SGW-63900
Revision 0

Description of Work for the Installation of Two Extraction Wells in the 200-DV-1 Operable Unit, FY2020

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

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

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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CH2M HILL Plateau Remediation Company

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TERMS

ALARACT	As Low As Reasonable Achievable Control Technology
BTR	Buyer's Technical Representative
CCU	Cold Creek Unit
CCU-PZSd	Cold Creek unit – perched zone sand
CCU-PZSt	Cold Creek unit – perched zone silt
CCUg	Cold Creek unit gravel
DOE	U.S. Department of Energy
DOW	Description of Work
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ft	foot/feet
gpm	gallons per minute
Hf1	Hanford formation unit 1
Hf2	Hanford formation unit 2
Hf3	Hanford formation unit 3
IHT	Industrial Hygiene Technician
in	inch(es)
NTCRA	non-time-critical removal action
PNNL	Pacific Northwest National Laboratory
QA	quality assurance
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	Radiological Control Technician
SAP	sampling and analysis plan
SGRP	Soil and Groundwater Remediation Project
TD	total depth
TPA	Tri-Party Agreement
WAC	Washington Administrative Code
WDOH	Washington Department of Health

1 Introduction/Scope of Work

This description of work (DOW) describes the drilling, construction, development, and sampling activities associated with the installation of two 200-DV-1 Operable Unit (OU) extraction wells. The work associated with this DOW is planned for fiscal year 2020. Extraction wells 299-E33-269 (D0112) and 299-E33-270 (D0113) are being installed to collect characterization information to evaluate remediation alternatives within and surrounding the perched water zone for protection of groundwater and to support the non-time-critical removal action to increase the perched water extraction rate.

The installation of the two new extraction wells supports Ecology et al., (1989), *Hanford Federal Facility Agreement and Consent Order*, also known as the Tri-Party Agreement (TPA), and will be in compliance with substantive requirements of the *Resource Conservation and Recovery Act of 1976* (RCRA), as well as the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

The 200-DV-1 OU activities to be carried out during the installation of the new extraction wells will include well drilling, soil and groundwater sampling, borehole geophysical logging, and well construction and development in accordance with DOE/RL-2013-52, *Sampling and Analysis Plan for Perched Water Wells C8914 and C8915 in the 200-DV-1 Operable Unit* as amended by TPA-CN-0879, *Tri Party Agreement Change Notice Form,* and other applicable change notices.

A project site map with locations of the two wells is presented in Figure 1. Wells 299-E33-269 (D0112) and 299-E33-270 (D0113) are located in the 200 East Area of the Hanford Site. Table 1 lists the well identification numbers, well names, and location information.

Drilling activities will consist of advancing the wells between approximately 282 and 284 feet (ft) below ground surface (bgs), depending on well location. Both wells will be drilled approximately 20 ft into the basalt. Boreholes are being drilled into the basalt for sump placement. Any section of the borehole drilled beyond the expected well completion depth will be decommissioned in accordance with the substantive standards of *Washington Administrative Code* (WAC) 173-160.

Sampling activities will include most, if not all, of the following: 1) collection of soil grab samples for archive purposes; 2) collection of soil grab samples in the proposed screened interval for sediment grain size (sieve) analysis (may be completed at a laboratory instead of by the Field Geologist); 3) split spoon samples in the vadose zone and saturated zone for physical properties and contaminant analysis; 4) borehole geophysical logging of the entire cased borehole for subsurface characterization; and 5) a baseline groundwater sample to be collected at the end of well development.

Well completion activities consist of installing 8 inch (in.) diameter stainless steel extraction well with approximately 10 to 15 ft of screen. Screens will be placed in the perched water zone. Due to the low recharge of the perched water, traditional well development will not be conducted for each well. Development will include surging in the well screen during sand pack installation, and bailing and pumping the well after installation; however, over-pumping after the well is built will not occur.

All drilling, decommissioning, geophysical logging, and well construction activities will be performed by a drilling subcontractor and appropriate drilling method. Sampling and testing will be performed by CH2M Hill Plateau Remediation Company (CHPRC).

Table 1. Well Identification and Location Summary

Well ID	Well Name	Easting (m)	Northing (m)	Elevation (m)
D0112	299-E33-269	573776.1	137386.0	198.8
D0113	299-E33-270	573839.0	137429.0	197.9

m = meters

Figure 1. Proposed Locations for Two New 200-DV-1 OU Extraction Wells

2 Background

The following section discusses previous work activities and regulatory decisions associated with the 200-DV-1 OU. General summaries of the site geology and hydrogeology and contaminants of concern relevant to the planned wells are presented.

All measurements in this document will be listed in English standard notation.

2.1 Historic Site Operations and Resulting Contamination

The Hanford Site covers approximately 580 square miles. Past nuclear weapons production activities at the Site resulted in approximately 450 billion gallons of liquid waste being released to the ground. Some of the associated contaminants remain in the vadose zone, but some have reached the groundwater. Hazardous chemical contaminants include various organics, chromium, and nitrate. Radioactive contaminants include iodine-129, cobalt-60, cesium-137, nickel-63, carbon-14, strontium-90, technetium-99, tritium, and uranium. The U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) have developed a remediation plan for remediating the Central Plateau. The Soil and Groundwater Remediation Project (SGRP) is largely responsible for ensuring the plan is implemented.

The 200-DV-1 OU perched water zone is located within the deep vadose zone in the B Complex in the 200 East Area of the Hanford Site. This area includes Waste Management Area B/BX/BY (B, BX, and BY Tank Farms) and the surrounding waste disposal sites (e.g., cribs and trenches). The perched water zone contains elevated levels of uranium, technetium-99, nitrate, and other contaminants of concern and is located in the vadose zone above a fine grained perching silt layer that overlies the unconfined aquifer in the 200-BP-5 groundwater OU.

Contaminated perched water is present in the deep vadose zone in the B Complex. Liquid waste contaminated with uranium and other contaminants was discharged to the subsurface in the B Complex area through engineered waste disposal sites from 1946 through 1974 (DOE/RL-2011-102, *Remedial Investigation/Feasibility Study and RCRA Facility Investigation/ Corrective Measures Study Work Plan*). The most significant unplanned release of waste occurred when tank 241-BX-102 was overfilled in 1951. Perched water conditions are present in the vadose zone above a fine-grained unit (perching silt layer) that is located a few feet above the unconfined aquifer within the B Complex area (200-BP-5 OU).

DOE/RL-2014-34, *Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*, was issued in 2014 for extracting contaminated water in the perched water zone and transferring it to the 200 West pump and treat (P&T). The extracted water is then treated and injected into the aquifer below the 200 West Area. The goal of this non-time-critical removal action (NTCRA) is to remove uranium, technetium-99, nitrate, total chromium, hexavalent chromium, and tritium from the perched water zone.

The NTCRA is designed to recover as much perched water as practical in accordance with DOE/RL-2014-37, *Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water Pumping / Pore Water Extraction*, while awaiting issuance of the 200-DV-1 OU Record of Decision. Additional extraction wells are needed to increase the perched water extraction rate.

2.2 Site Stratigraphy and Hydrogeology

The following section summarizes the stratigraphic setting and hydrogeologic conditions in the vicinity of the new wells. Table 2 provides a listing of estimated contact depths for each borehole planned in this document, based on contour maps developed from the nearest available well logs.

2.2.1 Stratigraphic Setting

The Hanford Site lies within the semiarid, shrub-steppe Pasco Basin of the Columbia Plateau in southeastern Washington State. The 200 Areas are located on a broad, relatively flat area that constitutes a local topographic high near the center of the Hanford Site (Central Plateau). The 200-DV-1 perched water zone is located within the deep vadose one in the B Complex in the 200 East Area.

The subsurface geologic interpretation in the B Complex area is based primarily on borehole and geophysical logs. ECF-200DV1-18-0036, *B-Complex Perched Zone Geoframework, 200 East, Hanford Site*, discusses the three-dimensional geoframework modeling that has been performed for the B Complex area. In this area, the Hanford formation consists of the thinner Hanford formation upper gravel-dominated sequence near the ground surface (Hanford formation unit 1 [Hf1] composed of interstratified gravel, sand, and minor silt), followed by the thicker Hanford formation sand-dominated sequence (Hanford formation unit 2 [Hf2] composed of interstratified sand and silt with local gravel horizons), followed by the Hanford formation lower gravel-dominated sequence (Hanford formation unit 3 [Hf3] composed of interstratified gravel and sand with local silt and/or clay horizons).

Below the Hanford formation is the Cold Creek unit (CCU). The structure of the CCU low-permeability layer has resulted in formation of a perched water zone, which intercepts contaminated water migrating through the vadose zone. Transition from the high-permeability Hanford formation to the CCU occurs deep in the vadose zone at elevations of 446.2 to 426.5 ft above mean sea level. The CCU is bounded by the underlying basalt formation.

The CCU is subdivided into four zones. The upper silt-dominated CCU is the top of the perched zone sequence and is mostly sandy silt to silt. The CCU-PZSd is located below the upper silt-dominated CCU. The CCU-PZSd contains perched water and is composed of a very fine sand and silt. The CCU perched zone silt (CCU-PZSt) is low-permeability perching silt and is located below the CCU-PZSd zone. The CCU-PZSt is on top of a higher permeability sand and gravel zone, designated as the CCU gravel (CCUg). The CCUg contains the unconfined aquifer.

The CCU-PZSd ranges in thickness from 0 to approximately 16 ft at depths of approximately 220 to 236 ft bgs. The CCU-PZSd saturated thickness ranges from 0 to approximately 12 ft. The perched water zone occupies a roughly southwest- to northeast-trending oval that is somewhat bowl-shaped. The depth to the perched water is roughly 227 to 230 ft bgs. The CCU-PZSt thickness ranges from 0 to approximately 9 ft.

Basalt is expected to be encountered between 260 ft bgs and 264 ft bgs. Estimated depths to the geologic units expected at the well locations are summarized in Table 2.

Table 2. Estimated Geologic Contacts for 200-DV-1 OU Perched Water Extraction Wells

Well ID/ Well Name	Estimated Depth of Perched Water	Estimated Depth to Groundwater	Hanford and Surficial Deposits	Upper Silt-Dominated Cold Creek Unit	Cold Creek Unit Perched Zone Sand	Cold Creek Unit Perched Zone Silt	Cold Creek Unit Gravel	Columbia River Basalt	Estimated Total Depth
	ft bgs								
D0112 299-E33-269	226	253	Ground surface to top of CCU.	215	222	238	244	264	284
D0113 299-E33-270	226	250		218	222	233	238	260	282

ft bgs = feet below ground surface

2.2.2 Hydrogeology

These wells will be screened in the perched water zone located within the CCU-PZSd.

Perched water is contained within the CCU-PZSd (sand lens) and on top of a low permeability silt layer CCU-PZSt (silt layer). The top of the sand lens is defined at approximately 222 ft bgs and the maximum thickness of the sand lens is approximately 11 ft to 16 ft at the two well locations. The lateral and vertical extent of the perched water is limited to the CCU-PZSd region and underlying CCU-PZSt; the bottom of the CCU-PZSd is about 15 ft above the unconfined aquifer. The underlying CCU-PZSt forms a natural barrier that slows contaminant migration from the sand layer to the aquifer. Liquid wastes containing uranium, technetium-99, and nitrate have migrated vertically and laterally in the subsurface and accumulated within the CCU-PZSd.

2.3 Contaminants of Concern

The list of contaminants of concern for the perched water is provided in the Action Memorandum for the perched water non-time-critical removal action (DOE/RL-2014-34). Table 3 presents the contaminants of concern for the 200-DV-1 OU perched water.

Table 3. Perched Water Contaminants of Concern

Contaminants of Concern	
Contaminant	**CAS Number**
Chromium (total)	7440-47-3
Chromium, hexavalent	18540-29-9
Nitrate	14797-55-8
Technetium-99	14133-76-7
Tritium	10028-17-8
Uranium	7440-61-1

3 Description of Work Activities

Activities to be conducted at each well site include site preparation, drilling, sampling, geophysical logging, well construction, and well development. All activities described in this document will be conducted in accordance with the guidelines and requirements set forth in SGRP-PRO-EN-50030 (GRP-EE-02-14.1), *Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings,* and shall conform to minimum resource protection well substantive standards as defined in WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." The Washington Department of Health (WDOH) (2012), *The Department of Energy Hanford Site Radioactive Air Emissions License #FF-01*, Enclosure 3, "ALARACT Agreements," As Low As Reasonable Achievable Control Technology (ALARACT) 18, "Environmental Restoration Program ALARACT Demonstration for Drilling," shall also apply. A record of well site activities will be maintained by the field geologist and recorded in daily field activity reports.

3.1 Well Site Preparation

Drilling sites will be accessed by existing roads wherever possible and wherever limited access roads have been constructed as necessary. A drill pad of sufficient size for operations and limited access roads will be constructed for each well. Grub surveys will be performed by radiation control technicians for each site prior to the drill pad and access road construction. Ground penetrating radar surveys will also be conducted as necessary and excavation permits obtained as part of site preparation prior to drilling.

3.2 Drilling

The drilling contractor shall be responsible for complying with well drilling and construction standards defined in the substantive standards of WAC 173-160 and applicable CHPRC procedures. The drill rig and all down-hole equipment shall be high temperature and pressure washed prior to use between wells, including all wells located within the same OU, to minimize potential for cross-contamination. An environmentally-compatible non-petroleum lubricant, such as Jet-Lube Well-Guard®[1] thread compound or equivalent, may be used for lubricating the threads of the stainless steel and casing during installation activities. Hydrocarbon-based lubricants are not acceptable.

Both wells 299-E33-269 (D0112) and 299-E33-270 (D0113) are planned to be drilled approximately 20 ft into basalt to create a 40 ft long sump. The extraction wells will be screened in the thin perched water zone located in the CCU-PZSd with the sump extending into the basalt. The nominal casing diameter for the borehole at total depth (TD) for both wells shall be no less than 12 in. to allow completion of an 8 in. diameter well. This ensures the wells retain a minimum 2 in. annulus called for in the substantive standards of WAC 173-160.

For both wells it is imperative the borehole be sealed and downsized to prevent interconnecting the perched water aquifer and the unconfined aquifer. The seal and downsize shall occur approximately 1 ft into the CCU-PZSt at approximately 239 ft bgs at 299-E33-269 (D0112) and 234 ft bgs at 299-E33-270 (D0113). The following shall be done to ensure the seal is set prior to downsizing and continuing drilling through the CCU-PZSt. The borehole will be evacuated of all water. A bentonite pellet seal or a natural granular bentonite seal will be placed and hydrated. Installation of this seal must be confirmed by monitoring for recharge prior to the resumption of drilling. If no measurable recharge is observed, drilling

[1] Jet-Lube Well-Guard® is a registered trademark of Jet-Lube, Inc. of Houston, Texas.

can continue through the CCU-PZSt. Sealing and downsizing is required to eliminate contaminant drag down via the casing strings and/or the creation of a preferential pathway for contaminants or water.

Both boreholes will be geophysical logged and the aquifer characterized at TD and at each step down of casing.

Drilling aids such as bentonite, other clay-based agents, water, or any foreign matter capable of affecting the characteristics of the sediment samples, perched water, or ground water will not be placed in the wells without prior approval of CHPRC.

During drilling and sampling, all reasonable efforts shall be made to minimize, or eliminate, the addition of water to the borehole. If water addition is necessary, the volume added should be kept to the smallest volume required and only added with the approval of the buyer's technical representative (BTR) or OU Project Technical Lead. Only potable water shall be added during drilling. Added water volumes will be accurately recorded in the field geologist's log and drilling log, including volume added and depth interval.

The contractor shall establish a method to settle out solids from water extracted from the borehole. The Contractor shall also ensure the volume of solids pumped into the purge truck and/or poly tank is minimized while separating the water from the drill cuttings. The contractor shall use best industry standards to prevent sludge from being pumped into the truck and or poly tank. In the event the contractor fails to minimize solids pumped into the purge truck and/or poly tanks, CHPRC may suspend all water movement until the sand is controlled by the contractor.

The drilling contractor will be responsible for performing a straightness test prior to beginning well completion as required by the substantive standards of WAC 173-160. The pipe must freely pass without binding to declare the well straight. The test for straightness shall be made in the presence of the field geologist and CHPRC BTR or delegate.

At both wells 299-E33-269 (D0112) and 299-E33-270 (D0113) an air rotary drill rig may not be used to drill in the vadose or saturated zone.

Drilling activities for all wells have been evaluated as low radiological hazard with specific controls based on the site histories, sampling of nearby waste sites and existing wells. A grub survey is required prior to surface disturbance while preparing drilling pads for the proposed wells. For drilling and construction activities both 299-E33-269 (D0112) and 299-E33-270 (D0113) require continuous radiological control technician (RCT) coverage. A Radiological Work Permit and Radiological Buffer Area will also be required during the drilling and construction of these wells. Any other work will be identified and incorporated into applicable work instructions.

The planned frequency for Industrial Hygiene Technician (IHT) monitoring is AM/PM during drilling activities for volatile organic contaminants and ammonia. Continuous IHT support will not be required for water sampling unless requested by the groundwater samplers. Continued IHT support for well construction/development activities will be contingent upon data obtained during drilling. Additional sampling/monitoring may be required based on monitoring results, work activities conducted, and environmental conditions.

3.3 Sampling Requirements

All data collection requirements for this project meet the requirements established by the 200-DV-1 OU Perched Water SAP for drilling extraction wells (DOE/RL-2013-52), as amended by change notice TPA-CN-0879. A sampling summary of planned collection activities is contained in Table 4. Additional samples may also be collected if unusual or unexpected conditions are encountered in the field, in accordance with direction listed in change notice TPA-CN-0879 and listed in the following sections.

Table 4. Summary of Sample Intervals and Depths for 200-DV-1 Perched Water Wells

Well ID/ Well Name	Geologic Grab Sample[d]	Perched Water Samples[c] (ft bgs)	Split Spoon Samples (ft bgs)[a,b]
D0112 299-E33-269	Every 5 ft or where lithologic changes occur; in one pint jar and a chip tray from drill cuttings.	Post-Development	38 – 40.5 88 – 90.5 163 – 165.5 200 – 202.5 214 – 216.5 216.5 – 219 219 – 221.5 221.5 – 224 224 – 226.5 226.5 – 229 229 – 231.5 231.5 – 234 234 – 236.5 236.5 – 239 239 – 241.5 241.5 – 244 244 – 246.5 246.5 – 249 249 – 251.5 251.5 – 254
D0113 299-E33-270		Post-Development	42 – 44.5 92 – 94.5 167 – 169.5 215 – 217.5 217.5 – 220 220 – 222.5 222.5 – 225 225 – 227.5 227.5 – 230 230 – 232.5 232.5 – 235 235 – 237.5 237.5 – 240 240 – 242.5 242.5 – 245 245 – 247.5 247.5 – 250

Table 4. Summary of Sample Intervals and Depths for 200-DV-1 Perched Water Wells

Well ID/ Well Name	Geologic Grab Sample[d]	Perched Water Samples[c] (ft bgs)	Split Spoon Samples (ft bgs)[a,b]

a. If field screening instruments indicate radiological contamination above background at a given interval, two additional samples will be collected. One sample for a 24-hour turnaround time gamma-energy analysis and one sample based on the gamma-energy analysis results (as determined by the project manager).
b. If a split spoon sample has low recovery an additional split spoon will be collected at the same interval prior to continuing drilling. Intervals listed are estimated based on the anticipated geologic contact depths listed in Table 2 and may need to be adjusted based on depths of actual geologic contacts found in the field. During drilling, the field geologist, in consultation with the geology subject matter expert (SME), will identify the depth at which the transition between target geologic formations and perched water occur, and may adjust a sample depth in response to these conditions, in consultation with the OU Project Technical Lead, provided the target formation is sampled and the intent of the sample interval is achieved in accordance with Section 3.3.3.
c. One post development perched water sample will be collected following construction and final development of each well. Final well development will occur as described in section 3.5.2.
d. Collection of archive samples may not be possible at some depths given the continuous split spoon samples collected through the perched water zone and anticipated high radiological readings. If elevated radiological readings are encountered archive samples will not be collected by the field geologist.

ft bgs = feet below ground surface

3.3.1 Groundwater Samples

No depth-discrete groundwater samples will be collected during drilling. A baseline perched water sample will be collected from both wells at the end of well development.

Perched water samples are collected after a minimum of one borehole volume has been purged and water chemistry (e.g., temperature, pH, and conductivity) has stabilized within 10% variance over three consecutive measurements (SGRP-PRO-SMP-50060 [GRP-FS-04-G-028] *Field Characterization and Treatment Monitoring Activities Groundwater Sampling*).

If during the collection of the post development sample the borehole is not able to sustain sufficient water production, the OU Project Technical Lead will be contacted for consultation and direction. The drilling Contractor will provide low-flow pumps for perched water sampling to facilitate collection of quality post development groundwater sample.

3.3.2 Grab Samples

Grab soil samples for archive purposes will be collected from drill cuttings every 5 ft and at other changes in lithology or at depths where unusual conditions are encountered (as determined by the field geologist) for lithologic descriptions, from ground surface to TD. Archive grab samples will be collected in one-pint glass jars and chip trays. Archive samples will not be collected if contamination is encountered. The field geologist will collect grab samples for archives, examine material from the boreholes, and prepare borehole logs as specified in SGRP-PRO-EN-50025 (GRP-EE-01-7.0), *Geologic Logging*.

The screen interval lengths are expected to be approximately 10 to 15 ft with the planned screened intervals outlined in Table 5. Anticipated contamination in the perched water zone will likely prevent collection of grab samples for sieve analysis in the projected screened interval. Particle size distribution in the perched water zone will be completed by Pacific Northwest National Laboratory (PNNL) using light scattering (ASTM B822-17) and/or sieve analysis (ASTM D6913-17) from split spoon sample material provided. Results of the particle size distribution analysis, together with the field geologist's borehole log, will be used to select the final filter pack and well screen slot size. If the field geologist collects grab samples and conducts sieve analyses it will be done in accordance with SGRP-PRO-OP-50037 (GRP-EE-05-1.21), *Particle Size Distribution of Sediment-Wet Sieve Analysis*.

3.3.3 Split Spoon Samples

Split spoon samples of vadose zone sediment, perched water sediment, and aquifer sediment from the saturated zone will be collected at each well for physical properties and chemical analysis at depths described in Table 4. Split spoon samplers will be equipped with four polycarbonate liners. The percent recovery for each split spoon will be recorded. If insufficient material is recovered, a second split spoon will be collected prior to advancing the borehole, except for depths where continuous samples are already being collected. If there is not enough sample volume recovered during split spoon sampling for the entire planned analysis, the OU Project Technical Lead will be consulted to determine the sample priority.

The sample intervals listed in Table 4 are anticipated depths based on the estimated depths to groundwater and geologic contacts listed in Table 2 for each well. The actual depths to groundwater and to geologic contacts may be different during drilling. During drilling, the field geologist, in consultation with the geology subject matter expert (SME), will identify the depth at which the transition between target formations and perched water occur and, in consultation with the OU Project Technical Lead, may adjust the sample depth in response to these conditions, provided the target formation is sampled and the intent of the sample interval is achieved. The following must be considered when adjusting sample intervals:

- The periodic split spoon samples in the vadose zone are intended to be collected either at depths corresponding to information gathered from nearby boreholes (e.g., zones of moisture, manmade radionuclides, silt zones) or approximately evenly space throughout the formation.
- Continuous split spoon sample intervals are planned to start at the approximate transition from Hf3 to the upper silt-dominated CCU and go on through top of the CCUg above the unconfined aquifer.

The field geologist will notify the drilling BTR who will contact the OU Project Technical Lead (or designee) if unexpected conditions are encountered in the field that may warrant collection of additional samples. Additional samples may be collected at the discretion of the project manager if unexpected conditions are encountered that indicate the need for additional data.

The soil/sediment material from liner C from each interval listed in Table 4 will be used for contaminant concentration analyses at an offsite laboratory. The remaining split spoon liners (A, B, and D) from each interval will be transported to PNNL for special testing and analysis. Particle size distribution throughout the sample intervals will be determined by PNNL using ASTM B822 17, *Standard Test Method for Particle Size Distribution of Metals Powders and Related Compounds by Light Scattering* or ASTM D6913-17, *Standard Test Methods for Particle Size Distribution (Gradation) of Soils Using Sieve Analysis*.

3.3.4 Geophysical Logging

The planned wells will be geophysically logged with a high-resolution, spectral gamma-ray logging system and neutron water content logging to support determination of the depth and extent of both the perched water zone and unconfined aquifer, provide information supporting well completion, and screen for gamma-emitting radionuclides. The boreholes will be logged before the temporary casing is telescoped and/or at the point of TD.

3.4 Well Construction

Well construction shall meet the minimum standards required by the substantive standards of WAC 173-160, Part II, for construction of resource protection wells, unless a state approved variance is utilized. The use of a variance for these wells is not expected. Table 5 provides a summary of estimated well construction parameters, including estimated water levels, well depths, screen intervals, filter-pack

intervals, bentonite-seal intervals, and cement-seal intervals. The generalized well design for the two extraction wells is illustrated in Figure 2.

3.4.1 Screen Riser and Sump

Well screen depths will be determined based on observations made while drilling each well, but are anticipated to be placed at the top of the CCU-PZSd and extend to the top of the CCU-PZSt. All wells shall be constructed using a sump, screen, and riser/couplings composed of 8 in. diameter, Schedule 10, Type 304/304L or 316/316L stainless steel with flush-joint design and O-rings, and will extend to approximately 2 ft above the ground surface. The wells will be constructed using a 40 ft long sump with end cap. All wells will be constructed using a V-Slot continuous wire-wrap well screen.

For each well, a well design will be developed with a selected screen slot size, filter pack mesh and screened interval(s) dependent on sediment examination, particle size distribution analysis results, borehole log, analytical results, and geophysical log collected during drilling. The well design shall be prepared by CHPRC's Well Design Technical Lead in consultation with CHPRC's OU Project Technical Lead, drilling BTR and/or CHPRC's field geologist/hydrogeologist. Anticipated screen lengths are expected to be approximately 10 ft (Figure 2). All wells will be drilled approximately 20 ft into the basalt for sump placement.

The wells will be screened in the thin perched water zone. Screen lengths and depths are subject to change depending on several factors, including the aquifer thickness. Final screen length and placement will be designed by the Well Design Technical Lead with concurrence of the OU Project Technical Lead. The Contractor will obtain CHPRC approval before purchasing stainless steel casing, screen and filter pack materials for the wells.

Stainless steel centering guides (centralizers) shall be placed both above and below the well screen. Centralizers shall also be placed at 40 ft intervals above the top of the screen along the entire permanent casing string.

Well construction will not be carried out until the filter pack mesh size, screen length, and slot size are confirmed by particle size distribution analysis results from PNNL and sediment examination. Drilling Contractors are required to use clean gloves when handling well materials to be placed below groundwater.

Table 5. Well Construction Parameters

Well ID / Well Name	Depth to Perched Water	Drill Depth	Cement Grout	Bentonite Slurry	Bentonite Pellet Seal	Sump	Screened Interval	Filter Pack Interval	Bentonite Pellet Seal	Bentonite	Cement Grout Seal
	feet below ground surface										
D0112 299-E33-269	226	284	284 – 264	264 – 244	244 – 238	278 – 238	238 – 223	238 – 218	218 – 215	215 – 10	10 – 0
D0113 299-E33-270	226	282	282 – 260	260 – 238	238 - 233	273 – 233	233 – 223	233 – 218	218 – 215	215 – 10	10 – 0

Note: Information presented in table are estimates and may vary. Final drill depth, position of well screen, backfill interval, filter pack interval, and bentonite seal intervals will be determined based upon actual borehole conditions, and sieve analysis; intervals may be subject to change based on geologic conditions. The depth of the screened interval may vary significantly, depending on perched water thickness. Assume a 40 ft sump.

3.4.2 Annular Seal and Filter Pack

Boreholes extending below the designed well depth shall be decommissioned from TD to the depth equivalent to the bottom of the proposed sump with cement grout. Cement grout will be used from TD to the top of the Basalt. A bentonite slurry will be used from the top of the basalt to the bottom of the CCU-PZSt. A Bentonite pellet seal will be placed from the bottom of the CCU-PZSt to the top of the CCU-PZSt.

The filter pack will extend from the top of the CCU-PZSt to up to 5 ft above the top of the screen. Screen size will correspond to the chosen mesh size (i.e., filter pack mesh size is chosen based on formation particle size distribution analysis results; screen slot size is based on the mesh size where up to 10% of the filter pack is capable of passing into the screen). The Contractor shall place and develop the filter pack in no greater than 3 ft intervals using a dual surge block method. As a general guide, if the filter pack in the annulus drops out at a rate of less than 0.1 ft in 15 minutes, the interval is considered sufficiently settled (Section 3.5.1).

At both wells a minimum 3 ft layer of bentonite pellets will be placed directly on top of the filter pack. Bentonite will be used to seal the annulus from the top of the pellet seal to approximately 10 ft bgs. Non-shrinking, neat cement grout, containing no more than 5% bentonite gel powder by dry weight and no more than 6 gallons of water per 94 pounds of grout, will be used to seal the remaining borehole annulus from 10 ft bgs to 0.5 ft bgs. The cement seal shall be emplaced using tremie pipe while maintaining the tremie nozzle inside the cement to prevent dilution of the cement. The cement must be allowed to cure for a minimum of 8 hours before additional well construction activities take place.

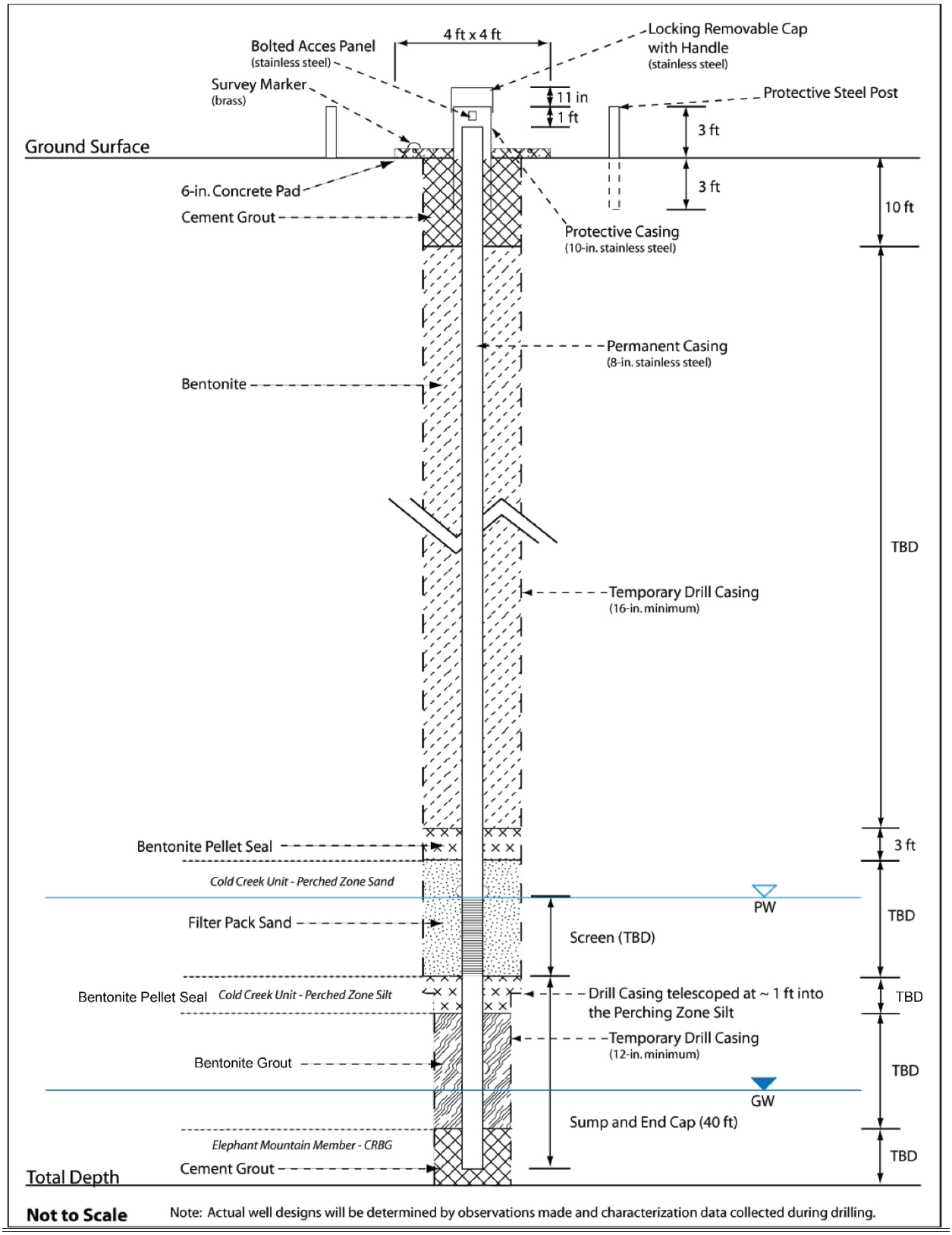

Figure 2. Generic 200-DV-1 OU Perched Water Extraction Well Design

3.4.3 Wellhead

Surface protection for each well will be installed in accordance with the substantive standards of WAC 173-160-420 and SGRP-PRO-EN-50030, and the design specified in the contract release. As shown in Figure 2, a minimum 10 in diameter stainless steel protective casing will be placed from 3 ft above ground surface to at least 2 ft bgs. The protective casing shall be fitted with a light weight (Schedule 10 stainless steel) lockable cap extending 11 in. above the protective casing. The well cap shall have two handles affixed near the top of the well cap and on opposing sides of the well cap.

A 4 ft by 4 ft by 0.5 ft concrete pad will be placed around the well monument. This pad will be labeled on the north side by a 3 in. domed brass survey marker stamped with the well identification number, well name, and date of completion. The pad will be reinforced with 6 in. by 6 in. W1.4 by W1.4 (metric wire gage, approximately equivalent to 16 gage) welded wired fabric. Four protective posts (3 in. diameter) will surround the pad, extending to 3 ft above ground surface and be cemented at least 3 ft into the ground. At least one post will be removable for well access. Posts will be painted yellow per ANSI (1991), *ANSI Z53.1 Safety Color Code,* for making physical hazards. Posts will be capped if hollow to prevent bird nesting in the posts.

An access port will be provided on the protective casing and shall be configured as shown in Figure 3.

The permanent sampling or extraction pump will be installed by CHPRC personnel after the wells are accepted by CHPRC from the Contractor.

3.5 Well Development

The objectives of well development are to settle the filter pack, remove formation fines, prevent uncontrolled infiltration of fines, and ensure efficient hydraulic communication of the well with the surrounding perched water aquifer. Well development will be conducted in two stages with initial development and final development.

3.5.1 Initial Well Development

Initial development will be performed during well completion in conjunction with placement of the filter pack. Surging using a dual-flange surge block both settles the filter pack and begins to pull drilling-generated fines and aquifer sediment fines from the borehole wall to improve hydraulic communication with the perched water aquifer. Surging during the sand pack placement generates turbulence along the annulus and borehole wall that will enhance borehole efficiency by removing fines and setting the filter pack grains firmly in place throughout the annulus.

Surging should be carried out evenly in 3 ft intervals. Fines will be removed from the well, as necessary, using a sand pump or other apparatus. A dart bailer is not recommended for this process because the use of this tool runs an increased risk of puncturing the bottom of the well. Well surging will continue until there is less than 0.1 ft of screen infill per 15 minutes of surge time. Each interval shall be surged until CHPRC's field geologist delegate, in consultation with the OU Technical Lead, deems the development satisfactory.

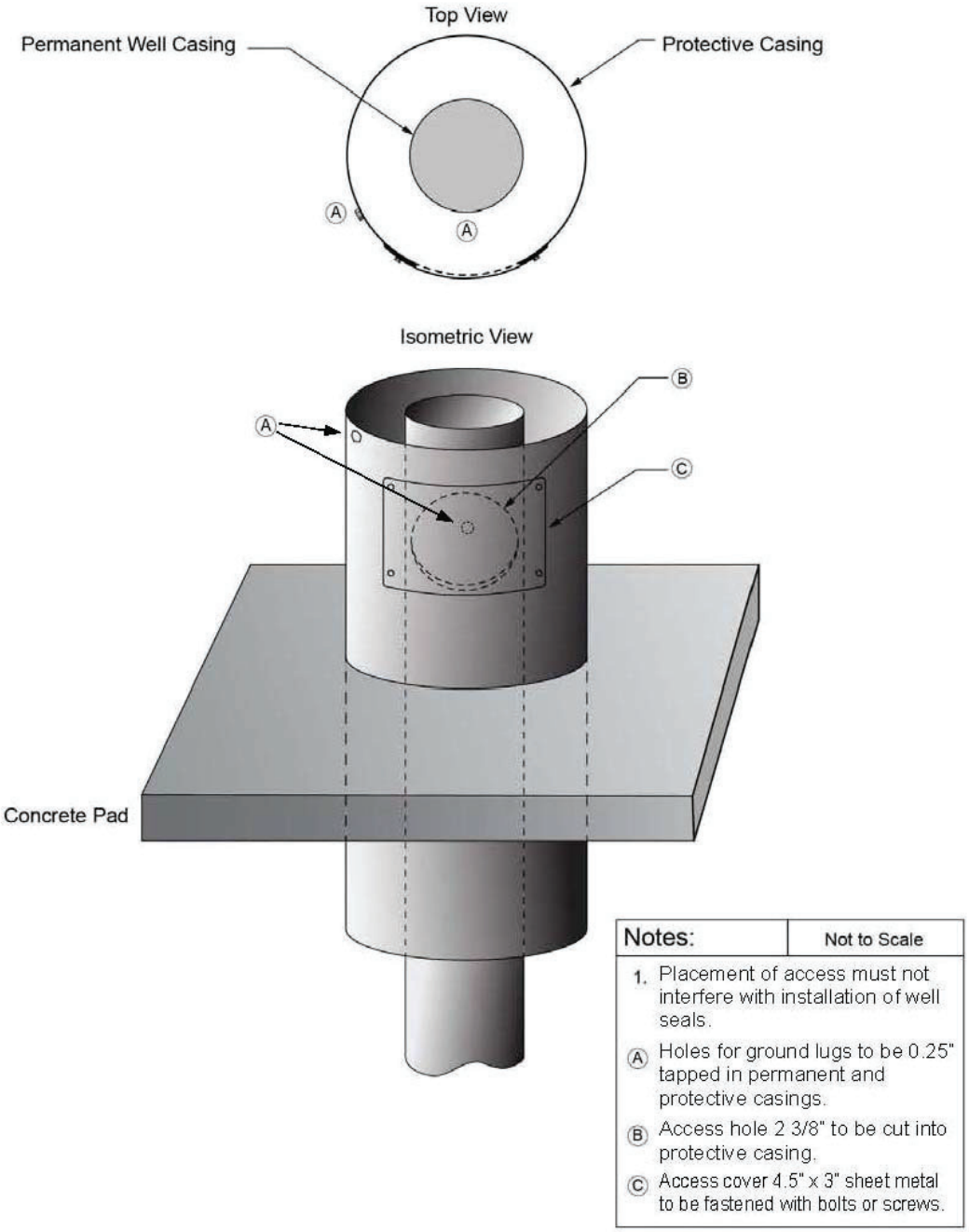

Figure 3. Diagram Showing Configuration of Access Port in Protective Casing

3.5.2 Final Well Development

Final well development may be conducted prior to the placement of the annular seal. If final well development is performed after the placement of the annular seal, then it shall not be started sooner than 12 hours following placement of the annular cement grout seal, but shall take place within two weeks of installation of the well screen/casing for each well. The drilling contractor shall notify the BTR 24 hours prior to the anticipated final development time in order to arrange for purgewater transportation, hydrogeologic support, and other support necessary to implement final development.

Final well development shall be performed as follows:

- Bail fines from the well to within 0.5 ft of the bottom of the sump in preparation for final development.
- Due to expected low water flow, the development pump, utilizing a pump sleeve or shroud, shall be placed near the bottom of the well sump and the well will be pumped with sufficient drawdown to drop the water level below the bottom of the screen three times at a minimum.
- Then a sustainable flow rate of 1 to 5 gallons per minute should be established, if possible.
- Physical parameters, such as turbidity, temperature, pH, and conductivity will be measured periodically to monitor well development.
- Development will continue until the well water has been determined stabilized by the field geologist, in consultation with the drilling BTR and OU Project Technical Lead (or designee). Less than 5 nephelometric turbidity units will by attempted to be met, however, due to the expected low flow rates, well development will be considered complete once water has been determined stabilized (temperature, pH, and conductivity have stabilized [at least three consecutive measurements with less than 10% mean variance]) regardless of turbidity measurement.
- The post-development perched water sample will be collected upon completion of final well development.

CHPRC's field geologist will monitor aquifer response and recovery time utilizing a data logger in conjunction with a pressure transducer (or similar device) or manually using an e-tape. During recovery monitoring, the pump and all down-hole monitoring equipment must remain in place. Recovery monitoring is expected to take at least 60 minutes per final development stage.

3.6 Final Report

A borehole summary report will be prepared after well completion to compile and archive records, observations, and measurements associated with the drilling and well construction. The borehole summary report will include field notes, forms prepared during the drilling, sampling information, well construction details, well development data, geologic logs, civil surveys, a summary of the management and disposition of drilling-derived waste, the well acceptance documentation, and geophysical log data reports.

4 Waste Management

Waste generated during the activities described in this document will be managed according to *Waste Management Plan for Perched Water Pumping/Pore Water Extraction, 200-DV-1 Operable Unit* (DOE/RL-2016-22), as amended by applicable change notices. For waste designation purposes, analytical data for existing wells 299-E33-350 and 299-E33-351 may be queried in the HEIS database, and the maximum concentration for each analyte within the most recent 5 years will be evaluated for use in creating a waste profile if required. Waste from these sampling activities will be handled in accordance with CERCLA. Ultimate disposal of supplemental samples collected for other organizations (i.e., Pacific Northwest National Laboratory) will be the responsibility of those organizations.

Vadose and saturated zone soil cuttings and miscellaneous solid waste will be stored and managed as investigation-derived waste and surveyed by the IHT and RCT in accordance with the site-specific Health and Safety Plan. The contractor shall be responsible for packaging and handling all wastes generated during construction, testing, decontamination, and demobilization. The SGRP Waste Management Specialist will provide final waste management instructions for the project.

Purgewater will be collected and contained at the well head until it is transported to the Modular Storage Units. Purgewater, groundwater samples, and decontamination fluids generated during well drilling and sample screening shall be managed as purgewater in accordance with purgewater guidance provided in DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan,* and DOE/RL-2011-41, *Hanford Site Strategy for the Management of Investigation Derived Waste*.

5 Quality Assurance

Document PRC-MP-QA-599, *Quality Assurance Program*, describes how CHPRC implements the quality assurance (QA) requirements conveyed in DOE O 414.1D, *Quality Assurance,* and 10 Code of Federal Regulations (CFR) 830.121, "Nuclear Safety Management," also shows how the TPA (Ecology et al. 1989) and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document (HASQARD)*, apply to Environmental QA Program Plans. CHPRC has also issued CHPRC-00189, *CH2M Hill Plateau Remediation Company Environmental Quality Assurance Plan*. All work performed under this DOW will be performed in compliance with Project Hanford Management System overall QA program design (PRC-MP-QA-599). A project-specific QA Program plan for the SGRP scope is presented in Appendix B of CHPRC-00189.

All operations including drilling, sampling and well completion/decommissioning, testing and associated documentation are subject to surveillance by CHPRC, CHPRC's authorizing agent, and/or owner. This surveillance shall in no way relieve the contractor of any contractual responsibilities. Note the term "surveillance" as used here may include inspection, survey, and/or assessment.

The surface of the ground adjacent to the borehole will be used as the "ground surface" reference for depth measurements. The elevation of the brass marker on the concrete well pad and the top of the protective casing will be surveyed after the well has been completed. A correlation of the measurements made while drilling to the surveyed elevation will be included in the final report.

Technical procedures to be followed are listed in Section 6.2 of this document.

6 General Requirements

Fieldwork for the wells will be conducted in accordance with existing CHPRC procedures and protocols and the specifications set forth in this DOW. The applicable procedures are discussed in the following sections.

6.1 Safety and Health

All personnel working at the drilling sites addressed by this plan will have completed, at a minimum:

- Occupational Safety and Health Administration Act 40-hour Hazardous Waste Site Worker training program (29 CFR 1910.120).
- CHPRC General Employee Training.
- Hanford Radiation Worker II training (as required).

Work will be performed in accordance with the following procedures:

- CHPRC-00073, *CH2M Hill Plateau Remediation Company Radiological Control Manual.*
- Site specific plans, as applicable:
  - Health and safety plans
  - Radiological evaluation/radiation work permits
  - Activity hazard analysis/job safety analysis
  - Site-specific Waste Packaging Instruction
- Hanford Site procedures.
- CHPRC procedures.
- Soil and Groundwater Remediation Project Radiological Control Procedures.
- CHPRC Environmental Procedures.

6.2 Technical Procedures/Specifications

This section identifies technical procedures/specifications applicable to field activities performed under this DOW. Activities associated with the drilling and installation of these wells and management of waste generated by these activities will adhere to, at a minimum, the following procedures and requirements:

- PRC-PRO-EP-15333, Environmental Protection Processes
- PRC-PRO-EP-15334, Effluent and Environmental Monitoring for Radionuclide Airborne Emissions
- PRC-PRO-EP-15335, Environmental Permitting and Document Preparation
- PRC-PRO-IRM-8310, Document Control Processes
- PRC-RD-EP-15332, Environmental Protection Requirements
- SGRP-PRO-EN-50025 (GRP-EE-01-7.0), *Geologic Logging*

- SGRP-PRO-EN-50030 (GRP-EE-02-14.1), Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings
- SGRP-PRO-EP-50026 (GRP-EE-01-7.4), Requirements for Use of Hydrogeologic Field Measurement & Monitoring Equipment
- SGRP-PRO-OP-50004 (GRP-EE-01-1.11), *Purgewater Management*
- SGRP-PRO-OP-50021 (GRP-EE-01-3.1), Environmental and IH Sample Preparation and Shipping Authorization
- SGRP-PRO-OP-50024 (GRP-EE-01-6.3), *Well Development and Testing*
- SGRP-PRO-OP-50037 (GRP-EE-05-1.21), Particle Size Distribution of Sediment - Wet Sieve Analysis
- SGRP-PRO-OP-50120, Waste Packaging and Handling at S&GRP
- SGRP-PRO-OP-52998, Gamma 1 and 4 Geophysical Logging System Set Up and Power Up
- SGRP-PRO-OP-53002, Gamma 1 and 4 Geophysical Logging System Shutdown
- SGRP-PRO-OP-53023, Perform SGLS Logging
- SGRP-PRO-OP-53024, Perform NMLS Logging
- SGRP-PRO-RP-52789 Radiological Control Coverage and Survey Requirements for S&GRP Activities
- SGRP-PRO-SMP-50015 (GRP-EE-01-2.7), Sample Management and Reporting Sample Issue Resolution
- SGRP-PRO-SMP-50043 (GRP-FS-04-G-004), Operational Monitoring Groundwater Sampling
- SGRP-PRO-SMP-50047 (GRP-FS-04-G-012), Sample Packaging, Transporting and Shipping
- SGRP-PRO-SMP-50060 (GRP-FS-04-G-028), Field Characterization and Treatment Monitoring Activities Groundwater Sampling
- SGRP-PRO-SMP-50061 (GRP-FS-04-G-029), *Non-VOC Soil and Sediment Sampling*
- SGRP-PRO-SMP-50062 (GRP-FS-04-G-030), *VOC Soil and Sediment Sampling*
- WAC 173-160, Minimum Standards for Construction and Maintenance of Wells

7 Project Documentation

Documentation requirements for these activities are separated into scoping documents, field activity documents, and reporting documents. The following documents will be prepared to support the well drilling activity:

- Scoping Documents
  - DOW (this document)
  - Drilling specifications/subcontractor scope of work (procurement package)
  - Excavation permit
  - SGRP-PRO-OP-50120, Waste Packaging and Handling at S&GRP
  - Additional waste management documents, as required
  - Radiological Hazard Screening Form
- Field Documentation
  - Well Drilling/Decommissioning Planning form
  - Daily Field Activity Reports
  - Sample collection, custody, and shipment documentation for waste samples
  - Well logs (borehole, lithologic, and completion)
  - Borehole Geophysical Log Data Reports
  - Field Logbook
  - Well Construction summary reports
  - Well Summary sheets
  - Field Cleaning and/or Decontamination sheets
  - Well Development and Test data sheets
  - Sieve Analysis sheets
  - Well Survey Data Reports
  - Well Acceptance Reports
- The WDOH (2012) ALARACT Agreements(s)
- Reporting Documents
  - Field documentation will be transmitted to Drilling Operations for incorporation into the well database
  - Borehole Summary Report

- State of Washington Resource Protection Well Report (generated by driller)

The records produced for this project will undergo technical and management review in accordance with CHPRC practices and procedures. The required reviewers will be identified prior to document completion, and the review time will be established as soon as practical.

8 References

CH2M HILL Plateau Remediation Company Soil and Groundwater Remediation Project Procedures:

PRC-MP-QA-599, *Quality Assurance Program*

PRC-PRO-EP-15333, *Environmental Protection Processes*

PRC-PRO-EP-15334, *Effluent and Environmental Monitoring for Radionuclide Airborne Emissions*

PRC-PRO-EP-15335, *Environmental Permitting and Document Preparation*

PRC-PRO-IRM-8310, *Document Control Processes*

PRC-RD-EP-15332, *Environmental Protection Requirements*

SGRP-PRO-EN-50025 (GRP-EE-01-7.0), *Geologic Logging*

SGRP-PRO-EN-50030 (GRP-EE-02-14.1), *Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings*

SGRP-PRO-EP-50026 (GRP-EE-01-7.4), *Requirements for Use of Hydrogeologic Field Measurement & Monitoring Equipment*

SGRP-PRO-OP-50004 (GRP-EE-01-1.11), *Purgewater Management*

SGRP-PRO-OP-50021 (GRP-EE-01-3.1), *Environmental and IH Sample Preparation and Shipping Authorization*

SGRP-PRO-OP-50024 (GRP-EE-01-6.3), *Well Development and Testing*

SGRP-PRO-OP-50037 (GRP-EE-05-1.21), *Particle Size Distribution of Sediment - Wet Sieve Analysis*

SGRP-PRO-OP-50120, *Waste Packaging and Handling at S&GRP*

SGRP-PRO-OP-52998, *Gamma 1 and 4 Geophysical Logging System Set Up and Power Up*

SGRP-PRO-OP-53002, *Gamma 1 and 4 Geophysical Logging System Shutdown*

SGRP-PRO-OP-53023, *Perform SGLS Logging*

SGRP-PRO-OP-53024, *Perform NMLS Logging*

SGRP-PRO-RP-52789, *Radiological Control Coverage and Survey Requirements for S&GRP Activities*

SGRP-PRO-SMP-50015 (GRP-EE-01-2.7), *Sample Management and Reporting Sample Issue Resolution*

SGRP-PRO-SMP-50043 (GRP-FS-04-G-004), *Operational Monitoring Groundwater Sampling*

SGRP-PRO-SMP-50047 (GRP-FS-04-G-012), *Sample Packaging, Transporting and Shipping*

SGRP-PRO-SMP-50060 (GRP-FS-04-G-028), *Field Characterization and Treatment Monitoring Activities Groundwater Sampling*

SGRP-PRO-SMP-50061 (GRP-FS-04-G-029), *Non-VOC Soil and Sediment Sampling*

SGRP-PRO-SMP-50062 (GRP-FS-04-G-030), *VOC Soil and Sediment Sampling*

Other References:

10 CFR 830.121, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations,* as amended.

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CHPRC-00189, 2013, *CH2M Hill Plateau Remediation Company Environmental Quality Assurance Program Plan*, CH2M Hill Plateau Remediation Company, Richland, Washington

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