DOE/RL-2011-40
Revision 0

Field Test Plan for the Perched Water Pumping/Pore Water Extraction Treatability Test

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

U.S. DEPARTMENT OF ENERGY

Richland Operations Office

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Terms

bgs	below ground surface
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M HILL Plateau Remediation Company
DQA	data quality assessment
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
FS	feasibility study
FTP	field test plan
FY	fiscal year
HASP	health and safety plan
HEIS	Hanford Environmental Information System
OU	Operable Unit
PWE	pore water extraction
SAP	sampling and analysis plan
VER	vacuum enhanced recovery

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1 Project Description

In response to the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989), Milestone M-015-50, "Submit a Treatability Test Work Plan for Deep Vadose Zone Technetium and Uranium to Ecology and EPA," DOE/RL-2007-56, *Deep Vadose Treatability Test Plan for the Hanford Central Plateau*, was issued in March 2008 to define tests that are focused on mitigating the potential of technetium-99 and uranium to contaminate groundwater. This field test plan (FTP) specifically defines the parameters for evaluating vacuum-assisted extraction of contaminated sediment pore water as a potential remedy.

This FTP supports DOE/RL-2007-18, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*. The 200-BP-5 Operable Unit (OU) includes groundwater beneath the B-BX-BY Tank Farm complex, which is the source of much of the contamination associated with the perched water intercepted by the well that is the focus of this test. This FTP specifically defines the parameters for evaluating perched water pumping/pore water extraction (PWE) as a potential remedy, with a focus on uranium. The corresponding sampling and analysis plan (SAP) is DOE/RL-2011-37, *Sampling and Analysis Plan for the Perched Water Pumping/Pore Water Extraction Treatability Test*.

1.1 Introduction

In the characterization testing conducted for the Soil Desiccation Pilot Test in fiscal year (FY) 2009, nitrate and technetium-99 measured in the water condensate from soil gas extraction (DOE/RL-2009-119, *Characterization of the Soil Desiccation Pilot Test Site*) suggested that pore water was stripped from the sediment and entrained in the exhausted soil gas. At that time, it was believed that this phenomenon was limited to high extraction flow rates and short duration by imposing sufficient vacuum near the well to create a hydraulic gradient that could induce pore water flow toward the well. Subsequently, a limited numerical simulation was performed that predicted capability to remove a portion of the pore water from sediment with high moisture content (PNNL-SA-74945, *Pore Water Extraction Simulation Results*).

Field testing is planned to provide further evaluation of the perched water pumping/PWE process for potential application to protect groundwater from mobile contamination residing in the deep vadose zone of the Hanford Site Central Plateau. Groundwater risk mitigation is derived from removing contaminated perched water and sediment pore water. The testing described by this document will focus on a zone of perched water in the Cold Creek unit (CCU) silt formation, located on the north side of the B Tank Farm. The test will extend a simple pumping test by applying a vacuum to accelerate removal of the perched water and a substantial fraction of the remaining sediment pore water.

1.2 Project Activities

This FTP describes the methodologies that will be used to evaluate perched water pumping/PWE as a potential remedy for protecting groundwater from deep vadose zone contamination. The test focus is to gather information for use in a subsequent feasibility study (FS) evaluation of this technology. This information can be interpreted in terms of FS criteria such as short-term effectiveness, implementability, long-term effectiveness, and cost. The impact to groundwater will not be measureable over the duration of the test. Therefore, information needed to conduct fate and transport modeling will be collected so numerical models can be used to estimate the effectiveness of the treatment for protection of groundwater.

2 Treatment Technology Description

The treatment technology being tested is PWE via vacuum application to the saturated/semi-saturated sediment formation. In July 2009, bulk permeability testing was conducted near the C5923 borehole

located in the BC Cribs and Trenches area. (Testing included application of a vacuum, measuring approximately 200 cm [80 in.] water gauge, which was accompanied by exhausted soil gas flow rates of approximately 11 m^3/min [400 ft^3/min]). Unexpectedly, collected condensate from that test exhibited substantial contamination representative of the sediment pore water (DOE/RL-2009-119). Subsequent numerical simulation focusing on generic sand, silt, and clay materials corroborated observed results and provided general guidance for exploitation of this phenomenon (PNNL-SA-74945). The simulation showed that pore water would be removed from the sediment as a function of the applied vacuum, sediment saturation and associated matric potential, and sediment hydraulic properties. Simulation also showed that the range of influence could be at least 15 m (50 ft), and the process could be sustained as long as saturation conditions remained above the threshold for pore water movement. The process is most efficient in silty sediment with high water saturation. The test within the CCU is within a silt-dominated sediment of high water saturation where the most efficient PWE is expected. Existing Well 299-E33-344 is screened in a zone of perched water that is currently draining into the aquifer (PNNL-19277, *Conceptual Models for Migration of Key Groundwater Contaminants through the Vadose Zone and into the Unconfined Aquifer below the B-Complex*). Following traditional drawdown pumping to estimate "reservoir" extent and sediment permeability, a vacuum will be applied to accelerate the pumping rate and enable an estimation of overall capability to remove the perched water and thereby protect groundwater. Continued vacuum application will also contribute to PWE from unsaturated sediment.

3 Test Objectives

The following overall objectives of DOE/RL-2007-56 have been refined based on the discovery of contaminated perched water draining into the aquifer adjacent to the B Tank Farm (PNNL-19277):

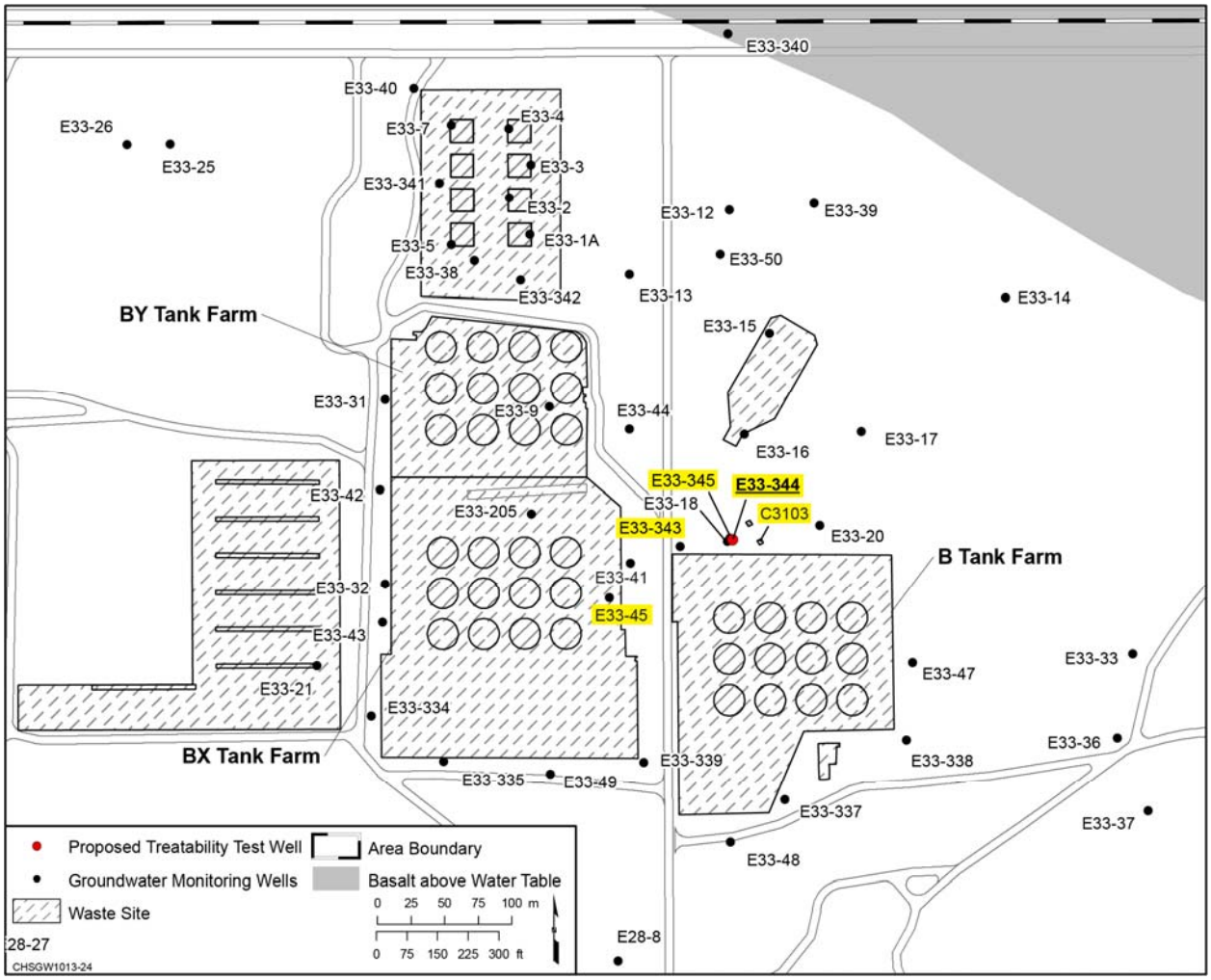
- Refine the parameters of perched water zone using traditional pumping and vacuum enhanced recovery (VER) testing, including operational parameters, such as applied vacuum and extraction flow rates and properties, and identify targets to achieve acceptable reduction of the perched water zone and sediment pore water content.
- Demonstrate field scale treatment for targeted areas within the vadose zone:
  - Quantify operational equipment, parameters, and instrumentation to evaluate implementability of the process on a large scale.
  - Quantify the extent and rate of perched water removal/PWE and the associated moisture content decrease in the field test treatment zone.
  - Collect data to allow consideration of perched water pumping/PWE as a remedy in the FS process.

4 Experimental Design and Methods

The treatability test design is intended to evaluate removal of a vadose zone contaminated perched water zone by application of traditional and vacuum enhanced pumping as a potential remedy for groundwater protection. The test will be conducted in the deep, high-silt content CCU in the B Tank Farm region of the Hanford Site 200 East Area. The test will initially focus on a zone of saturated sediment and transition to the unsaturated sediment as the perched water is removed.

4.1 Test Site Location and Description

Figure 1 shows the test location that will use existing Well 299-E33-344, located on the north side of the B Tank Farm. Well 299-E33-344 includes a 5.8 m (19 ft) long screen that overlaps a 3.7 m (12 ft) deep zone of perched water that starts at approximately 68.5 m (225 ft) below ground surface (bgs). Selection of this location was enhanced by the opportunity to combine this test with another activity focused on removing the perched water that is believed to be contributing to groundwater contamination. Prior to the application of the vacuum, other workers will perform a pumping test to evaluate the drawdown rate of the perched water. This initial pumping test is expected to provide considerable information important to the perched water pumping/PWE testing.



Note: Highlighted wells indicate observation of perched water.

Figure 1. Location of the Test Site (Well 299-E33-344) Adjacent to B Tank Farm

At this time, it is not known whether pumping can be sustained due to potentially low hydraulic permeability of the sediment. Conditions are assumed to suitable for fruitful testing. If otherwise, the test design will be revisited or terminated. Duration of the pumping test is anticipated to be a few months before application of the vacuum to enhance the perched water pumping rate and to initiate sediment PWE from unsaturated sediment exposed to a portion of the screen.

Much of the contamination in this perched water zone came from the 1951 Tank BX-102 overfill event that inadvertently discharged an estimated 347 m^3 (91,600 gal) (RPP-23405, *Tank Farm Vadose Zone Contamination Volume Estimates*), including 10 metric tons of uranium to the soil. Lesser contributions came from nearby waste disposal sites (PNNL-19277).

Table 1 shows contaminant concentration versus depth data for Well 299-E33-344 (test site) and adjacent Well 299-E33-345 sediment from PNNL-19277.

Table 1. Contamination Profile for Wells 299-E33-344 and 299-E33-345

Depth (ft bgs)	Na (WE) µg/g	Ca (WE) µg/g	F µg/g	Nitrate µg/g	Nitrite µg/g	Sulfate µg/g	Tc pCi/g	U (AE) µg/g	U (WE) µg/g	Cr (WE) (µg/g)
299-E33-344										
41.5	7.4	7.1	0.28	2.24	<1.00	9.96	<8.51E-02	0.35	2.53E-04	<3.19E-04
55	10.9	6.7	0.33	3.39	<1.00	13.9	<8.51E-02	0.40	3.12E-04	<3.00E-04
67.5	10.6	7.4	0.27	4.32	<1.00	17.9	<8.49E-02	0.38	2.11E-04	<2.45E-04
85.4	12.9	10.7	0.28	8.37	<1.00	18.2	<8.48E-02	0.35	2.19E-04	<3.16E-04
107.5	10.1	9.5	0.21	8.12	<1.00	11.3	<8.50E-02	0.31	1.32E-04	<2.96E-04
122.5	10.4	7.0	0.37	2.12	<1.00	12.4	<8.48E-02	0.33	1.05E-04	<3.13E-04
137.5	8.2	7.3	0.21	1.57	<1.00	16.8	<8.49E-02	0.39	2.62E-04	<3.43E-04
152.5	13.1	8.9	0.32	2.09	<1.00	27.8	<8.48E-02	0.37	1.99E-04	<2.61E-04
162.5	11.0	11.6	0.22	3.03	<1.00	43.8	<8.48E-02	0.32	3.60E-04	<3.47E-04
172.5	7.3	5.6	0.21	1.02	<1.00	9.04	<8.51E-02	0.35	1.59E-04	<2.90E-04
182.5	10.5	10.7	<2	<10	<10.00	36.7	<8.51E-02	0.36	3.58E-04	<1.99E-04
192	16.6	12.7	<2	<10	<10.00	46.9	<9.45E-02	0.34	2.31E-04	<3.55E-04
202.5	12.7	14.0	<2	<10	<10.00	51.0	<8.48E-02	0.40	2.14E-04	<2.82E-04
212.3	14.3	13.7	<2	<10	<10.00	50.7	<8.48E-02	0.39	1.83E-04	<3.26E-04
219.8	**118**	**2.1**	**7.38**	30.1	<10.00	**107**	<8.48E-02	1.11	1.05E-02	**0.017**
225	**360**	**1.8**	**54.2**	**136**	<10.00	**154**	*0.26*	0.64	**0.10**	**0.076**
Perched Water						perched				
227.5	**147**	**1.0**	**21.6**	**43.0**	<10.00	82.3	*0.34*	1.05	**9.48E-03**	**0.014**
230	**232**	**2.0**	**26.0**	**97.1**	<10.00	**133**	*0.64*	**9.09**	**3.93**	**0.015**
232.5	**234**	4.8	**10.1**	**158**	<10.00	**158**	**7.52**	**5.61**	**0.97**	5.08E-03
233.25	**259**	9.8	1.43	**290**	NR	**177**	**22.8**	1.07	0.04	NR
235	**256**	10.8	<2	**325**	<10.00	**176**	**17.6**	1.25	0.03	**0.039**
235.25	**223**	7.52	16	**97.4**	NR	**176**	1.88	**28.6**	**11.3**	6.1 E-03
299-E33-345										
220	**137**	**1.69**	1.48	**47.0**	<1.00	**107**	0.48	0.67	2.64E-03	9.53E-03
225	**212**	**0.72**	**32.6**	**56.9**	<1.00	**117**	0.38	0.49	**1.17E-02**	9.49E-03
230	**88.2**	**40.5**	0.20	18.4	<1.00	14.0	**10.5**	**46.4**	**12.6**	5.91E-03
235	**135**	**149**	0.20	**58.8**	<1.00	42.2	**90.0**	**119**	**18.2**	<0.0014634
239.5	**233**	13.2	0.20	36.2	<1.00	17.8	**46.9**	1.33	**0.03**	<0.0018224
247.25	**83.3**	**1.19**	0.20	4.57	<1.00	4.06	1.87	0.42	3.23E-03	0.11
252.25	**67.6**	**1.44**	0.20	3.32	<1.00	3.43	1.91	0.39	1.46E-03	0.05
253.29 ft bgs		water table								
257.5	12.4	8.84	0.20	1.26	<1.00	1.60	0.24	0.35	1.12E-03	2.74E-03

Tan shading = CCU_z sediments; Red type = very high concentrations; Bold type = elevated above natural background; Blue type = depleted concentrations caused by ion exchange; NR= not reported WE = water extraction, AE = acid extraction

Table 2 provides Well 299-E33-344 perched water sampling results from July 2008 to May 2010, exhibiting 788 to 5,300 µg/L of uranium; 4,130 to 6,200 pCi/L of technetium-99; and 417 to 522 mg/L nitrate (Hanford Environmental Information System [HEIS]). Data for additional contaminants and water attributes exist but are not reproduced here.

4.2 Experimental Design

The experimental design for the field test is guided by the objectives outlined in Chapter 3. Overall test design includes the initial unassisted pumping activity as part of the perched water pumping/PWE evaluation. These objectives are targeted at collecting information to support inclusion of perched water pumping/PWE as a technology in future *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) FSs. The experimental design includes plans for field testing and complementary numerical simulations.

Table 2. 299-E33-344 Perched Water Analyses

Sampling Date	Nitrate (µg/L)	Technetium-99 (pCi/L)	Uranium (µg/L)
7/15/08	436,000	4,400	897
9/19/08	522,000	4,130	788
11/18/08	483,000	4,800	1,820
5/22/09	--	5,400	1,460
6/26/09	474,000	--	--
8/04/09	478,000; 483,000	5,900; 5,800	5,300; 4,940
11/12/09	433,000; 417,000	6,000; 6,200	2,910; 2,980
5/24/10	469,000	5,900	1,660
12/19/10	580,000	4,320; 5,400	409

The overall approach uses the following elements to obtain the necessary treatability information for the PWE technology.

- The first element of the test is to evaluate the unassisted perched water drawdown from Well 299-E33-344 to provide valuable information regarding hydraulic permeability and pumping characteristics.
- A vacuum will be applied to accelerate perched water pumping. PWE will accompany VER of the perched water, because a fraction of the well screen is placed above the top of the perched water. As the perched water is pumped out, the fraction of recovered water represented by PWE will steadily increase.
- Variable suctions and cyclic operations (on/off) will be applied during VER to obtain additional information on the subsurface hydraulic conditions and perched water extent. This information will also be evaluated using numerical simulations to evaluate the contribution of PWE during this operational mode. Suction will be limited to avoid cessation of PWE resulting from creation of a capillary break between the sediment and well screen sand pack. To the extent possible, nearby wells will be monitored via periodic neutron moisture logging to measure water content reduction. Depending on the hydraulic response and extent of perched water recovery by vacuum enhanced pumping, testing may transition solely to PWE (unsaturated recovery only). Alternatively, the testing activities may continue under VER operations, or the approach may need to be reconfigured to enable testing of PWE.
- Duration of the test is uncertain due to the unknown quantity of perched water and hydraulic permeability of the sediment. Because the perched water quantity and its removal rate are uncertain and scoping calculations suggest its removal could easily exceed a year, continual evaluation of the test performance data is planned.
- Variable suction will be applied to validate numerical simulation performed previously. PWE will be continued after perched water recovery has diminished to negligible value. To the extent possible,

nearby wells will be monitored via periodic neutron moisture logging to measure water level reduction during VER of the perched water and sediment moisture content reduction during PWE.

- Collected water, pumped from the extraction well sump and/or condensed from exhausted soil gas, will be periodically analyzed to determine contaminant concentration. While the major focus will be on uranium, technetium-99, and nitrate, more comprehensive sampling and analyses will be performed on a less frequent basis based on DOE/RL-2007-18 and review of previous perched water sampling.

Table 3 outlines details of the test.

Table 3. Experimental Design Details

Activity	Key Features of Design	Basis for Sampling Design
Phase 1—Perform Additional Baseline Characterization		
Evaluate perched water pumping data.	Use existing screened Well 299-E33-344. No monitoring wells installed. Perform neutron moisture logging of nearby completed wells (299-E33-345 and 299-E33-18). Reconsider test parameters if pumping rate >50 gallons per day cannot be sustained.	Define baseline conditions.
Phase 2—Perform Vacuum Enhanced Recovery		
Perform VER of perched water. VER is anticipated to begin after a few months of pumping without vacuum assistance and to continue for many months before removal of all drainable water.	Use blower from Soil Desiccation Pilot Test to apply vacuum.	Accelerate removal of perched water and initiate pore water extraction.
Vary applied suction.	Begin at low suction and cautiously progress to values that are more negative.	Accelerate removal of perched water.
Monitor contaminant concentration in collected water.	Periodically analyze for carbon-14, technetium-99, tritium, iodine-129, gross alpha/beta, arsenic, chromium, iron, calcium, magnesium, mercury, sodium, uranium, chloride, nitrate, nitrite, sulfate, specific conductance, and pH.	Quantify reduction in potential groundwater contamination.
Monitor collected water electrical conductivity.	Separately measure conductivity of water pumped to surface and water associated with exhausted soil gas.	Relate conductivity to impurity concentration to allow reduced laboratory analysis.

Table 3. Experimental Design Details

Activity	Key Features of Design	Basis for Sampling Design
Measure collected water accumulation rate(s).	Separately measure accumulation rates of water pumped to surface and water associated with exhausted soil gas.	Quantify overall reduction in sediment water content and contaminant inventory.
Phase 3—Perform Pore Water Extraction		
Continue after drainable water removed from perched water zone.	Pore water extraction will commence with VER of perched water. Because some fraction of extracted pore water will combine with perched water in the well sump, even if the velocity of the exhausted soil gas is sufficient to entrain water droplets, distinction of the collected water source will be problematic. Cessation of drainable water pumping is expected to be gradual. Pumping duration may be many months.	Remove contamination that represents an imminent threat to groundwater.
	Adjust vacuum to determine minimum value for pore water extraction. Increase vacuum to optimize pore water extraction.	Establish approximate threshold for pore water extraction.
Periodically* perform neutron moisture logging of nearby wells.	Log nearby Wells 299-E33-345 and 299-E33-18.	Monitor changes in perched water level and sediment moisture content.

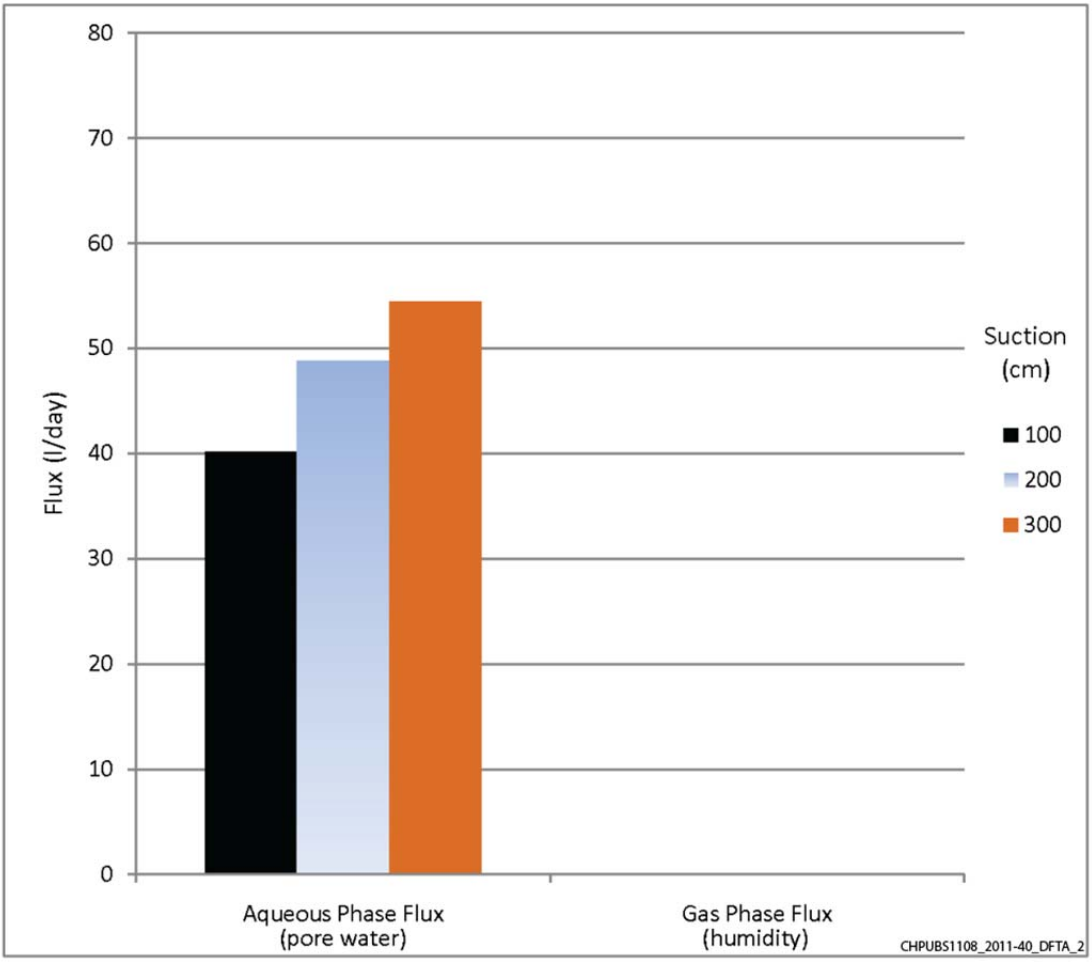
* Periodicity is determined by evaluation of liquid collection data and/or independent numerical simulation.

VER = vacuum enhanced recovery

4.2.1 Technical Basis

Numerical simulation of the PWE process was performed using recognized sediment hydraulic parameters (Carsel and Parrish, 1988, "Developing Joint Probability Distributions of Soil Water Retention Characteristics") as input to the Subsurface Transport Over Multiple Phases simulator to model the relevant capillary pressure processes (PNNL-SA-74945) when a vacuum is applied. Two contributions to collected water were simulated: soil gas phase humidity, and soil aqueous phase that includes dissolved contaminants.

Figure 2 shows simulated results for a 3 m (9.84 ft) thick silt lens in contact with a 1 m (3.28 ft) long well screen and applied vacuum ranging from 100 to 300 cm (39.37 to 118.11 in.) water gauge. In this case, virtually all of the collected water is sediment pore water that has been pulled into the well as the matric potential of the sediment was overcome by the applied suction.



Source: PNNL-SA-74945, *Pore Water Extraction Simulation Results*.

Figure 2. Flow Rates for Silt Layer in Sand (3 m Silt Lens; 1 m Well Screen)

Significant liquid phase pore water is removed, showing potential application to remove deep vadose zone contamination. Furthermore, the simulation suggested a zone of influence of at least 15 m (50 ft) and durations corresponding to that required to reduce water saturation to a value of near 0.6.

Extrapolation of the numerical simulation to existing Well 299-E33-344 is problematic, with the well screen traversing zones of sand, silt, silt-clay, and silty sand. In this case, approximately a third of the 5.8 m (19 ft) long screen length overlaps regions of silt and silt-clay, and another 2.4 m (8 ft) overlaps a region of silty sand.

Another numerical simulation was performed in conjunction with laboratory experiments to provide further investigation and demonstrate the PWE process in unsaturated systems (PNNL-20507, *Pore Water Extraction Intermediate-Scale Laboratory Experiments and Numerical Simulations*). The tested configurations consisted of homogeneous packings, with or without fine-grained well-pack material, representing subsurface sediments at the SX Tank Farm in terms of particle size distribution. Scoping experiments recommended that the imposed vacuum be slowly increased to avoid water continuity problems between the well-pack sand and sediment. The relative permeability of uniform coarse-grained and medium-grained well-pack sands during PWE was observed to decrease rapidly to a point where virtually no water outflow was observed. To avoid that problem, a fine-grained well-pack sand was used instead, with an entry pressure greater than the imposed vacuum.

4.2.2 Field Test Operations

The first operational element of the test is to collect and evaluate additional data for characterizing hydraulic conductivity of the perched water zone. Next, a blower system will be installed to provide suction to the well to accelerate water removal. Some degree of PWE is expected upon vacuum application because a portion of the well screen extends above the perched water level.

Figure 3 provides a portion of the Well Summary Sheet prepared by the geologist who attended well drilling and construction. This figure includes location of the screen and its relationship to local stratigraphy and the perched water. Pump inlet will be approximately 24 cm (10 in.) above the bottom of the well: 71.2 m (236.8 ft) bgs. Based on several perched water sampling activities and pumping tests, an initial pumping rate without vacuum assistance of 0.9 L/min (0.25 gal/min) is expected. If the applied vacuum is equivalent to 100 cm (40 in.) water gauge (vacuum is intentionally low to minimize water continuity problems between the well-pack sand and sediment), the effective "head" driving water collection into the well sump will be increased by 1 m (3.3 ft), increasing the effective head from 2.7 m (8.8 ft) to 3.7 m (12.2 ft). Under these conditions, a higher pumping rate is expected, up to 1.3 L/min (0.35 gal/min). More negative vacuum will be considered to increase the pumping rate, but it will be approached cautiously to avoid shutdown of attendant PWE. The pumping rate will decline as the perched water level declines.

Extent of the perched water zone is uncertain. Review of drilling records and logging data shows that perched water was observed at Wells 299-E33-344, 299-E33-343, 299-E33-345, and 299-E33-45. Without additional data, any estimate of the quantity of water that may be recoverable is speculative.

Pore water removal will be occurring during the initial vacuum-enhanced recovery operations. At this time and when operations transition to PWE, the production rates of water associated with soil gas humidity and perched water/pore water will be separately determined. If practicable (i.e., if additional blower capability exists), the suction will be increased, and similar production rates will be measured to provide further characterization of this technology. PWE will be continued for approximately six months or until collection of pore water ceases, whichever comes sooner.

4.2.3 Field Operations

Field operations, including blower operation and sample collection, will follow standard field test methods.

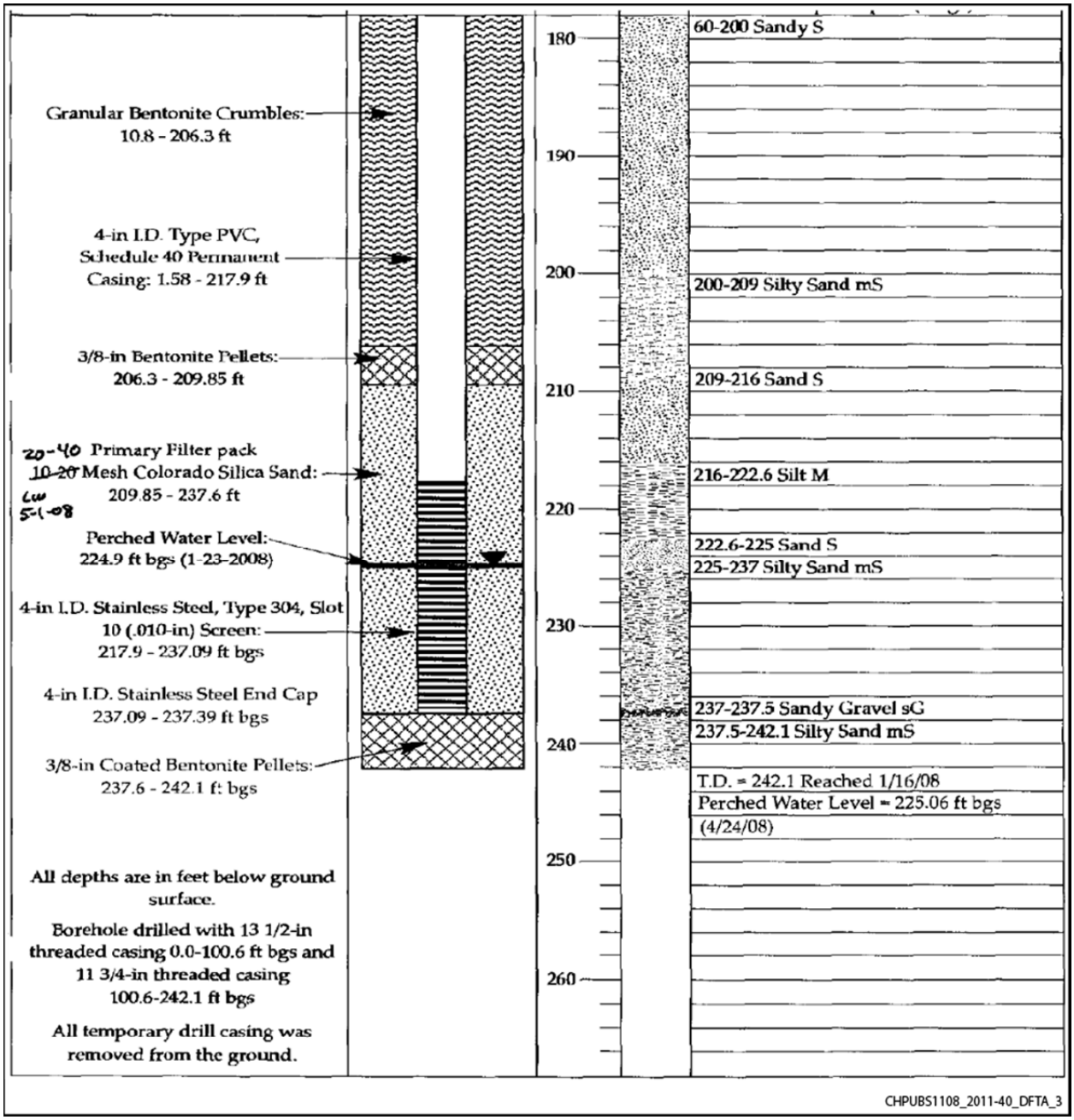


Figure 3. 299-E33-344 Well Construction

5 Equipment and Materials

Equipment anticipated to be required includes an exhaust blower to apply suction to the extraction well and piping to the water collection/transfer system, as described in the following subsections.

5.1 Test Equipment

A fixed-speed blower will be used to apply a vacuum to the extraction well. Suction will be controlled by varying the quantity of make-up air allowed to enter the blower.

Extracted gas will pass through a condenser to capture soil gas humidity and entrained pore water. These two components will be distinguished by comparing the overall contamination level of the combined sample with the contaminant concentration in the sediment pore water. The condenser water collection system will provide the capability to measure the accumulation rate. Before exhausting to the atmosphere, the gas will pass through a high-efficiency filter.

The extraction well will feature a sump and associated pumping system to pump the water to the surface for collection. The system will provide the capability to measure the accumulation rate.

No in-situ instrumentation will be used since the well is already installed, and no monitoring wells are planned.

5.2 Evaluation of Candidate Instrumentations

This section describes the candidate instruments and the testing that will be used to identify instruments for use in the field test.

5.2.1 Neutron Moisture Logging

Borehole neutron moisture logging of nearby wells will be performed to assess changes in sediment moisture content. This activity will be subcontracted. Although the wells are not configured ideally to perform this measurement, relative changes are expected to be discernable, which will allow assessment of treatment progress.

5.2.2 Aboveground Measurements

Water collection rate will be monitored using common industrial instrumentation. Electrical conductivity of the collected water will be monitored similarly.

6 Sampling and Analysis

The SAP (DOE/RL-2011-37) provides sampling and analysis details and includes the quality assurance plan for the sampling and associated analyses.

7 Data Management

The types of data collected include the following:

- Data from periodic neutron moisture logging
- Data from aboveground gauges that measure extracted gas properties (humidity, flow rate, and temperature), collected water collection rates, and other operational parameters
- Chemical and physical properties of collected water samples

A project-specific database will be developed and maintained to collect, organize, store, verify/validate, and manage analytical laboratory data and/or field measurements for environmental samples. The data will be stored electronically and maintained in the project files. A project data custodian will be designated to control and maintain the data.

The Sample Management and Reporting organization, in conjunction with the project manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements governing data management activities. Pertinent analytical data collected in the laboratory will also be recorded in HEIS. Details of the data management plan are included in the SAP (DOE/RL-2011-37).

8 Data Analysis and Interpretation

Evaluation of the perched water pumping/PWE test will include interpretation of treatment effectiveness, operational performance, and results with respect to supporting evaluation of the technology using the CERCLA FS criteria, described as follows:

- Treatment Effectiveness—Quantities of contaminants and pore water removed will be determined. Numerical simulations will be performed to estimate fate and transport parameters for pretreatment and post-treatment conditions.
- Operational Performance—The key factor in operational performance is the rate of perched water pumping/PWE from the target treatment zone. Tracking of water collection parameters and contaminant analyses will provide information on the conditions necessary to maintain the water removal processes. Information on required equipment and operations will be compiled to assess short-term effectiveness, implementability, and cost.
- FS Support—The PWE technology will be evaluated using the remaining CERCLA criteria (overall protection of human health and the environment; legal compliance; long-term effectiveness; and reduction in contaminant toxicity, mobility, or volume). The test will provide input to facilitate evaluation of these criteria.

9 Health and Safety

The CH2M HILL Plateau Remediation Company (CHPRC) hazardous waste operations safety and health program was developed for employees involved in hazardous waste site activities. The program was developed to comply with the requirements of 29 CFR 1910.120, “Occupational Safety and Health Standards,” “Hazardous Waste Operations and Emergency Response,” and 10 CFR 835, “Occupational Radiation Protection,” to ensure the safety and health of workers during hazardous waste operations.

A site-specific health and safety plan (HASP) has been developed in accordance with the health and safety program to define the chemical, radiological, and physical hazards and to specify the controls and requirements for work activities. Access and work activities will be controlled in accordance with approved work packages, as required by established internal work requirements and processes. The HASP, which will address the health and safety hazards of each phase of site operation, includes the requirements for hazardous waste operations and/or construction activities, as specified in 29 CFR 1910.120.

Project field staff must comply with the HASP at all times. Unescorted site visitors are required to read and sign the HASP before entering the test and construction areas and must have completed the required training outlined in the HASP. Escorted visitors are briefed on health and safety concerns and must be escorted by the test project manager (or designee) at all times when they are in the test and construction areas.

During the testing, emergency response for the 200-BP-5 OU treatability test activities will be covered by the site-specific HASP. The HASP specifies primary emergency response actions for site personnel, area alarms, implementation of the emergency action plan and emergency equipment at the task site, emergency coordinators, emergency response activities, and spill containment methods. A copy of the HASP will be maintained by the site superintendent (or designee).

A test-specific air emissions plan has been prepared (see Appendix A).

10 Waste Management

The waste management requirements for this treatability test are contained in DOE/RL-2003-30, *Waste Control Plan for the 200-BP-5 Operable Unit*.

11 Community Relations

No formal public review is planned for this treatability test plan. However, this plan will be discussed with representatives from the Hanford Advisory Board, Tribal Nations, and the State of Oregon. Information developed during this treatability study will support the FSs and proposed plans that consider uranium sequestration via vadose zone ammonia injection; those documents will be available for public review.

12 Reports

Reports to management on data quality issues will be made if and when these issues are identified. Laboratory or field sampling and analysis personnel will report these issues to the project manager. Subsequently, standard reporting protocols (e.g., project status reports) will be used to communicate these issues to management. Because no performance or system assessments are planned as part of this treatability test, the project manager will not be providing audit or assessment reports to management unless an unanticipated request is made to conduct such an assessment.

At the end of the project, a data quality assessment (DQA) report will be prepared to evaluate whether the type, quality, and quantity of data that were collected met the intent of the data quality objectives prepared for this treatability test. After completion of the DQA report, a treatability test report summarizing the results of the test will be issued.

13 Schedule

Figure 4 lists the project schedule and the schedule drivers.

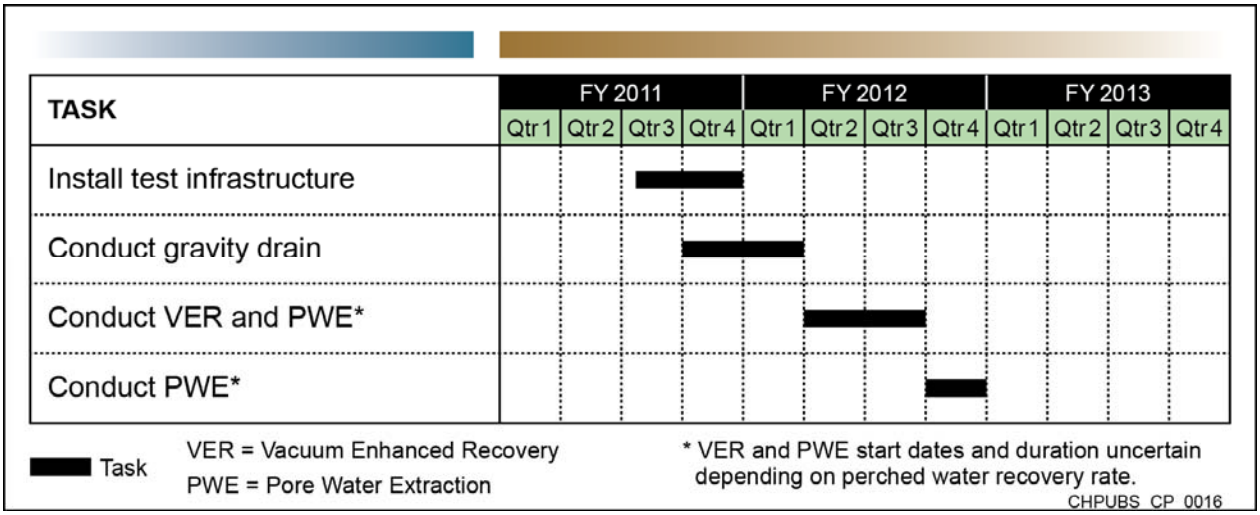


Figure 4. Treatability Test Schedule

14 Management and Staffing

This treatability test will be conducted by the U.S. Department of Energy, Richland Operations Office (DOE-RL). The test will be managed by CHPRC Soil and Groundwater Remediation Project personnel.

Staffing will include personnel from CHPRC, other Hanford Site contractors, and subcontractors as specified by the CHPRC project manager. The CHPRC project manager will ensure that selected personnel are qualified to perform all activities in accordance with the requirements specified in this test plan. Specific staffing plans are specified in work planning documents or subcontracts prepared on a task-specific basis.

15 Budget

Funding for all environmental restoration conducted at the Hanford Site is distributed to DOE-RL from the U.S. Department of Energy (DOE) Headquarters. Distribution of funds is based on the allocation provided to DOE in the President's budget; therefore, it is possible that not all funds requested for performance of activities are provided in a given FY.

CHPRC project management has prepared detailed cost estimates for the work required to complete this treatability test. Because not all activities will be completed in a single FY, all that is known about the budget for project completion is what is available in the current FY. As of the publication date for this test plan, activities that will be completed in the first FY of the treatability test are funded and will be performed as described.

Projected cost for the test is $548,000.

16 References

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Appendix A

Air Emissions Plan for the Pore Water Extraction Treatability Test

Terms

APQ	Annual Possession Quantity
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
EPA	U.S. Environmental Protection Agency
HEIS	Hanford Environmental Information System
HEPA	high efficiency particulate air
MEI	maximally exposed individual
PTE	potential-to-emit
SQER	small quantify emission rate

A1 Introduction

This air emissions document supports implementation of DOE/RL-2007-56, *Deep Vadose Zone Treatability Test Plan for the Hanford Central Plateau*. Treatability testing supports evaluation of remedial technologies for contaminant removal in the vadose zone at sites such as those adjacent to the B Tank Farm. The specific technology supported by this plan is perched water pumping combined with pore water extraction. Perched water pumping/pore water extraction has been selected for testing because it is a promising technology based on initial field evaluation and subsequent numerical simulation. Testing will evaluate the subsurface water removal processes and the long-term performance for mitigation of contaminant transport. Pilot testing will be performed on the north side of the B Tank Farm that will focus on a zone of perched water in the Cold Creek unit (CCU) silt zone contaminated primarily by technetium-99 (Tc-99), uranium-238 (U-238), and nitrate (NO_3^-). This air emissions document applies to the activities to be completed to perform the testing at this location that is assigned to the 200-BP-5 Operable Unit.

The test will use existing Well 299-E33-344 that is screened in the silt region of the CCU to intersect a zone of contaminated perched water. Testing will include a pumping test that is designed to remove a portion of the perched water. A negative pressure of up to 300 cm (118 in.) water gauge vacuum applied to this well will accelerate removal of the perched water and then remove pore water from unsaturated sediment. Soil vapors from this test will be discharged to the atmosphere following moisture reduction in a chiller or other condenser and following filtration by a high efficiency particulate air (HEPA) type filter. Following removal of the perched water, which is estimated to take twelve months for this evaluation, the test duration will continue for approximately six months. The purpose of the test is to obtain physical measurements to aid in evaluation of this technology as a remediation option. Figure A-1 provides a conceptual depiction of the test configuration.

Radiological and chemical release potential exists. The maximum values for radiological and chemical constituents, as observed in underlying sediment pore water or perched water analytical results, are used in calculating the release potentials described in Section A2 of this air emissions document.

A2 Air Emissions

The following subsections address radionuclide and criteria/toxic air emissions. *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), Section 121, "Degree of Cleanup," requires remedial actions to meet the substantive requirements of other promulgated environmental regulations that are either applicable, or relevant and appropriate, to the planned remedial activities. At the same time, the procedural and administrative aspects of these regulations, such as permitting requirements, do not apply to onsite CERCLA actions like this one.

A2.1 Radiological Air Emissions

The "Washington Clean Air Act" (RCW 70.94) requires regulation of radioactive air pollutants. The state implementing regulation, "Ambient Air Quality Standards and Emission Limits for Radionuclides" (WAC 173-480), sets standards that are as stringent or more stringent than the federal *Clean Air Act of 1990*, and the federal implementing regulation, "National Emission Standards for Hazardous Air Pollutants" (40 CFR 61), "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities" (Subpart H). The U.S. Environmental Protection Agency (EPA) partial delegation of the 40 CFR 61 authority to the State of Washington includes all substantive emissions monitoring, abatement, and the reporting aspects of the federal regulation. The state standards protect the public by conservatively establishing exposure standards applicable to a real or hypothetical

maximally exposed individual (MEI). The standards address any member of the public, at the point of maximum annual air concentration in an unrestricted area, where a member of the public may be. All combined radionuclide airborne emissions from the U.S. Department of Energy Hanford Site "facility" are not to exceed amounts that would cause an exposure to any said member of the public of greater than 10 mrem/yr effective dose equivalent. The state implementing regulation, "Radiation Protection—Air Emissions" (WAC 246-247), which adopts the WAC 173-480 standards and the 40 CFR 61, Subpart H standard, requires verification of compliance with the 10 mrem/yr standard, and would be applicable or relevant and appropriate to this characterization action.

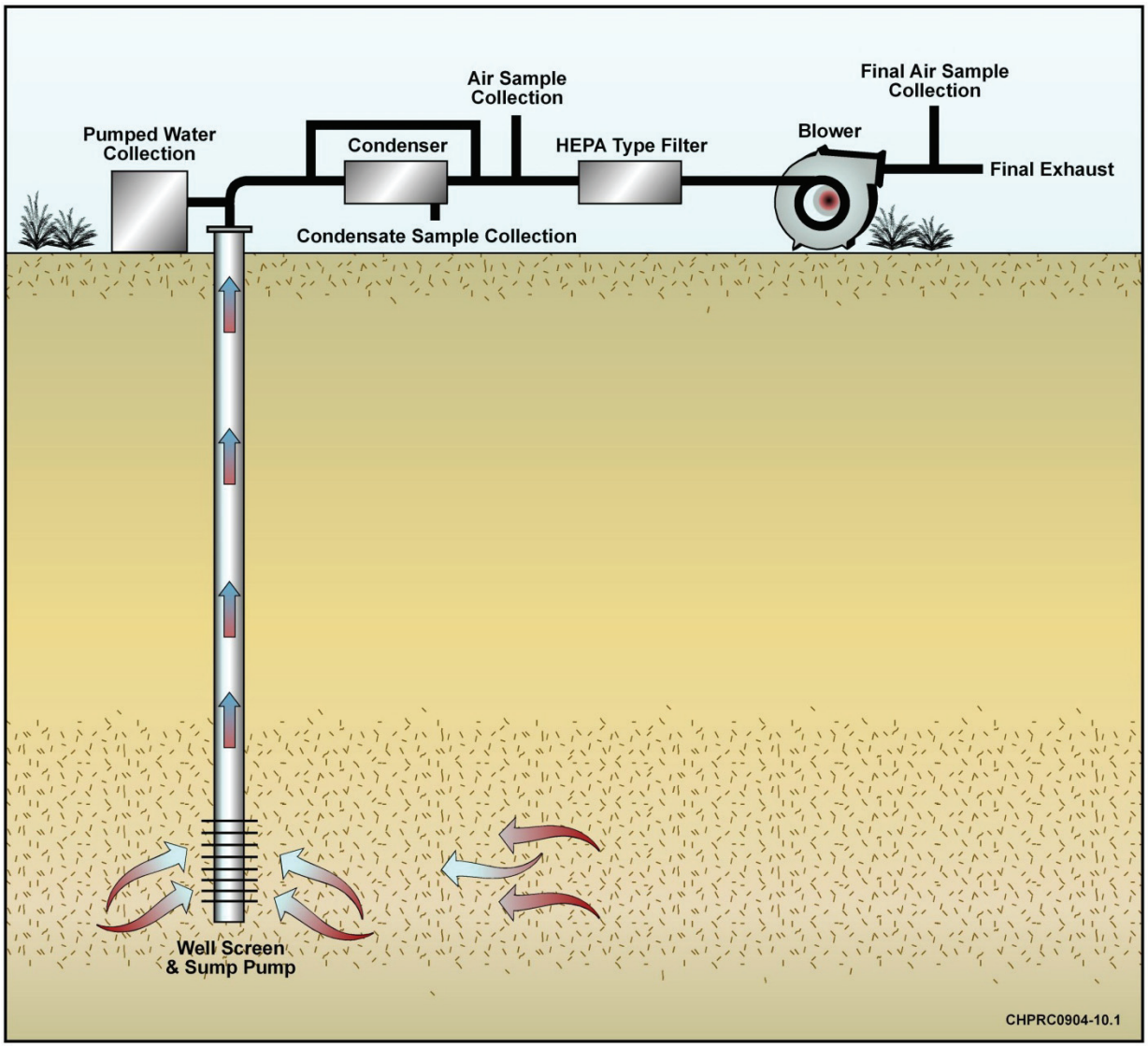


Figure A-1. Pore Water Extraction Test Configuration

WAC 246-247 addresses potential radioactive airborne emissions from point sources and from fugitive or diffuse sources by requiring monitoring of such sources. Monitoring for larger sources requires physical measurement of the effluent or ambient air, while monitoring of minor sources may estimate the radionuclide emissions, in lieu of monitoring, in accordance with regulatory approved procedures. Quality assurance ensures the precision, accuracy, and completeness of the environmental measurements.
The substantive provisions of WAC 246-247 that require monitoring of radioactive airborne emissions

would be applicable or relevant and appropriate to the minor emitting stack to be operated as part of this characterization action.

These state implementing regulations further address control of radioactive airborne emissions where economically and technologically feasible (WAC 246-247-040(3) and (4), "General Standards," and associated definitions). To address the substantive aspect of these requirements, best or reasonably achieved control technology will be addressed by ensuring that applicable emission control technologies (those successfully operated in similar applications) will be used to the extent economically and technologically feasible (i.e., based on cost/benefit).

A2.2 Criteria/Toxic Air Emissions

Under WAC 173-400, "General Regulations for Air Pollution Sources" and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," requirements are established for the regulation of emissions of criteria/toxic air pollutants. The powered exhaust will be for temporary use: twelve months with possible extension up to two years for the test adjacent to B Tank Farm using existing Well 299-E33-344. Therefore, WAC 173-400-035, "Portable and Temporary Sources," is applicable. In accordance with WAC 173-400-040, "General Standards for Maximum Emissions," reasonable precautions must be taken to prevent the release of air contaminants associated with point sources and fugitive emissions, resulting from excavation, materials handling, or other operations, if criteria/toxic emissions were expected. The use of treatment technologies for emissions of toxic air pollutants that would be subject to the substantive applicable requirements of WAC 173-460 and WAC 173-400 is anticipated to be a part of this characterization action.

Treatment of some waste encountered during this investigative action may be required to meet Environmental Restoration Disposal Facility waste acceptance criteria. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques, such as macroencapsulation or grouting, and WAC 173-460 would not be considered an applicable or relevant and appropriate requirement. If more aggressive treatment is required that would result in the emission of regulated air pollutants, the substantive requirements of "Requirements for New Sources in Attainment or Unclassifiable Areas" (WAC 173-400-113(2)) and "Control Technology Requirements" (WAC 173-460-060) would be evaluated to determine applicability.

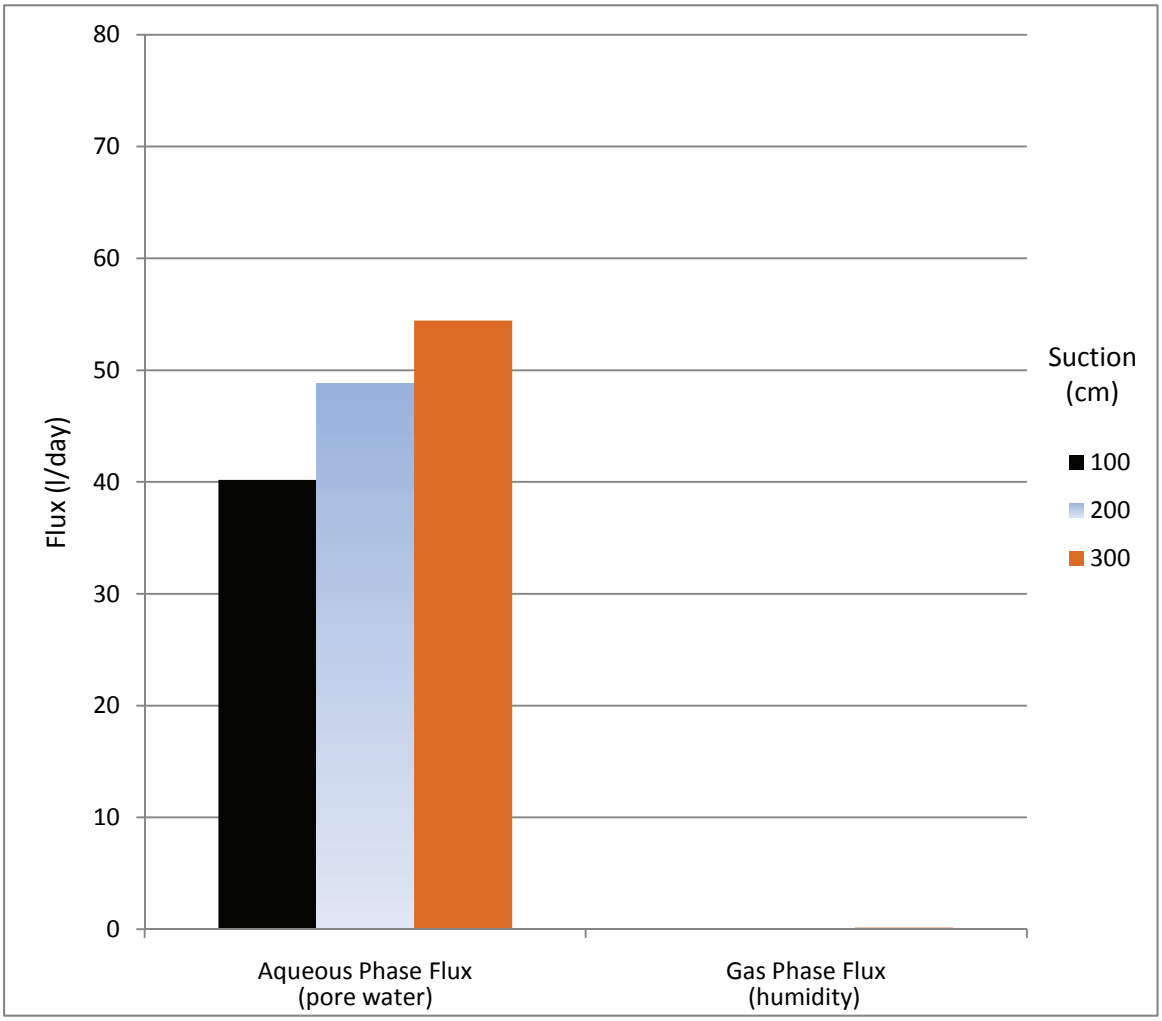
A2.3 Radiological Airborne Source Information

The potential-to-emit (PTE) is calculated using Method 1: Annual Possession Quantity (APQ), according to DOE/RL-2006-29, *Calculating Potential-to-Emit Radiological Releases and Doses*. Bases used for the calculations are conservative to provide bounding cases.

Well 200-E33-344 Test. The radiological constituents of concern are Tc-99, U-238, I-129, Np-237, Pu-239/240, Sr-90, and H-3. The PTE calculation is based upon the following:

- Sediment water removal is perched water.
- Because the Well 299-E33-344 screen is approximately 6 m long (19.7 ft) versus 1 m (3.28 ft) as modeled and shown in Figure A-2, the 54 L/day (14.27 gal/day) rate of pore water removal (assuming an applied vacuum of 300 cm [120 in.]) is increased by a factor of six, resulting in 324 L/day (85.6 gal/day).
- Release fractions are 1 E-03 for liquid and 1 E+00 for gas (DOE/RL-2006-29).

- No credit is taken for constituent reduction by removal of soil moisture in the chiller/condensate system.
- No credit is taken for constituent removal by high efficiency filtration.
- An evaluation period of 12 consecutive months is assumed.
- Use the most conservative (highest) Cs-137 plus progeny, or Sr-90 plus progeny, as the representative isotope for the beta/gamma unit dose conversion factor addressing the prospective MEI as provided in DOE/RL-2006-29.
- Use the highest Pu-239/240 plus progeny, or Am-241 plus progeny, as the representative isotope for the alpha unit dose conversion factor addressing the prospective MEI as provided in DOE/RL-2006-29.
- Use the highest constituent concentrations in the perched water for Well 299-E33-344 (Hanford Environmental Information System [HEIS], Well 299-E33-344) (Table A-1).
- APQ
  - (Volume of Water Discharged in L)(Concentration in Water in pCi/L)
  - (324 L/day)(365 day)(Concentration in pCi/L)(1 E-12 Ci/pCi) = Ci/yr
  - Tc-99 = 7.33 E-04 Ci/yr
  - U-238 = 5.96 E+00 Ci/yr
  - I-129 = 4.92 E-07 Ci/yr
  - Np-237 = 9.60 E-08 Ci/yr
  - Pu-239/240 = 9.11 E-09 Ci/yr
  - Sr-90 = 5.08 E-07 Ci/yr
  - Tritium = 5.68 E-04 Ci/yr
- PTE Quantity
  - (APQ)(Liquid Release Fraction for Tc-99, U-238, Np-237, Pu-239/240 and Sr-90)
  - (APQ)(Gas Release fraction for I-129 and Tritium)
  - Tc-99 = 7.33 E-07 Ci/yr
  - U-238 = 5.96 E-03 Ci/yr
  - I-129 = 4.92 E-07 Ci/yr
  - Np-237 = 9.60 E-11 Ci/yr
  - Pu-239/240 = 9.11 E-12 Ci/yr
  - Sr-90 = 5.08 E-10 Ci/yr
  - Tritium = 5.68 E-04 Ci/yr



Source: PNNL-SA-74945, *Pore Water Extraction Simulation Results*, M. Oostrom, et al., 2010

Note: A 3 m (9.84 ft) thick silt lens and a 1 m (3.28 ft) long well screen are assumed.

Figure A-2. Calculated Flux

Table A-1. Radiological Constituents in Well 299-E33-344 Perched Water

Constituent	Concentration (pCi/L)
Tc-99	6.2 E+3
U-238	5.04 E+07*
1-129	4.16 E+00
Np-237	8.12 E-01
Pu-239/240	7.7 E-02

Table A-1. Radiological Constituents in Well 299-E33-344 Perched Water

Constituent	Concentration (pCi/L)
Sr-90	4.3 E+00
H-3	4.8 E+03

* Conservatively derived assuming all uranium is U-233 with a specific activity for a measured maximum concentration of 5.3 E+03 µg/L for uranium.

- Unabated beta/gamma dose as Sr-90 plus progeny
  - (PTE Quantity)(Sr-90 plus Progeny MEI Unit Dose Conversion Factor [1.88 E-01])
  - Tc-99 = 1.38 E-07 mrem/yr
  - U-238 = 1.12 E-03 mrem/yr
  - I-129 = 9.25 E-08 mrem/yr
  - Np-237 = 1.80 E-11 mrem/yr
  - Sr-90 = 9.55 E-11 mrem/yr
  - Tritium = 1.07 E-04 mrem/yr
  - Total beta/gamma dose = 1.23 E-03 mrem/yr
- Unabated alpha dose as Pu-239 plus progeny
  - (PTE Quantity)(Pu-239 plus Progeny MEI Unit Dose Conversion Factor [5.03 E+00])
  - Pu-239/240 = 4.58 E-11 mrem/yr
- Total Dose
  - (Beta/Gamma Dose) + (Alpha Dose)
  - 1.23 E-03 mrem/yr + 4.58 E-11 mrem/yr = 1.23 E-03 mrem/yr

The distance to the Energy Northwest receptor is approximately 18.2 km (11.3 mi) east-southeast of Well 299-E33-344, located adjacent the 200 East B Tank Farm. This is the nearest public location where the hypothetical MEI might be located. The dose per unit curie airborne release factor, used specifically for the Well 299-E33-344 location, was taken from Table 4-7 of DOE/RL-2006-29. The factors are based on modeling using the EPA-approved CAP-88PC, Clean Air Act Assessment Package-1988. The total unabated PTE would result in a total effective dose equivalent to the MEI from the proposed deep vadose zone pore water extraction test near the B Tank Farm of 1.23 E-03 mrem/yr.

A2.4 Criteria/Toxic Airborne Source Information

The PTE is calculated using conservative and bounding cases.

A2.4.1 Well 299-E33-344 Test

Significant chemical constituents of sediment pore water determined by analysis (HEIS) are aluminum, antimony, arsenic, barium, calcium, chromium (including hexavalent chromium), cobalt, copper, iron, magnesium, manganese, mercury, potassium, sodium, strontium, uranium, vanadium, chloride, fluoride, nitrate, sulfate, and di-2-ethyl hexyl phthalate, a synonym for bis-(2-ethyl hexyl) phthalate. No other semivolatile organic analytes or volatile organic analytes were detected. Comparison with

WAC 173-400-110, "New Source Review (NSR) for Sources and Portable Sources" requires evaluation only for arsenic, cadmium, hexavalent chromium, cobalt, copper, manganese, mercury, sodium hydroxide, sodium sulfate, vanadium, and di-2-ethyl hexyl phthalate. Table A-2 shows maximum detected values of these constituents in perched water samples (HEIS).

Table A-2. Criteria/Toxic Contaminants in Well 299-E33-344 Perched Water

Analyte	Concentration (µg/L)*
Arsenic	28.9
Cadmium	1.35
Hexavalent Chromium	381
Cobalt	7.1
Copper	43.8
Manganese	106
Mercury	0.411
Sodium	929,000
Strontium	215
Vanadium	148
Cyanide	5
Fluoride	107
Sulfate	529
di-2-Ethyl hexyl Phthalate	5.9

* From the Hanford Environmental Information System.

The PTE calculation for each constituent is based upon the following:

- Sediment water removal is perched water.
- Because the Well 299-E33-344 screen is approximately 6 m (19.7 ft) long versus 1 m (3.28 ft) long, the 54 L/day rate of pore water removal (assuming an applied vacuum of 300 cm [120 in.]) is increased by a factor of six, resulting in 324 L/day.
- Release fraction for liquid is 1 E-03; release fraction for gas is 1 E+00.
- No credit is taken for reduction of constituents by removal of soil moisture in the chiller/condensate system.
- No credit is taken for constituent removal by high efficiency filtration.
- Evaluation period of 12 months is assumed.

A2.4.2 PTE Quantities

- (Volume Water Discharged in L)(Contaminant Concentration)(Liquid/Gas Release Fraction)
- Arsenic
  - (324 L/day)(365 day/yr)(28.9 µg As/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 7.53 E-06 lb As/yr
- Cadmium
  - (324 L/day)(365 day/yr)(1.35 µg Cd/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 3.52 E-07 lb Cd/yr
- Hexavalent Chromium
  - (324 L/day)(365 day/yr)(381 µg Cr^6/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 9.92 E-05 lb Cr^6/yr
- Cobalt
  - (324 L/day)(7.1 µg Co/L)(g/1E+06 µg)(lb/454 g)(1 E-03) = 5.07 E-09 lb Co/day
- Copper
  - (324 L/day)(day/24 h)(43.8 µg/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 1.30 E-09 lb Cu/h
- Cyanide
  - (324 L/day)(5 mg/L)(g/1E+06 µg/g)(lb/454g)(1 E+00) = 3.57 E-06 lb CN/day
- Fluoride
  - (324 L/day)(107 µg/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 7.64 E-08 lb F/day
- Manganese
  - (324 L/day)(106 µg/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 7.56 E-08 lb Mn/day
- Mercury
  - (324 L/day)(0.411 µg/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 2.93 E-10 lb Hg/day
- Sodium Hydroxide (NaOH)
  - (324 L/day)(day/24 h)(929,000 µg Na/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 2.76 E-05 lb Na/h
  - Fraction NaOH that is Na: 23/40 = 0.575
  - 2.76 E-05 lb Na/0.575 Na/NaOH = 4.80 E-05 lb NaOH/h
- Sodium Sulfate (Na_2SO_4)
  - (324 L/day)(day/24 h)(529 µg sulfate/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 1.57 E-08 lb sulfate/h
  - Fraction Na_2SO_4 that is sulfate: 80/126 = 0.635
  - 1.57 E-08 lb sulfate/0.635 Na/ Na_2SO_4 = 2.48 E-08 lb Na_2SO_4/hr
- Vanadium
  - (324 L/day)(148 µg/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 1.06 E-07 lb V/day

- di-2-Ethyl hexyl Phthalate
  - (324 L/day)(365 day/yr)(5.9 µg/L)(g/1 E+06 µg)(lb/454 g)(1 E-03) = 1.54 E-06 lb/yr

A2.4.3 Comparison with WAC-173-460-150 Criteria

The small quality emission rate (SQER) and de minimis values for toxic air pollutants tabulated in WAC-173-460-150, "Controls for New Sources of Toxic Air Pollutants," represent values that require controls to limit potential emissions. Table A-3 compares these values with calculated emissions.

Table A-3. Comparison of Potential Release of Criteria Toxic Chemicals from Pore Water Extraction Test Focusing on Well 299-E33-344 Perched Water with Criteria

Potential Contaminant	SQER*	de Minimis	Potential Emission	Potential Emission Exceeds SQER* and/or de Minimis?
Arsenic	0.0581 lb/yr	0.00291 lb/yr	7.53 E-06 lb/yr	No
Cadmium	0.0457 lb/yr	0.00228 lb/yr	3.52 E-07 lb/yr	No
Hexavalent Chromium	0.00128 lb/yr	6.40 E-05 lb/yr	9.92 E-05 lb/yr	Yes
Cobalt	0.013 lb/day	6.57 E-04 lb/day	5.07 E-09 lb/day	No
Copper	0.219 lb/h	0.011 lb/h	1.30 E-09 lb/h	No
Cyanide	1.18 lb/day	0.0591 lb/day	3.57 E-06 lb/day	No
Fluoride	1.71 lb/day	0.0854 lb/day	7.64 E-08 lb/day	No
Manganese	0.00526 lb/day	0.000263 lb/day	7.56 E-08 lb/day	No
Mercury	0.0118 lb/day	0.000591 lb/day	2.93 E-10 lb/day	No
Sodium Hydroxide	0.0175 lb/h	0.000876 lb/h	4.80 E-05 lb/h	No
Sodium Sulfate	0.263 lb/h	0.0131 lb/h	2.48 E-08 lb/h	No
Vanadium	0.0263 lb/day	0.00131 lb/day	1.06 E-07 lb/day	No
di-2-Ethyl hexyl Phthalate	8 lb/yr	0.4 lb/yr	1.54 E-06 lb/yr	No

* Small Quantity Emission Rate (SQER) and de minimis values are from WAC 173-460-150 "Controls for New Sources of Toxic Air Pollutants," "Table of ASIL, SQWE and de Minimis Emission Values."

Hexavalent chromium was the only constituent to exceed its de minimis value. It was, however, well below the SQER value.

A3 Emission Controls

Based on analysis of the potential radiological and criteria/toxic emissions to the atmosphere and available control technologies, controls have been selected for use during the investigative action. Although potential emissions do not challenge levels requiring controls, the following controls will be employed as a best management practice:

- The above-ground air handling systems will employ a chiller/condenser to remove a portion of the water vapor, for the purposes of collecting samples and protecting the blower and filter, and to reduce potential air emissions.
- One stage of HEPA-type filtration will remove potential particulates. "HEPA-type" is intended to reflect nonstandard application of HEPA abatement, not meeting engineered specifications of the applicable standards. No abatement credit is taken for HEPA-type devices.

A4 Monitoring

Based on an analysis of the unabated release potential for radiological emissions, the emission unit has a PTE of less than 0.1 mrem/yr total effective dose equivalent to the MEI (minor source). Specifically, the calculated unabated annual total effective dose equivalent to the MEI for the deep vadose zone perched water pumping/pore water extraction test at Well 299-E33-344 is 1.23 E-03 mrem/yr. Although this activity is considered a minor source that would normally require only periodic confirmatory measurement, very low emissions will be confirmed during the pore water extraction tests via a standard vacuum pump for effluent sampling using a standard sample collection head with a very high efficiency sample filter. The sampled effluent will be withdrawn from the point of active pump exhaust downstream of the control equipment whenever the pump exhaust is operating. Additionally, a low volume ambient air sampler will be used at the point of active pump exhaust whenever the system operates.

In the context of as low as reasonably achievable and worker protection, the following actions would be required based on radiological monitoring:

- If contamination surveys in the ventilation exhaust port exceed 1,000 disintegrations per minute/100 cm^2 beta-gamma or 20 disintegrations per minute/100 cm^2 alpha, then suspend work, secure ventilation, and investigate the source of the contamination.
- If the low volume air sample results at the ventilation exhaust exceed 0.3 derived air concentration after allowing for decay of naturally occurring radionuclides, then suspend work, secure ventilation, and investigate the source of the contamination.

Based on an analysis of the unabated release potential for criteria/toxic emissions, the emission unit at Well 299-E33-344 will have the potential to exceed the de minimis limit for hexavalent chromium (6.4 E-05 lb/yr)—specifically, the calculated unabated release of hexavalent chromium at 9.92 E-05 lb/yr for the B Tank Farm pore water extraction test. Application of the controls defined in Section A3, particularly the chiller to condense and capture extracted water and humidity, will reduce emissions by at least a factor of ten. Low emissions will be confirmed during the pore water extraction tests by use of summa canisters to collect samples of exhausted air. The sampled effluent will be withdrawn from the point of active pump exhaust at least quarterly to verify low emissions. Also, monthly real-time evaluation by an industrial hygiene technician using a handheld instrument(s) will be conducted.

A5 References

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