturated thickness of the unconfined aquifer at the well location.
- Determine the baseline contaminant concentrations in the shallow unconfined aquifer in the completed well.
- Determine hydraulic properties (aquifer testing) within the upper unconfined aquifer. The data will provide input to various models (e.g., geoframework and groundwater model updates) being developed in the 200 Areas.

To maximize the representativeness of samples collected during drilling, water may not be added to a borehole during drilling without prior approval of the field geologist, the FWS, and the OU technical lead, and in any case not prior to collection of vadose zone samples.

The sampling design for this field sampling plan is based on judgmental sampling. 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 (i.e., previous sampling) and on professional judgment. Judgmental sampling is distinguished from probability-based sampling in that inferences are based on professional judgment, not statistical methods. Therefore, conclusions about the target population are limited and depend entirely on the validity and accuracy of professional judgment. Sample design, sample methods, locations, frequencies, constituents/contaminants of interest, procedures, and documentation requirements are identified in this field sampling plan. Table 2-3 lists the performance requirements for laboratory analysis of soil and water samples.

3.2 Sample Location, Frequency, and Constituents

The sample locations, depths of sample collection by media (frequency), and constituents/parameters for analysis are described in this section.

3.2.1 Sample Locations and Frequency

Figure 1-3 shows the location of proposed monitoring well 299-E17-58 where soil and groundwater samples will be collected, and Table 1-4 provides location details for the well.

During drilling of well 299-E17-58, continuous split-spoon or sonic core samples will be collected from the vadose zone starting 1.8 m (6 ft) above the estimated top of the CCU through at least 1.2 m (4 ft) into the CCU as shown in Table 3-1. The fine-grained CCU layer may act as a baffle to vertical infiltration of contaminants. A sample collected from the top of the CCU layer will be used to investigate whether residual contamination is present. Based on the well location, which is approximately 60 m (197 ft) east of the 216-A-36B Crib, collection of shallower vadose zone samples is not planned. The soil sample collected from the actual top of the CCU (as determined by field observation) will be submitted for laboratory analysis. Soil samples will also be collected starting 1.5 m (5 ft) above the estimated historic high water level (shown in Table 1-1) and every 1.5 m (5 ft) to immediately above the current water table. Samples collected between the historic high groundwater level and the current water table will be used to investigate potential residual contamination within this interval.

Groundwater samples will be collected during drilling, starting 10 ft below the water table and then every 4.6 m (15 ft) until the top of the Rlm is encountered. Approximately four groundwater samples will be collected at the approximate depths shown in Table 3-2. One baseline groundwater sample will also be collected following well completion and acceptance in accordance with contractor procedures.

At the discretion of the OU technical lead, field geologist, or sampler, additional soil samples may be collected for possible laboratory analysis if contamination is indicated through radiological or industrial hygiene field screening or other field observations. If such samples are collected, the laboratory analyses performed will be determined based on the nature of the indicated contamination in consultation with SMR.

3.2.2 Constituent/Parameters

Soil and groundwater samples will be analyzed for radiological and chemical constituents in accordance with the sample designs listed in Tables 3-1 and 3-2.

Table 3-1. Soil Sampling Design for Monitoring Well 299-E17-58

Soil Sampling Interval[a] (ft bgs)	Soil Sample Analysis[b]		
Continuous split-spoon or sonic core samples to be collected starting at 273 ft bgs (6 ft above the estimated top of the CCU) through at least 4 ft into the CCU at the following estimated intervals: 273 – 275.5 275.5 – 278 278 – 280.5 280.5 – 283 If CCU is deeper than anticipated, continue sampling until at least 4 ft below top of CCU. The soil sample collected from the actual top of the CCU (as determined by field observation [e.g., identification of silt-dominant sediment]) will be submitted for laboratory analysis. Split-spoon or sonic core samples collected every 5 ft, starting 5 ft above the estimated historic high water level to immediately above the current water table at the following estimated intervals: 305 – 307.5 310 – 312.5 315 – 317.5 320 – 322.5 All four samples to be submitted for laboratory analysis.	**Anions and Others**	**Metals**	
	Ammonia	Antimony	Lead
	Chloride	Arsenic	Manganese
	Cyanide (free and total)	Barium	Mercury
	Fluoride	Beryllium	Nickel
	Nitrate	Cadmium	Selenium
	Nitrite	Chromium (total)	Silver
	pH	Chromium (VI)	Uranium (total)
	Phosphate	Cobalt	Vanadium
	Sulfate	Copper	Zinc
	Organics		
	1,1,1-Trichloroethane	Benzo(a)anthracene	gamma-BHC (Lindane)
	1,1,2-Trichloroethane	Benzo(a)pyrene	Indeno[1,2,3-cd]pyrene
	1,1-Dichloroethane	Benzo(b)fluoranthene	Methylene chloride
	1,2-Dichloroethane	Benzo(ghi)perylene	Naphthalene
	2-Butanone	Benzo(k)fluoranthene	n-Butanol (butyl alcohol)
	2-Hexanone	beta-BHC (beta-HCH)	n-Butylbenzene
	4,4'-DDD	Carbon tetrachloride	Hexane
	4,4'-DDE	Chlordane	Petroleum hydrocarbons (diesel to kerosene range)
	4,4'-DDT	Chlorobenzene	Phenanthrene
	4-Methyl-2-pentanone	Chloroform	Phenol
	Acenaphthene	Chrysene	Pyrene
	Acenaphthylene	cis-1,2-Dichloroethylene	Tetrachloroethene
	Acetone	Cyclohexane	Toluene
	Acetonitrile	Dibenz[a,h]anthracene	Total polychlorinated biphenyls
	Aldrin	Dibenzofuran	trans-1,2-Dichloroethylene
	alpha-BHC (alpha-HCH)	Dieldrin	Tributyl phosphate
	Anthracene	Endrin	Trichloroethene
	Aroclor 1254[b]	Ethylbenzene	Vinyl chloride
	Aroclor 1260[b]	Fluoranthene	Xylenes (total)
	Benzene	Fluorene	
	Radionuclides		
	Americium-241	Hydrogen-3 (tritium)	Strontium-90
	Carbon-14	Iodine-129	Technetium-99
	Cesium-137	Neptunium-237	Thorium-232
	Cobalt-60	Nickel-63	Uranium-233
	Europium-152	Plutonium-238	Uranium-234
	Europium-154	Plutonium-239	Uranium-235
	Europium-155	Plutonium-240	Uranium-238

Table 3-1. Soil Sampling Design for Monitoring Well 299-E17-58

Soil Sampling Interval[a] (ft bgs)	Soil Sample Analysis[b]

a. Additional soil samples may be analyzed if contamination is indicated through radiological screening or other field observations.

b. Analyte list is based on DOE/RL-2016-58, Draft A, *200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Work Plan*.

bgs = below ground surface

CCU = Cold Creek unit

Table 3-2. Groundwater Sampling Design for Monitoring Well 299-E17-58

Groundwater Sampling Depths (ft bgs)	Groundwater Sample Analysis*	
Samples to be collected every 15 ft, starting 10 ft below the water table to the top of the Rlm at the following estimated depths: 331 346 361 376 If top of Rlm is deeper than anticipated, continue sampling every 15 ft. One baseline sample after well completion.	**Anions**	**Metals**
	Nitrate Sulfate	Chromium Hexavalent chromium Uranium (total)
	Radionuclides	**Field Parameters**
	Gross alpha Hydrogen-3 (tritium) Iodine-129 Strontium-90 Technetium-99	pH Specific conductance Temperature Turbidity

*Analyte list is based on DOE/RL-2009-85-ADD1, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit Addendum 1*, and input from the operable unit technical leads.

bgs = below ground surface

Rlm = Ringold Formation member of Wooded Island – lower mud unit

Each groundwater sample will be screened in the field for pH, temperature, conductivity, and turbidity. Groundwater samples will be collected after field measurements stabilize as follows:

- **pH:** Two consecutive measurements agree within 0.2 pH units.
- **Temperature:** Two consecutive measurements agree within 0.2°C (0.36°F).
- **Conductivity:** Two consecutive measurements agree within 10% of each other.
- **Turbidity:** <5 NTUs prior to sampling.[2]

The OU technical lead will be contacted if screening levels cannot be achieved prior to sampling.

[2] For groundwater samples collected during drilling, turbidity values <5 NTUs may not be achievable, and samples may be collected at the discretion of the field geologist or sampler once the other field parameters stabilize as indicated.

After well construction, development, and acceptance, baseline groundwater samples will be collected from each well in accordance with contractor procedures and as shown in Table 3-2. Baseline groundwater samples will also be collected for RCRA in accordance with DOE/RL-2010-93, which is not part of this SAI.

3.3 Sampling Methods

Soil samples for laboratory analysis will be collected in Lexan™ liners using a decontaminated split-spoon sampler or sonic core barrel (depending upon the drilling method) and sealed in the field. The split-spoon sampler is typically 2.5 ft long with the shoe and will not be overdriven. Each liner typically has a diameter of 4 in., a length of 6 in., and the three deepest liners within the sampling interval will be saved. For a sonic core barrel, the liner typically has a diameter of 3 to 4 in. and a length of 5 ft; to facilitate sample inspection by the field geologist and selection of sample intervals to be saved or submitted for laboratory analysis, the liner will be pre-cut into 6 in. lengths. Other methods for collecting representative soil samples for laboratory analysis may also be used during drilling.

Groundwater samples collected during drilling will be obtained using an environmental-grade pump supplied by the drilling contractor at the approximate depths shown in Table 3-2. Prior to sample collection, purging of the sampling interval will be performed at flow rates of <38 L/min (10 gal/min) until field parameters stabilize, as indicated in Section 3.2.2. Samples will be collected from the aquifer at flow rates of <3.8 L/min (1 gal/min). A baseline groundwater sample will also be collected following well completion and acceptance in accordance with contractor procedures.

3.3.1 Decontamination of Equipment

Equipment will be decontaminated in accordance with contractor procedures. To prevent potential contamination of samples, care will be taken to use decontaminated equipment for each specific sampling activity.

Special care will 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 the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

To decontaminate sampling pumps that are not permanently installed, the pump cowling is first removed, washed (if needed) in phosphate-free detergent solution, and then reinstalled on the pump. The pump is then submerged in phosphate-free detergent solution, and 11.4 L (3 gal) of solution is pumped through the unit and disposed. Additional detergent solution is then circulated through the submerged pump for 5 minutes. The pump is removed from solution and rinsed with high-purity water. The pump is submerged in high-purity water, and 30.3 L (8 gal) of high-purity water is pumped through the unit and disposed. The pump is removed from the high-purity water and the intake and housing are covered

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with plastic sleeving. The cleaning is documented on a tag affixed to the pump, which includes the following information:

- Date pump cleaned
- Pump identification
- Comments
- Signature of person performing decontamination

The drill rig derrick, all downhole equipment, and temporary casing will be decontaminated in the field (e.g., high-pressure and temperature wash), at a minimum, before mobilization and demobilization at each drilling location.

3.3.2 Radiological and Industrial Hygiene Field Data

Radiological and industrial hygiene field screening will be performed by the RCT, industrial hygiene technician, and other qualified personnel in accordance with approved methods and procedures for assessment of health and safety needs. The RCT and industrial hygiene technician will record field measurements, noting the depth of the sample and the instrument reading for alpha, beta, and gamma radiation; ammonia; oxygen; lower explosive level for combustible gases; and volatile organic compounds. Field measurements will be communicated to the field geologist for inclusion in the field logbook or operational records, as applicable.

The following information will be provided to field personnel performing work in support of this SAI:

- Instructions to RCTs on the methods required to measure sample activity and media for gamma, alpha, and/or beta emissions, as appropriate.
- Information regarding the portable radiological field instrumentation, including a physical description of the instruments, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. These instruments are commonly used at the Hanford Site to obtain measurements of removable surface contamination and direct measurements of the total surface contamination.
- 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 radiological information.
- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related information.
- 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.

3.4 Aquifer Testing

Single-well aquifer pumping and recovery tests (aquifer testing) are planned following construction of well 299-E17-58. An aquifer test is a controlled field experiment using a discharging (pumping) well. Aquifer testing is accomplished by applying a known stress to the aquifer of known or assumed dimensions and then observing the water-level response over time. Hydraulic characteristics of the aquifer can then be determined by measuring water-level drawdown and water discharge rates. When pumping is complete, a recovery test is performed as part of the testing to refine the hydraulic properties within the aquifer. The testing will be conducted to determine the transmissivity and hydraulic conductivity within the unconfined aquifer and the specific capacity of the completed well. The data will be evaluated using aquifer test analysis software and provide input to various models (e.g., geoframework and groundwater model updates) being developed for the 200 Areas.

Aquifer testing will consist of a step-drawdown test, a constant-rate discharge test, and a recovery test. Data from the step-drawdown test will be used to determine the optimum discharge rate for the constant-rate discharge test and may be evaluated as part of the hydraulic properties assessment. Each pumping step is of nearly equal duration and is conducted until the drawdown minimally changes. Total drawdown will not exceed 20% of available drawdown. After the step-drawdown test is completed, the water level will be allowed to fully recover before the constant-rate discharge test is initiated.

A constant-rate pumping test will follow the step test using the optimum pumping rate. Drawdown test data will be evaluated during testing to determine when it is appropriate to end the pumping test. The pumping test duration will likely not exceed one day shift. If it is determined that a pumping duration beyond a standard day shift is required to evaluate hydraulic properties, a separate test plan will be developed that incorporates the required resources for additional aquifer testing at a later date.

For the constant-rate test, the initial pumping rate may be adjusted during the first few minutes of the test if excessive drawdown is observed. Following flow rate adjustment (if needed), the test must be left undisturbed throughout its duration. Table 3-3 summarizes the aquifer test information.

Table 3-3. Aquifer Test Information

Well	Depth to Water (ft bgs)	Saturated Open Interval (ft bgs)	Hydrostratigraphic Unit to Be Tested	Estimated Length of Pumping/ Recovery Tests*	Maximum Drawdown
299-E17-58	321	321–341	Rwie	8 hours/ up to 16 hours	20% of water column

*Following installation of the pump and pressure transducer(s), water levels will be allowed to stabilize until static conditions are observed.

bgs = below ground surface

Rwie = Ringold Formation member of Wooded Island – unit E

Equipment used for aquifer testing includes the following:

- **Submersible pump:** Used to extract groundwater from the aquifer.
- **Flow meter:** Used to document the pumping rate (e.g., in gal/min) and totalizer reading (total cumulative gallons).

- **Gate valve or flow controller:** Used to adjust the flow rate at the surface. The gate valve (if used) must be placed downstream of the flow meter.
- **Data logging system:** This includes a self-powered data logger and transducer(s). The system is used to automatically record changes in water levels over time.
- **E-tape:** Used for recording manual water levels.

A pressure transducer will be used in the pumping well to measure water levels before, during, and after testing. Water levels from transducer readings will be confirmed with manual measurements both before the constant-rate pumping test begins and after the recovery test is completed. The riser pipe method of installing the water-level transducer (i.e., transducer is installed simultaneously with the pump) will be used in the pumping well. Measurement of the transducer and pump intake distance below the first section of riser pipe will be made to determine the location below ground surface and the water table. Arrangements will be made with the Hanford Meteorological Station to provide hourly measurements of barometric pressure during the test.

Following installation of the pump and pressure transducer, the water level is measured manually. Water levels then are allowed to stabilize, and the transducer collects water-level measurements without disturbance during this period. Before starting the aquifer test, the water level is again measured manually, and the water-level transducer data are evaluated to ensure that static water levels have been achieved. Once static water levels have been verified, aquifer testing may begin. No downhole adjustments or other subsurface activities (other than manual water-level measurements) may be made after the transducers are installed and set to collect pre-test, test, and post-test measurements. Following termination of the pumping test, recovery testing will be performed. The recovery test consists of monitoring water levels with the transducer for up to two times the pumping duration or until water levels recover to static. For accurate collection of recovery test data, the downhole equipment and tubing string must not be disturbed, and the pump should be equipped with a check valve to prevent backflow; however, a check valve may not be used unless waste management and health and safety issues can be addressed. If a check valve cannot be used, evaluation of the recovery test data will need to account for backflow following termination of the pumping test. After recovery testing, the water level is again measured manually.

Following completion of the aquifer test, baseline water levels will be collected hourly using a pressure transducer for a period of at least 2 weeks.

3.5 Documentation of Field Activities

Logbooks are required for field sampling activities. The logbook must be identified with a unique project name and number. Only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes. Data forms are also required for field activities and will be controlled in accordance with internal work requirements and processes.

Logbooks will be used in accordance with HASQARD requirements (DOE/RL-96-68). Logbook entries will be reviewed by the FWS, cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, 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.

Data forms for sampling will be used to collect some field information; however, 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 or on data forms is as follows:

- Day and date; time task started; weather conditions; and names, titles, and organizations of personnel performing the task.
- Purpose of visit to the task area.
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information (e.g., soil boring log or well completion log). Also, details of any field tests that were conducted, with reference to any forms that were used, other data records, and methods followed in conducting the activity.
- Details of any field calibrations and surveys that were conducted. Reference any forms that were used, other data records, and the methods followed in conducting the calibrations and surveys.
- Details of any samples collected.
- Reference the methods followed in sample collection or preparation; list location of sample collected, sample type, each label or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and analytical request form number pertinent to each sample or sample set; and note the time and the name of the individual to whom custody of samples was transferred.
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed. Reference the page numbers of any logbook where detailed information is recorded.
- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements.

3.5.1 Corrective Actions and Deviation for Sampling Activities

The OU project manager, FWS, appropriate field crew supervisors, and SMR must document deviations from protocols, as well as issues pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected due to field conditions.

As appropriate, such deviations or issues will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The OU project manager, FWS, field crew supervisors, or SMR will be responsible for communicating field corrective action requirements and for ensuring that corrective actions are applied to field activities as soon as practical. The project director (or designee) will notify DOE, as appropriate.

Table 2-2 defines the types of changes that may impact sampling and the associated approvals, notifications, and documentation requirements.

3.6 Calibration of Field Equipment

Onsite environmental instruments are calibrated in accordance with manufacturer's operating instructions, internal work requirements and processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records will include the raw calibration data, identification of the standards used, associated reports, date of analysis, and analyst's name or initials. The results from all instrument calibration activities are recorded in accordance with HASQARD requirements (DOE/RL-96-68).

Field instrumentation calibration and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system
- At the frequency recommended by the manufacturer or methods, or as required by regulations
- Upon failure to meet specified quality control criteria

Calibration of radiological field instruments at the Hanford Site is performed by Hanford Mission Integration Solutions, as specified by their calibration program.

Daily calibration checks will be performed and documented for each instrument used. These checks will be made on standard materials sufficiently similar to the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.

Standards for calibration will be used that are traceable to a nationally recognized standard agency source or measurement system. Manufacturers' recommendations for storage and handling of standards (if any) will be followed. Expired standards will not be used for calibration.

3.7 Sample Handling

Sample handling and transfer will be in accordance with established methods and procedures to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date. If during the chain-of-custody process it is discovered that the custody tape has been tampered with or broken on the sample bottle, SMR will be notified, and the sample will be analyzed; however, the results will include a flag to indicate that custody was broken. If the custody tape has been tampered with or broken on the cooler, this condition will be documented in the data package.

A sampling and analytical database is used to track samples from the point of collection through the laboratory analysis process.

3.7.1 Containers

Samples will be collected, where and when appropriate, in break-resistant containers. The field sample collection record will indicate the laboratory lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, the name of the manufacturer, lot identification, and certification will be retained for documentation.

Containers will be capped and stored in an environment that minimizes the possibility of sample container contamination. If contamination of the stored sample containers occurs, corrective actions will be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting

analytical detection limits. Container types and sample amounts/volumes are identified on the chain-of-custody form.

The Radiological Control organization will measure both the contamination levels and dose rates associated with the filled 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 radioactivity acceptance criteria. If the dose rate on the outside of a sample container or the curie content exceeds levels acceptable by an offsite laboratory, the FWS (in consultation with SMR) can send smaller sample volumes to the laboratory. Such a sample size reduction may result in elevated minimum detectable concentrations or practical quantitation limits, and it may not be possible to perform all requested analyses. If this occurs, the OU project manager or OU technical lead will consult with DOE-RL and the lead regulatory agency regarding which analyses will be performed.

3.7.2 Container Labeling

Each sample is identified by affixing a standardized label or tag to the container. The label or tag will contain the sample identification number. The label will identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be either pre-printed or handwritten in indelible or waterproof ink.

3.7.3 Sample Custody

Sample custody will be maintained in accordance with contractor and subcontract laboratory protocols to ensure that sample integrity is maintained throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each sample or set of samples shipped 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 for the custody of the sample changes, the new and previous custodians will sign the record and note the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to SMR.

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

- Project name
- Collectors' names
- Unique sample number
- Date, time, and location (or traceable reference thereto) of sample collection
- Matrix
- Preservatives
- Chain-of-possession information (i.e., signatures and printed names of each individual involved in the transfer of sample custody and storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)

- Number of sample containers per unique sample identification number
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers should note any anomalies with the samples. If anomalies are found, samplers should inform SMR so special direction for analysis can be provided to the laboratory if deemed necessary.

3.7.4 Sample Transportation

Packaging and transportation instructions will comply with applicable transportation regulations and DOE requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 177, "Carriage by Public Highway."[3] Carrier-specific requirements defined in the current edition of International Air Transportation Association (IATA), 2019, *Dangerous Goods Regulations,* will also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents above regulated amounts will be considered hazardous material in transportation and transported in accordance with DOT/IATA requirements. If the sample material is known or can be identified, then it will be packaged, marked, labeled, and shipped according to the specific instructions for that material. Appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

Materials are classified by DOT/IATA as radioactive when the isotope specific activity concentration and the exempt consignment limits described in 49 CFR 173, "Shippers—General Requirements for Shipments and Packagings," are exceeded. Samples will be screened, or relevant historical data will be used, to determine if these values are exceeded. When screening or historical data indicate samples are radioactive, the samples will be properly classified, described, packaged, marked, labeled, and transported in accordance with DOT/IATA requirements.

Prior to shipping radioactive samples to the laboratory, the organization responsible for shipping will notify the laboratory of the approximate number of samples and the radiological levels. The laboratory is responsible for ensuring that the applicable license limits are not exceeded. Prior to sample receipt, the laboratory will provide SMR with written acceptance for samples with elevated radioactive contamination or dose.

[3] Transportation regulations 49 CFR 174, "Carriage by Rail"; and 49 CFR 176, "Carriage by Vessel," are not applicable, as these two transportation methods are not used.

4 Management of Waste

Waste materials are generated during sample collection, processing, and subsampling activities. Waste will be managed in accordance with DOE/RL-2004-18, *Waste Control Plan for the 200-PO-1 Operable Unit*, which was updated through a Tri-Party Agreement change notice (TPA-CN-0904, *Tri-Party Agreement Change Notice Form: DOE/RL-2004-18, Waste Control Plan for the 200-PO-1 Operable Unit, Rev. 1*) to add proposed well 299-E17-58.

Miscellaneous solid waste that has contacted suspect dangerous waste will be managed as dangerous waste. Purgewater and decontamination fluids will be collected and managed in accordance with DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*; and DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste*. Purgewater will be sent to the modular storage units. If purgewater cannot be sent to the modular storage units, it may be sent to the 200 West pump and treat facility if feed stream acceptance criteria can be met. Small amounts of liquid waste can also be sent to the Environmental Restoration Disposal Facility if the waste is stabilized. If additional treatment for stabilization is necessary, treatment options will be evaluated based on the waste characteristics. If treatment options are not available, the waste may be managed at an appropriate onsite facility (i.e., Solid Waste Operations Complex) until an appropriate offsite disposal facility is identified and approved.

Packaging and labeling during waste storage and transportation will meet the applicable substantive federal and/or state requirements. Waste materials requiring collection will be placed into containers appropriate for the material and the receiving facility in accordance with the applicable waste management or waste control plan and applicable substantive federal and/or state requirements.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities and wastes generated during analytical processes.

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5 Health and Safety

DOE established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed-waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response"; 10 CFR 830, "Nuclear Safety Management"; and 10 CFR 835. The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training; control of industrial safety and radiological hazards; personal protective equipment; site control and general emergency response to spills, fire, accidents, injury, site visitors; and incident reporting are governed by the health and safety program. Site-specific health and safety plans will be used to supplement the general health and safety program.

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6 Reporting

A field summary report will be prepared to document the drilling, well construction, geologic logging, geophysical logging, aquifer testing, and soil and groundwater sampling results. Information provided in the report will include, but not be limited to, the following:

- Well location maps
- Sample depths
- Sample numbers
- Sampling methods, including purging and sampling rates for collection of all groundwater samples (during drilling and post-construction)
- Sample recoveries (documented on the geologic log/field paperwork)
- Groundwater chemistry data
- Groundwater radionuclide data
- Field screening data (radiological controls/industrial hygiene)
- Depth to water measurements
- Geologic log
- Borehole geophysical logging report
- Surface geophysical logging report
- Dates of drilling and well construction
- Water added to the borehole
- Photographs
- Well construction information presented in a summary table and figures (e.g., as-builts)
- Aquifer test results
- Survey data (vertical and horizontal)
- Evaluation of borehole sealant effectiveness (as discussed in Section 1.4.3)
- Any major deviations from the plan described in this SAI

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Appendix A

Data Quality Objective Systematic Planning Record for 216-A-36B Crib Replacement Well

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A1 Data Quality Objective Systematic Planning Record for 216-A-36B Crib Replacement Well

This systematic planning record documents the data quality objective (DQO) process for the purpose of determining the quality and quantity of data to be collected during and after installation one groundwater monitoring well, 299-E17-58, to replace well 299-E17-1. The well is being planned to support *Resource Conservation and Recovery Act of 1976* (RCRA) groundwater monitoring efforts at the 216-A-36B Crib.

Although RCRA groundwater monitoring is the driver for well installation at the 216-A-36B Crib, data will also be collected during and after well installation to support multiple Hanford Site contractor characterization needs.

The systematic planning process incorporates the steps identified in EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Proces*s (EPA QA/G-4). Major elements of the DQO process and reference to relevant information are identified as follows:

1. Statement of the problem
2. Identification of the study goals
3. Identification of information inputs
4. Definition of the study boundaries (i.e., data needs)
5. Development of the analytical approach (Tables A-1, A-2, and A-3)
6. Specification of performance or acceptance criteria (Table A-3)
7. Development of the plan for obtaining data

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Project Summary	
Project Name: M-24-00 Characterization of 299-E17-58 to replace 299-E17-1 upgradient of the 216-A-36B Crib	Date: November 13, 2020
Name of Person Completing Record: Bob Martin	Position: Hydrogeologist
Name of Responsible Manager: William Faught	

Project Background:

The 216-A-36B Crib is an inactive crib that is located approximately 360 m (1,200 ft) south of the Plutonium-Uranium Extraction (PUREX) Plant in the southeast corner of the 200 East Area (Figures A-1 and A-2). The 216-A-36B Crib comprises the southern 152 m (500 ft) portion of the original 216-A-36 Crib. The bottom of the crib is approximately 7.3 m (24 ft) below grade. During construction, a 15 cm (6 in.) diameter perforated stainless-steel distribution pipe was placed horizontally at 7 m (23 ft) below grade. Crib construction also included approximately 7 m (23 ft) of clean backfill soil that became naturally revegetated with native grasses over time. An herbicide treatment program has controlled deep-rooting plants.

Beginning in September 1965, the 216-A-36 Crib received ammonia scrubber distillate effluent wastewater from the PUREX Plant. In March 1966, the 216-A-36 Crib was divided into two sections: 216-A-36A and 216-A-36B. The northern section of the crib (216-A-36A) was removed from service due to the rapid buildup of fission products within the first 30 m (100 ft) of the crib. In 1966, a vertical grout barrier was placed 30 m (100 ft) from the north end of the crib to isolate the heavily contaminated northern portion, thus subdividing the crib into the 216-A-36A (northern) portion and the 216-A-36B (southern) portion. After the grout barrier was placed in 1966, the 216-A-36B Crib continued to receive wastewater until it was temporarily removed from service in October 1972. The 216-A-36B Crib was returned to service in 1982 due to the restart of the PUREX Plant and received ammonia scrubber distillate effluent wastewater through 1987. Between 1966 and 1987, the 216-A-36B Crib received approximately 315 million L (83 million gal) of ammonia scrubber distillate effluent wastewater.

The groundwater beneath the 216-A-36B Crib area is contaminated. The primary contaminants of potential concern are nitrate, strontium-90, and tritium, which occur at concentrations above drinking water standards. Additional information concerning groundwater conditions beneath the 216-A-36B Crib area is provided in DOE/RL-2019-66, *Hanford Site Groundwater Monitoring Report for 2019*. The sampling and analysis instruction (SAI) describes the opportunistic sampling planned during the drilling and construction of one Milestone M-24-00 groundwater monitoring well, 299-E17-58, to replace 299-E17-1 upgradient of the 216-A-36B Crib. The well is being drilled to support RCRA groundwater monitoring as described in SGW-60595, *Engineering Evaluation Report for the 216-A-36B Crib Groundwater Monitoring*. The engineering evaluation report provides background information justifying the well location in support of the final status groundwater monitoring network.

The borehole will be advanced a total depth of 119.2 m (391 ft) below ground surface (bgs) into the Ringold Formation member of Wooded Island – lower mud unit (Rlm), which is anticipated to be present approximately 117.7 m (386 ft) bgs. The borehole will then be backfilled with grout to the shallower completion depth of the well at approximately 104.9 m (344 ft) bgs, with an anticipated water level of 97.8 m (321 ft) bgs. Although RCRA regulations drive the development of a groundwater network through drilling of groundwater wells, opportunistic sampling and analysis of soil and groundwater, geologic characterization, and aquifer testing are planned at the

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Characterization Data Collection Planning Record

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well location for *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). Soil samples will be collected to better define the nature and extent of contamination in the vadose zone, and groundwater will be sampled to better define the nature and extent of contamination across the saturated thickness of the unconfined aquifer. The various data needs are integrated into this opportunistic SAI to create efficiencies and reduce costs. Efficiencies are achieved by exploiting opportunities associated with Milestone M-24-00 well drilling and construction, as defined in SGW-60595.

RCRA groundwater monitoring at the 216-A-36B Crib is currently conducted in accordance with DOE/RL-2010-93, *Interim Status Groundwater Monitoring Plan for the 216-A-36B PUREX Plant Crib*. Prior to completion of the new well, DOE/RL-2010-93 will be updated to include the well and specify the initial and continuing sampling and analysis necessary to support final status groundwater monitoring for RCRA at the 216-A-36B Crib.

Opportunistic samples collected under this SAI will be analyzed in accordance with DOE/RL-2003-04, *Sampling and Analysis Plan for the 200-PO-1 Groundwater Operable Unit*; and DOE/RL-2016-58, Draft A, *200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Work Plan*.

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Planning Type:
(If systematic planning is not required, state the reason)

This systematic planning record (i.e., DQO) describes the characterization and sampling efforts planned during and after the drilling and construction of one groundwater monitoring well (299-E17-58) (Figure A-2). Construction of the well is required to support RCRA interim and final status groundwater monitoring as agreed upon between the Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Richland Operations Office (DOE-RL). Justification for RCRA activities is described in SGW-60595. Although RCRA groundwater monitoring provides the impetus for drilling and groundwater well construction, sampling and analysis of soil and groundwater are also planned to support other environmental data needs that may be useful for cleanup efforts under the authority of CERCLA. These unrelated CERCLA needs are reflected in agreements between DOE-RL and the remediation contractor. The various data needs for RCRA, CERCLA, and other activities are integrated into this SAI to create efficiencies and reduce costs. Efficiencies are achieved by incorporating current and future drilling and sampling needs into a single versus multi-investigation approach to reduce drilling and planning costs. The objectives of the SAI are to describe data collection activities to provide additional information for the following:

- Determine the depths and lithologic character of stratigraphic units at each drilling location (through geologic and geophysical logging) to refine the conceptual site model in the 216-A-36B Crib vicinity.
- Better define the vertical extent of soil contamination in the upper portion of fine-grained sediments within the Cold Creek unit (CCU) and in the vadose zone immediately above the groundwater table.
- Better define the vertical distribution of groundwater contamination across the saturated thickness of the unconfined aquifer.
- Determine the baseline contamination in the upper unconfined aquifer in the completed well

Field activities will also include aquifer testing within the upper unconfined aquifer to better define the hydraulic properties.

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Organization, Schedule, and Goal

(State the problem, requirements, schedule, PSQs, and outcomes)

State the Problem

(Describe the reason/need for data collection and project goals/objectives)

There is a lack of data for the 216-A-36B Crib regarding the vertical distribution of contamination across vadose zone soil and the saturated thickness of the unconfined aquifer. In addition, baseline contamination and hydraulic properties in the upper unconfined aquifer need to be determined after well 299-E17-58 is completed.

Principal Study Questions (PSQs) *(What questions are data needed to answer?)*	PSQ #1	What is the nature and vertical extent of soil contamination in the upper portion of fine-grained sediments within the CCU and immediately above groundwater at well 299-E17-58 (specific to the depths and analytes identified in Table A-1)?	PSQ #3	Is the nature of contamination in the upper unconfined aquifer, as found in baseline samples collected following acceptance of groundwater monitoring well 299-E17-58 (specific to the analyte list identified in Table A-2) consistent with contamination found through implementation of DOE/RL-2003-04?
	PSQ #2	What is the vertical distribution of groundwater contamination across the saturated thickness of the unconfined aquifer at well 299-E17-58 (specific to the analytes identified in Table A-2)?		
Define alternative outcomes or actions that can occur upon answering PSQs.	AA #1	Soil contaminant data obtained from well 299-E17-58 (specific to the depths and analytes identified in Table A-1) may better define the upper portion of fine-grained sediments within the CCU and immediately above groundwater for remedial decision making.	AA #3	If the nature of contamination in the unconfined aquifer at 299-E17-58 (specific to the analyte list identified in Table A-2) is consistent with contamination found through implementation of DOE/RL-2003-04, then continue monitoring these wells in accordance with DOE/RL-2003-04. If the nature of contamination in the unconfined aquifer at 299-E17-58 (specific to the analyte list identified in Table A-2) is not consistent with contamination found through implementation of DOE/RL-2003-04, then update the conceptual site model, which could include changes to DOE/RL-2003-04 and optimization of remedial design.
	AA #2	Groundwater contaminant data obtained from well 299-E17-58 (specific to the analyte list in Table A-2) may better define the vertical distribution of contamination across the saturated thickness of the unconfined aquifer.		

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Identify the decision statements or estimation statements needed to address the PSQs.	AA #1	Determine the vertical distribution of soil contamination across the unsaturated thickness of the vadose zone at well 299-E17-58 and determine the depths of maximum contamination for each constituent.
	AA #2	Determine the vertical distribution of groundwater contamination across the saturated thickness of the unconfined aquifer at well 299-E17-58 and determine the depths of maximum contamination for each constituent.
	AA #3	Determine whether groundwater contamination concentrations in baseline samples collected from well 299-E17-58 are consistent with contamination found through implementation of DOE/RL-2003-04.

Data Needs

(Define the spatial and temporal boundaries of the study)

Define what constitutes a sampling unit:

Sampling of vadose soil and groundwater is within the scope of this DQO. Soil sampling will be collected in Lexan™ liners using a split-spoon sampler or sonic core barrel. A pump will be used to collect groundwater samples during well drilling and following well completion and acceptance.

Spatial boundaries:

- Sampling is organized to support the following: determine contaminant concentrations in the upper portion of fine-grained soil within the CCU and immediately above groundwater, and to determine groundwater contaminant concentrations across the saturated thickness of the unconfined aquifer.
- The investigation includes sampling and analysis of soil and groundwater during drilling of well 299-E17-58. Drilling and sampling will terminate approximately 1.5 m (5 ft) into the Rlm, which is expected at a depth of approximately 119.2 m (391 ft) bgs.
- The location of groundwater monitoring well 299-E17-58 is shown in Figure A-2. The sample design for the well is presented in Tables A-1 and A-2.

Temporal boundaries:

- Soil sampling will be conducted during well drilling. Groundwater sampling will be conducted during drilling and after well completion and acceptance.

What is the smallest unit upon which decisions or estimates will be made?

For the purpose of soil sampling, the smallest unit for decision/estimation is the sampling depth interval measured in half-foot increments.

For the purpose of groundwater sampling, the smallest unit for decision/estimation is the depth of the pump intake measured in whole feet.

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Data Needs Summary

(Information inputs to answer PSQs: target population, characteristics of interest, spatial and temporal limits, scale of inference)

PSQ	Data Need	Media of Interest	Location	Sampling Method	Action Level	Frequency	Practical Constraints	Analytical Method	Potential Source of Data
1	Data for parameters listed in Table A-1 are needed to determine the vertical distribution of contamination in the vadose soil.	Soil	299-E17-58	Split spoon or sonic core	Samples will be collected as defined in Table A-1	Table A-1	Provided in "Plan for Obtaining Data"	Table A-3	Site-specific sampling
2	Data for parameters listed in Table A-2 are needed to determine vertical distribution of contamination in the unconfined aquifer.	Groundwater	299-E17-58	Pump	Samples will be collected as defined in Table A-2	Table A-2	Provided in "Plan for Obtaining Data"	Table A-3	Site-specific sampling
3	Data for parameters listed in Table A-3 are needed to determine baseline contaminant concentrations in the upper unconfined aquifer after well completion and acceptance.	Groundwater	299-E17-58	Pump	Samples will be collected as defined in Table A-2	Table A-2	Provided in "Plan for Obtaining Data"	Table A-3	Site-specific sampling

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Performance or Acceptance Criteria
(Determine the quality of data needed and analytical approach)

Specify the population parameter (e.g., mean, median, or percentile), appropriate for making decisions or estimates:

Judgmental sampling will be used to identify sampling units (i.e., the number and location and/or timing of collecting samples) based on knowledge of the feature under investigation (i.e., previous sampling) and on professional judgment.

Decision Problem	**Provide a decision rule related to the action level identified above that includes a clear "if…then…else" statement:** **PSQ #1:** If soil data obtained from well 299-E17-58 (specific to the depths and analytes identified in Table A-1) better define the vertical distribution of contamination in the upper portion of fine-grained sediments within the CCU and immediately above groundwater, update the conceptual site model and assess the need to optimize the remedial design; else, make no changes to the conceptual site model or remedial design. **PSQ #2:** If groundwater data obtained from well 299-E17-58 (specific to the depths and analytes identified in Table A-2) better define the vertical distribution of contamination across the saturated thickness of the unconfined aquifer, update the conceptual site model and assess the need to optimize a remedy; else, make no changes to the conceptual site model or remedial design. **PSQ #3:** If the nature of contamination in the unconfined aquifer at groundwater monitoring well 299-E17-58 (specific to the analyte list identified in Table A-2) is consistent with contamination found through implementation of DOE/RL-2003-04, then continue monitoring these wells in accordance with DOE/RL-2003-04; else, update the conceptual site model, assess the need to supplement monitoring within DOE/RL-2003-04, and assess the need to optimize a remedy.

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Specify the population parameter (e.g., mean, median, or percentile), appropriate for making decisions or estimates:

What are the consequences of making an incorrect decision and what is the tolerance for an incorrect decision?

PSQ #1: If the data show elevated concentrations of contaminants in the upper portion of fine-grained sediments within the CCU and immediately above groundwater when in fact concentrations are low, then contaminant concentrations and risk from the vadose soil will be overestimated, leading to incorrect changes to the conceptual site model and potentially unneeded changes to a remedy. If the data show low concentrations of contaminants in the upper portion of fine-grained sediments within the CCU and immediately above groundwater when in fact concentrations are elevated, then contaminant concentrations and risk from the vadose soil will be underestimated, leading to an incorrect conceptual site model and potentially required changes not being made to a remedy.

PSQ #2: If the data show elevated concentrations of contaminants across the saturated thickness of the aquifer when in fact concentrations are low, then contaminant concentrations and risk across the saturated thickness of the aquifer will be overestimated, leading to incorrect changes to the conceptual site model and potentially unneeded changes to a remedy. If the data show low concentrations of contaminants across the saturated thickness of the aquifer when in fact concentrations are elevated, then contaminant concentrations and risk across the saturated thickness of the aquifer will be underestimated, leading to an incorrect conceptual site model and potentially required changes not being made to a remedy.

PSQ #3: If the data show contaminant concentrations in the upper unconfined aquifer consistent with contamination found through implementation of DOE/RL-2003-04 when in fact concentrations are lower or higher, then contaminant concentrations and risk within the upper unconfined aquifer will be overestimated or underestimated, respectively, and necessary changes to DOE/RL-2003-04, to the remedial design, or to the conceptual site model would not be made. If the data show contaminant concentrations in the upper unconfined aquifer inconsistent with contamination found through implementation of DOE/RL-2003-04 when in fact concentrations are consistent, then unnecessary or erroneous changes could be made to DOE/RL-2003-04, to the remedial design, or to the conceptual site model.

Estimation Problem

Develop the specification of the estimator by combining the true value of the selected population parameter with the scale of estimation and other boundaries:

A statistical sampling design is not applicable to this effort; therefore, concentrations detected will only be compared to background levels, cleanup values, or both for decision-making purposes. The sampling design is based on judgmental sampling.

What are the acceptable limits on uncertainty?

Limits of uncertainty are mainly associated with analytical laboratory error. The limits on analytical uncertainty are specified in the SAI. A robust quality assurance/quality control program minimizes analytical uncertainties.

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Plan for Obtaining the Data

(Specify the general plan of obtaining the needed data and explain where and how the information in this Planning Record will be formalized in a data collection plan)

Characterization data necessary to evaluate the PSQs identified in this DQO will be collected during and after the drilling and construction of well 299-E17-58 by sampling and analysis of vadose soil and groundwater according to the sample design in Table A-1, and as follows:

- **PSQ #1:** Soil samples will be collected during drilling at the depth intervals shown in Table A-1 for well 299-E17-58.
- **PSQ #2:** Groundwater samples will be collected during drilling as the depth intervals shown in Table A-2 for well 299-E17-58.
- **PSQ #3:** Groundwater samples will be collected from the upper unconfined aquifer following completion and acceptance of well 299-E17-58.

Geologic logging, geophysical logging, and aquifer testing are also within the scope of planned activities. All sampling, analysis, logging, aquifer testing, drilling, well construction, and associated activities (e.g., decontamination and sample custody) will be conducted and controlled in accordance with contractor procedures. Radiological control and industrial hygiene coverage will be provided during these efforts.

Practical considerations to be accounted for during the planning of sample collection include cultural and ecological site restrictions.

Figures A-1 and A-2 show the location of the 216-A-36B Crib and planned groundwater monitoring well 299-E17-58, respectively.

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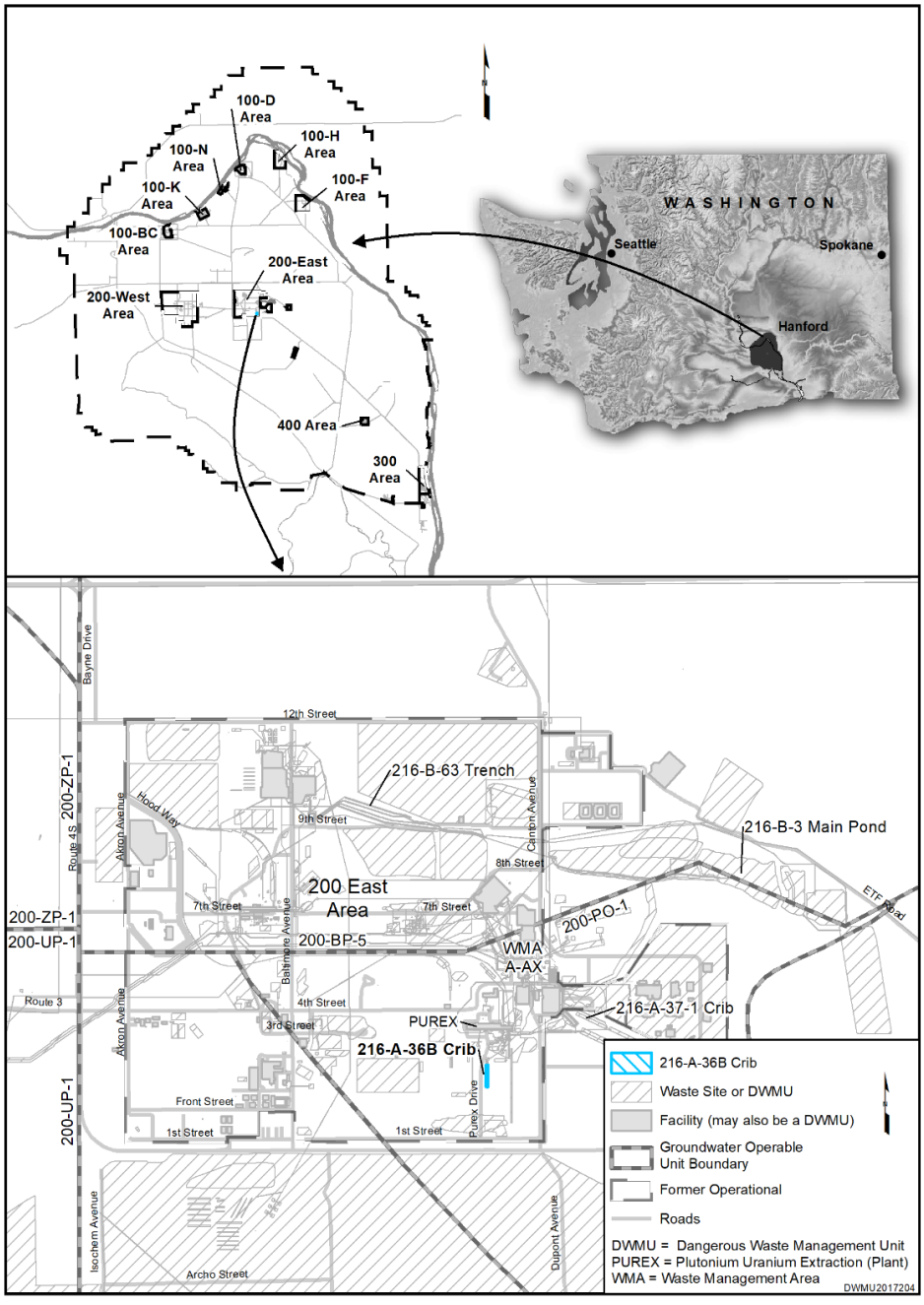

Figure A-1. Location Map of the Hanford Site, 200 East Area, and 216-A-36B Crib

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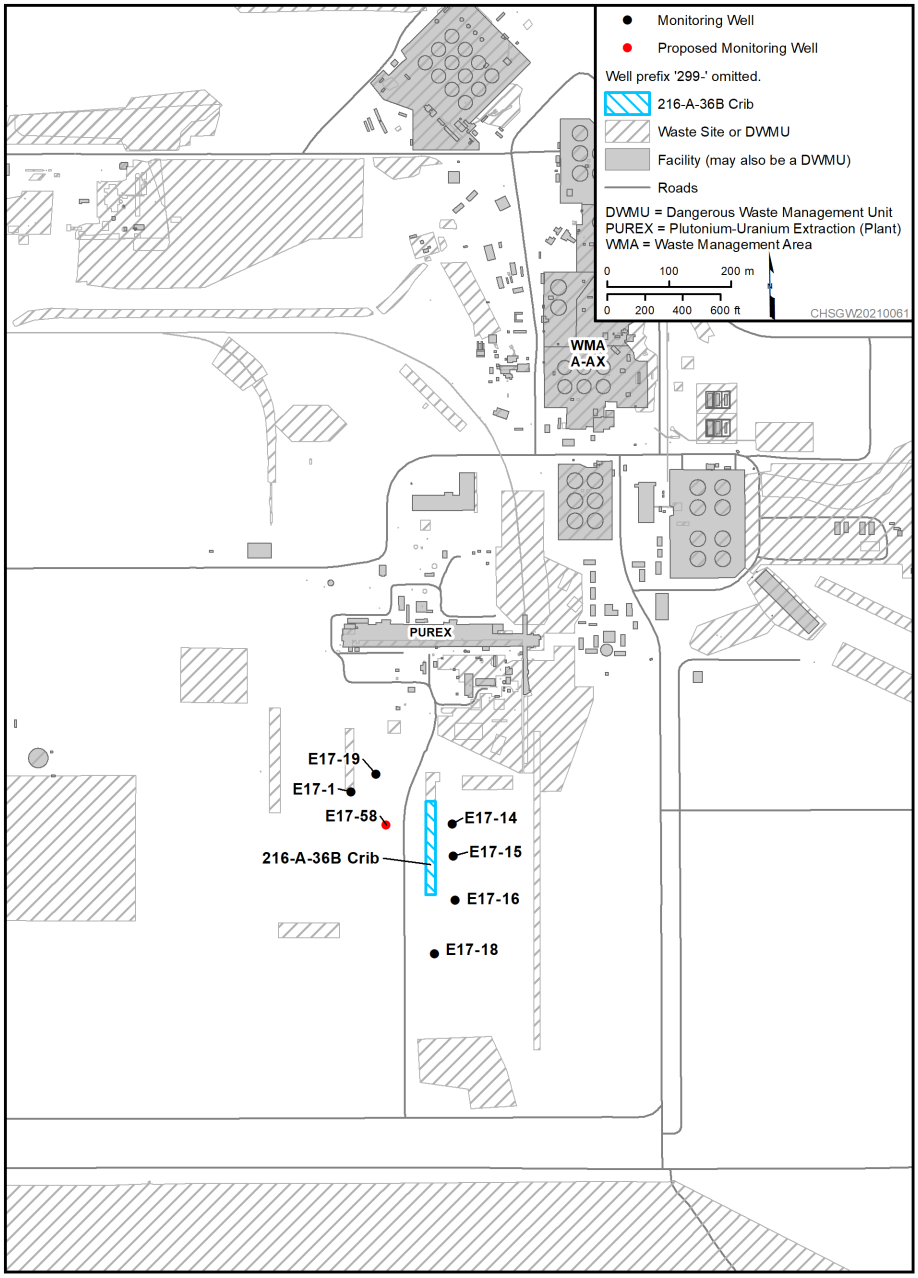

Note: Drilling locations may be subject to change pending the identified practical considerations.

Figure A-2. Groundwater Monitoring Well Locations for the 216-A-36B Crib (Existing and Proposed)

Table A-1. Soil Sampling Design for Monitoring Well 299-E17-58

Soil Sampling Interval[a] (ft bgs)	Soil Sample Analysis[b]		
Continuous split-spoon or sonic core samples to be collected starting at 273 ft bgs (6 ft above the estimated top of the CCU) through at least 4 ft into the CCU at the following estimated intervals: 273 – 275.5 275.5 – 278 278 – 280.5 280.5 – 283 If CCU is deeper than anticipated, continue sampling until at least 4 ft below top of CCU. The soil sample collected from the actual top of the CCU (as determined by field observation [e.g., identification of silt-dominant sediment]) will be submitted for laboratory analysis. Split-spoon or sonic core samples collected every 5 ft, starting 5 ft above the estimated historic high water level to immediately above the current water table at the following estimated intervals: 305 – 307.5 310 – 312.5 315 – 317.5 320 – 322.5 All four samples to be submitted for laboratory analysis.	**Anions and Others**	**Metals**	
	Ammonia	Antimony	Lead
	Chloride	Arsenic	Manganese
	Cyanide (free and total)	Barium	Mercury
	Fluoride	Beryllium	Nickel
	Nitrate	Cadmium	Selenium
	Nitrite	Chromium (total)	Silver
	pH	Chromium (VI)	Uranium (total)
	Phosphate	Cobalt	Vanadium
	Sulfate	Copper	Zinc
	Organics		
	1,1,1-Trichloroethane	Benzo(a)anthracene	gamma-BHC (Lindane)
	1,1,2-Trichloroethane	Benzo(a)pyrene	Indeno[1,2,3-cd]pyrene
	1,1-Dichloroethane	Benzo(b)fluoranthene	Methylene chloride
	1,2-Dichloroethane	Benzo(ghi)perylene	Naphthalene
	2-Butanone	Benzo(k)fluoranthene	n-Butanol (butyl alcohol)
	2-Hexanone	beta-BHC (beta-HCH)	n-Butylbenzene
	4,4'-DDD	Carbon tetrachloride	Hexane
	4,4'-DDE	Chlordane	Petroleum hydrocarbons (diesel to kerosene range)
	4,4'-DDT	Chlorobenzene	Phenanthrene
	4-Methyl-2-pentanone	Chloroform	Phenol
	Acenaphthene	Chrysene	Pyrene
	Acenaphthylene	cis-1,2-Dichloroethylene	Tetrachloroethene
	Acetone	Cyclohexane	Toluene
	Acetonitrile	Dibenz[a,h]anthracene	Total polychlorinated biphenyls
	Aldrin	Dibenzofuran	trans-1,2-Dichloroethylene
	alpha-BHC (alpha-HCH)	Dieldrin	Tributyl phosphate
	Anthracene	Endrin	Trichloroethene
	Aroclor 1254[b]	Ethylbenzene	Vinyl chloride
	Aroclor 1260[b]	Fluoranthene	Xylenes (total)
	Benzene	Fluorene	
	Radionuclides		
	Americium-241	Hydrogen-3 (tritium)	Strontium-90
	Carbon-14	Iodine-129	Technetium-99
	Cesium-137	Neptunium-237	Thorium-232
	Cobalt-60	Nickel-63	Uranium-233
	Europium-152	Plutonium-238	Uranium-234
	Europium-154	Plutonium-239	Uranium-235
	Europium-155	Plutonium-240	Uranium-238

Table A-1. Soil Sampling Design for Monitoring Well 299-E17-58

Soil Sampling Interval[a] (ft bgs)	Soil Sample Analysis[b]

a. Additional soil samples may be analyzed if contamination is indicated through radiological screening or other field observations.

b. Analyte list is based on DOE/RL-2016-58, Draft A, *200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Work Plan*.

bgs = below ground surface

CCU = Cold Creek unit

Table A-2. Groundwater Sampling Design for Monitoring Well 299-E17-58

Groundwater Sampling Depths (ft bgs)	Groundwater Sample Analysis*	
Samples to be collected every 15 ft, starting 10 ft below the water table to the top of the Rlm at the following estimated depths: 331 346 361 376 If top of Rlm is deeper than anticipated, continue sampling every 15 ft. One baseline sample after well completion.	**Anions**	**Metals**
	Nitrate Sulfate	Chromium Hexavalent chromium Uranium (total)
	Radionuclides	**Field Parameters**
	Gross alpha Hydrogen-3 (tritium) Iodine-129 Strontium-90 Technetium-99	pH Specific conductance Temperature Turbidity

*Analyte list is based on DOE/RL-2009-85-ADD1, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit Addendum 1*, and input from the operable unit technical leads.

bgs = below ground surface

Rlm = Ringold Formation member of Wooded Island – lower mud unit

Table A-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
General Chemistry Parameters				
pH	PH	150.1	N/A	N/A
Chloride	16887-00-6	300 or 9056	—	55,000
Fluoride	16984-48-8	300 or 9056	—	25,000
Nitrate	14797-55-8	300 or 9056	525	12,500
Nitrite	14797-65-0	300 or 9056	—	12,500
Phosphate	14265-44-2	300 or 9056	—	5,000
Sulfate	14808-79-8	300 or 9056	1,050	27,500
Ammonia	7664-41-7	350.1	—	500
Cyanide	57-12-5	9012 or 335.4 or 4500-CN	—	1,000
Metals				
Antimony	7440-36-0	6020	—	500
Arsenic	7440-38-2	6020	—	1,000
Barium	7440-39-3	6020	—	2,000
Beryllium	7440-41-7	6020	—	200
Cadmium	7440-43-9	6020	—	200
Chromium	7440-47-3	6020	10.5	1,000
Cobalt	7440-48-4	6020	—	400
Copper	7440-50-8	6020	—	1,000
Lead	7439-92-1	6020	—	300
Manganese	7439-96-5	6020	—	1,000
Nickel	7440-02-0	6020	—	500
Selenium	7782-49-2	6020	—	500
Silver	7440-22-4	6020	—	200
Uranium	7440-61-1	6020	1.05	150
Vanadium	7440-62-2	6010	—	5,000
Zinc	7440-66-6	6010	—	5,000
Hexavalent chromium	18540-29-0	7196	10.5	500
Mercury	7439-97-6	7471	—	200

Table A-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
Volatile Organics				
1,1,1-Trichloroethane	71-55-6	8260	—	5
1,1,2-Trichloroethane	79-00-5	8260	—	5
1,1-Dichloroethane	75-34-3	8260	—	10
1,2-Dichloroethane	107-06-2	8260	—	5
2-Butanone	78-93-3	8260	—	20
2-Hexanone	591-78-6	8260	—	20
4-Methyl-2-pentanone	108-10-1	8260	—	20
Acetone	67-64-1	8260	—	20
Acetonitrile	75-05-8	8260	—	100
Benzene	71-43-2	8260	—	5
Carbon tetrachloride	56-23-5	8260	—	5
Chlorobenzene	108-90-7	8260	—	5
Chloroform	67-66-3	8260	—	5
cis-1,2-Dichloroethylene	156-59-2	8260	—	5
Cyclohexane	110-82-7	8260	—	10
Ethylbenzene	100-41-4	8260	—	5
Hexane	110-54-3	8260	—	10
Methylene chloride	75-09-2	8260	—	5
n-Butyl alcohol	71-36-3	8260	—	250
n-Butylbenzene	104-51-8	8260	—	5
Tetrachloroethene	127-18-4	8260	—	5
Toluene	108-88-3	8260	—	5
trans-1,2-Dichloroethylene	156-60-5	8260	—	5
Trichloroethene	79-01-6	8260	—	5
Vinyl chloride	75-01-4	8260	—	10
Xylenes (total)	1330-20-7	8260	—	10

Table A-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
Semivolatile Organics and Other Organics				
Acenaphthene[c]	83-32-9	8270	—	333
Acenaphthylene[c]	208-96-8	8270	—	333
Anthracene[c]	120-12-7	8270	—	333
Benzo(a)anthracene[c]	56-55-3	8270	—	333
Benzo(a)pyrene[c]	50-32-8	8270	—	333
Benzo(b)fluoranthene[c]	205-99-2	8270	—	333
Benzo(ghi)perylene[c]	191-24-2	8270	—	333
Benzo(k)fluoranthene[c]	207-08-9	8270	—	333
Chrysene[c]	218-01-9	8270	—	333
Dibenzo(a,h)anthracene[c]	53-70-3	8270	—	333
Dibenzofuran	132-64-9	8270	—	333
Fluoranthene[c]	206-44-0	8270	—	333
Fluorene[c]	86-73-7	8270	—	333
Indeno(1,2,3-cd)pyrene[c]	193-39-5	8270	—	333
Naphthalene[c]	91-20-3	8270	—	333
Phenanthrene[c]	85-01-8	8270	—	333
Phenol	108-95-2	8270	—	333
Pyrene[c]	129-00-0	8270	—	330
Tributyl phosphate	126-73-8	8270	—	333
4,4'-DDD	72-54-8	8081	—	3.3
4,4'-DDE	72-55-9	8081	—	3.3
4,4'-DDT	50-29-3	8081	—	3.3
Aldrin	309-00-2	8081	—	1.7
alpha-BHC	319-84-6	8081	—	1.7
beta-BHC	319-85-7	8081	—	1.7
Chlordane	57-74-9	8081	—	16.5
Dieldrin	60-57-1	8081	—	1.7
Endrin	72-20-8	8081	—	1.7

Table A-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
gamma-BHC (Lindane)	58-89-9	8081	—	1.7
Aroclor 1254	11097-69-1	8082	—	33
Aroclor 1260	11096-82-5	8082	—	33
Total polychlorinated biphenyls	PCBTOT	8082	—	N/A
TPH - diesel range organics	TPHDIESEL	WTPH	—	25,000
TPH - kerosene	TPHKEROSENE	WTPH	—	25,000
Radionuclides				
Am-241	14596-10-2	Alpha energy analysis	—	1 pCi/g
C-14	14762-75-5	Liquid scintillation counting	—	5 pCi/g
Cs-137	10045-97-3	Gamma energy analysis	—	0.1 pCi/g
Co-60	10198-40-0	Gamma energy analysis	—	0.1 pCi/g
Eu-152	14683-23-9	Gamma energy analysis	—	0.1 pCi/g
Eu-154	15585-10-1	Gamma energy analysis	—	0.1 pCi/g
Eu-155	14391-16-3	Gamma energy analysis	—	0.1 pCi/g
I-129	15046-84-1	Low-energy gamma spectroscopy or liquid scintillation counter	1 pCi/L	2 pCi/g
Ni-63	13981-37-8	Liquid scintillation counting	—	10 pCi/g
Np-237	13994-20-2	Alpha energy analysis	—	1 pCi/g
Pu-238	13981-16-3	Alpha energy analysis	—	1 pCi/g
Pu-239/240	PU-239/240	Alpha energy analysis	—	1 pCi/g
Sr-90	10098-97-2	Gas proportional counting	2 pCi/L	2 pCi/g
Gross alpha	12587-46-1	Gas proportional counting	3 pCi/L	N/A
Tc-99	14133-76-7	Liquid scintillation counting	50 pCi/L	5 pCi/g
Th-232	TH-232	Alpha energy analysis	—	1 pCi/g
Tritium	10028-17-8	Liquid scintillation counting	700 pCi/L	30 pCi/g
U-233/234	U-233/234	Alpha energy analysis	—	1 pCi/g
U-235	15117-96-1	Alpha energy analysis	—	1 pCi/g
U-238	U-238	Alpha energy analysis	—	1 pCi/g

Table A-3. Performance Requirements for Soil and Water Analysis

Constituent/Parameter	CAS Number	Analytical Method[a]	PQL for Water (µg/L)[b]	PQL for Soil (µg/kg)
Field Screening				
Radiological screening by radiological control technician	N/A	Field measurement instrument/meter	N/A	N/A
pH	N/A	Field measurement instrument/meter	N/A	N/A
Specific conductance	N/A	Field measurement instrument/meter	N/A	N/A
Temperature	N/A	Field measurement instrument/meter	N/A	N/A
Turbidity	N/A	Field measurement instrument/meter	N/A	N/A

Note: Analytical methods and PQLs provided in this table do not represent EPA requirements but are intended solely as guidance.

a. For EPA Method 300.0 and 335.4, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For EPA Methods 150.1, 310.1, and 350.1, see EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (current update). For standard methods, see APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater* (current revision). Equivalent methods may be substituted.

b. PQLs are listed only for groundwater analytes for which analysis is required.

c. Method 8270 (selected ion monitoring) will be used to determine concentrations for polynuclear aromatic hydrocarbons.

d. For field measurement analytical methods, see Table 1-5.

CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
N/A = not applicable
PQL = practical quantitation limit
TPH = total petroleum hydrocarbons

A2 References

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