SGW-55438
Revision 0

Hanford Site Groundwater Monitoring for 2012: Supporting Information

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

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Terms

AEA	*Atomic Energy Act of 1954* **or** alpha energy analysis
aG	amber glass
aGs	amber glass with septum cap
ASTM	ASTM International (formerly American Society for Testing and Materials)
bgs	below ground surface
BTV	background threshold value
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	chain of custody
CRDL	contract required detection limit
CY	calendar year
DF	dilution factor
DQA	data quality assessment
DOE	U.S. Department of Energy
DUP	(laboratory sample) duplicate
DWS	drinking water standard
EB	equipment blank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FTB	full trip blank
FXR	field transfer blank
G	glass
GC	gas chromatography
GPS	gas-flow proportional counter
HEIS	Hanford Environmental Information System
ICP	inductively coupled plasma
ID	identification
IDF	Integrated Disposal Facility
LCS	laboratory control sample

LCSD	laboratory control sample duplicate
LEPS	low-energy photon spectroscopy
LLWMA	low-level waste management area
LOQ	limit of quantitation
LPU	low-permeability unit
LSC	liquid scintillation counting
LVL	Lionville Laboratory
LWDF	Liquid Waste Disposal Facility
MB	method blank
MDA	minimum detectable activity
MDL	method detection limit
MS	matrix spike **or** mass spectrometry
MSD	matrix spike duplicate
MTCA	"Model Toxics Control Act—Cleanup" (WAC 173-340)
NA	not applicable
ND	not detected
NRDWL	Nonradioactive Dangerous Waste Landfill
P	plastic
PCB	polychlorinated biphenyl
PTFE	polytetrafluorinatedethylene
RCRA	*Resource Conservation and Recovery Act of 1976*
RDL	required detection limit
RDR	request for data review
RPD	relative percent difference
RSD	relative standard deviation
QC	quality control
SUR	surrogate
SVOA	semivolatile organic analyte
SVOC	semivolatile organic compound
TAKN	TestAmerica Knoxville

TARL	TestAmerica Richland
TASL	TestAmerica St. Louis
TCE	trichloroethene
TOC	total organic carbon
TOX	total organic halides
TPH	total petroleum hydrocarbon
VOA	volatile organic analyte
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WIDL	Well Information and Document Lookup
WMA	waste management area
WSCF	Waste Sampling and Characterization Facility

Hanford Site Groundwater Monitoring for 2012: Supporting Information

1 Introduction

This document provides additional information that supports the 2012 annual groundwater report (*Hanford Site Groundwater Monitoring for 2012* [DOE/RL-2013-22]). This information appeared within the annual groundwater report for previous years but is published separately here to complement the new, online reporting format.

Contents of this report include the following.

- Chapter 2: Supporting Information for CERCLA Operable Units
- Chapter 3: Supporting Information for RCRA and Other Monitored Facilities
- Chapter 4: Supporting Information for Aquifer Sampling Tubes
- Chapter 5: Groundwater Monitoring Data Quality Assessment
- Chapter 6: Confined Aquifers
- Chapter 7: Well Installation, Maintenance, and Decommissioning
- Chapter 8: References

2 Supporting Information for CERCLA Operable Units

Under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), the contaminated groundwater beneath portions of the Hanford Site is divided into 11 groundwater operable units.

The tables provided in this chapter list the constituents, monitoring wells, and sampling frequency for each operable unit, as required by their respective sampling and analysis plans or other documentation. The tables also indicate whether the wells were sampled as scheduled during 2012. Aquifer tubes are also sampled at the Hanford Site as part of the CERCLA groundwater monitoring program. Details regarding aquifer tube sampling are provided in Chapter 4.

In many cases, wells are sampled for additional constituents not strictly required by the plans. Those constituents are not listed in the tables of this chapter, but data files accompanying DOE/RL-2013-22 include all of the required and supplemental data.

Table 2-1. Monitoring Wells and Constituents for the 100-BC-5 Operable Unit

Well	Hydrologic Unit Monitored	Alkalinity	Gross Alpha/Beta	Anions	Hexavalent Chromium	Metals	Strontium-90	Tritium	Technetium-99	Volatile Organic Analytes	Sampled as Planned in 2012?
199-B2-12	Ringold aquitard	BO	--	BO	BO	BO	BO	BO	--		Not Scheduled
199-B2-13	Top of unconfined	BE	--	BE	BE	BE	BE	BE	--		Yes
199-B2-14	Top of unconfined	--	--	--	A	--	A	A	--		Yes
199-B2-15	Ringold aquitard	--	--	--	BE	--	BE	BE	--		Yes
199-B2-16	Bottom of unconfined	A	--	A	S	A	S	S	--	A	Yes
199-B3-1	Top of unconfined	BE	--	BE	A	BE	A	A	--		Yes
199-B3-46	Top of unconfined	BO	--	BO	A	BO	A	A	--		Yes
199-B3-47	Top of unconfined	BE	--	BE	A	BE	A	A	--		Yes
199-B3-50	Top of unconfined	--	--	--	A	--	A	A	--		Yes
199-B3-51	Bottom of unconfined	BO	--	BO	BO	BO	BO	BO	--		Yes
199-B4-1	Top of unconfined	BE	--	BE	A	BE	A	A	--		Yes
199-B4-4	Top of unconfined	--	--	--	BE	--	BE	BE	--		Yes
199-B4-7	Top of unconfined	A	--	A	S	A	A	S	--		Yes
199-B4-8	Top of unconfined	BE	--	BE	BE	BE	BE	BE	--		Yes
199-B4-14	Top of unconfined	--	--	--	A	--	A	A	--		Yes
199-B5-1	Top of unconfined	A	--	A	S	A	A	S	--		Yes
199-B5-2	Top of unconfined	--	--	--	A	--	A	A	--		Yes
199-B5-5	Bottom of unconfined	--	--	--	A	--	--	A	--	A	Yes

Table 2-1. Monitoring Wells and Constituents for the 100-BC-5 Operable Unit

Well	Hydrologic Unit Monitored	Alkalinity	Gross Alpha/Beta	Anions	Hexavalent Chromium	Metals	Strontium-90	Tritium	Technetium-99	Volatile Organic Analytes	Sampled as Planned in 2012?
199-B5-6	Bottom of unconfined	A	A	A	M	A	--	M	--	A	Yes
199-B5-8	Top of unconfined	BE	BE	BE	BE	BE	--	BE	BE	BE	Yes
199-B8-6	Top of unconfined	BO	BO	BO	A	BO	--	A	--		Yes
199-B8-9	Top of unconfined	--	A	--	Q	--	--	Q	--	--	Yes
199-B9-2	Top of unconfined	--	BE	--	BE	--	--	BE	--		Yes
199-B9-3	Top of unconfined	BO	BO	BO	BO	BO	--	BO	--		Not Scheduled
699-63-90	Unconfined	BE	BE	BE	--	BE	--	BE	--		Yes
699-65-83	Unconfined	--	--	--	--	--	--	BE	--		Yes
699-67-86	Unconfined	--	--	--	--	--	--	BO	--		Not Scheduled
699-68-105	Unconfined	BO	--	BO	--	BO	--	BO	--		Not Scheduled
699-71-77	Unconfined	BO	--	BO	--	BO	--	BO	BO		Not Scheduled
699-72-73	Unconfined	BE	--	BE	--	BE	--	BE	BE		Not Sampled for Alkalinity
699-72-92	Unconfined	BO	--	BO	--	BO	--	BO	--		Not Scheduled
Spring037-1	Unconfined	--	A	--	A	--	--	A	--	--	Yes
Spring039-2	Unconfined	--	A	--	A	--	--	A	--	--	Yes

Note: The sampling requirements are from DOE/RL-2003-38, *100-BC-5 Operable Unit Sampling and Analysis Plan*, as modified by TPA-CN-522, *Tri-Party Agreement Change Notice Form: 100-BC-5 Operable Unit Sampling and Analysis Plan, DOE/RL-2003-38, Rev. 1 (as modified by TPA-CN-240, 12/8/2008 and TPA-CN-293 (10/6/2009)*.

Additional constituents sampled for include field parameters specific conductance, temperature, and turbidity.

A = to be sampled annually

BE = to be sampled biennially, even fiscal years

BO = to be sampled biennially, odd fiscal years

M = to be sampled monthly

Q = to be sampled quarterly

Table 2-2. Monitoring Wells and Constituents for the 100-KR-4 Operable Unit

Well	Carbon-14	Hexavalent Chromium	Strontium-90	TCE	Tritium	Sampled as Scheduled in 2012?	Comment
199-K-13	A	S	A	--	A	Yes	--
199-K-18	A	Q	A	--	A	Yes	--
199-K-19	A	S	A	--	A	Yes	--
199-K-20	S	Q	A	--	A	Yes	--
199-K-21	A	S	A	--	A	Yes	--
199-K-22	A	S	A	--	A	Yes	--
199-K-23	S	S	S	--	A	Yes	--
199-K-31	A	A	A	--	S	Yes	--
199-K-32A	Q	Q	Q	--	Q	Yes	--
199-K-32B	A	A	A	--	A	Yes	--
199-K-34	Q	Q	Q	A	Q	Yes	--
199-K-36	A	S	A	--	A	Yes	--
199-K-37	A	S	A	--	S	Yes	--
199-K-106A	S	S	S	S	Q	Yes	--
199-K-107A	A	S	A	S	Q	Yes	--
199-K-108A	A	Q	S	A	S	Yes	--
199-K-110A	--	S	--	--	S	Yes	--
199-K-111A	S	S	S	A	Q	Yes	--
199-K-112A	--	A	A	--	A	Yes	--
199-K-113A	--	S	S	--	A	Yes	KR-4 Extraction
199-K-114A	A	S	A	--	A	Yes	KR-4 Extraction
199-K-115A	A	S	A	--	A	Yes	KR-4 Extraction
199-K-116A	A	S	A	--	A	Yes	KR-4 Extraction
199-K-117A	S	Q	S	--	S	Yes	--
199-K-118A	--	A	A	--	A	Yes	--
199-K-119A	S	S	S	--	S	Yes	--
199-K-120A	A	S	A	--	S	Yes	--
199-K-124A	A	S	A	--	S	Yes	--
199-K-125A	A	S	A	--	A	Yes	--
199-K-127	A	S	A	--	S	Yes	KR-4 Extraction
199-K-129	--	A	--	--	A	Yes	KR-4 Extraction
199-K-130	A	S	A	--	A	Yes	KX Extraction
199-K-131	A	S	A	--	A	Yes	KX Extraction
199-K-132	S	S	A	S	S	Yes	KW Extraction
199-K-137	A	S	A	--	S	Yes	KW Extraction
199-K-138	A	S	A	S	A	Yes	KW Extraction

Table 2-2. Monitoring Wells and Constituents for the 100-KR-4 Operable Unit

Well	Carbon-14	Hexavalent Chromium	Strontium-90	TCE	Tritium	Sampled as Scheduled in 2012?	Comment
199-K-139	A	S	A	S	A	Yes	KW Extraction
199-K-140	S	S	S	S	--	Yes	--
199-K-141	S	Q	S	--	Q	Yes	Scheduled 3 out of 4 quarters for hexavalent chromium and tritium
199-K-142	A	--	S	--	S	Yes	--
199-K-144	A	S	S	--	S	Yes	KR-4 Extraction
199-K-145	A	S	A	--	S	Yes	KR-4 Extraction
199-K-146	A	S	A	--	A	Yes	KX Extraction
199-K-147	A	S	S	--	A	Yes	KX Extraction
199-K-148	A	S	A	--	A	Yes	KX Extraction
199-K-149	S	S	S	--	S	Yes	--
199-K-150	A	S	A	--	A	Yes	--
199-K-151	A	S	S	A	S	Yes	--
199-K-152	--	S	A	A	A	Yes	KX Extraction
199-K-153	A	S	A	--	A	Yes	KX Extraction
199-K-154	A	S	A	--	A	Yes	KX Extraction
199-K-157	A	S	A	--	S	Yes	--
199-K-161	A	S	S	--	A	Yes	KX Extraction
199-K-162	A	S	S	--	A	Yes	KR-4 Extraction
199-K-163	A	S	A	--	A	Yes	KX Extraction
199-K-165	S	S	A	A	S	Yes	KW Extraction
199-K-166	A	Q	A	S	A	Yes	KW Extraction
199-K-168	A	Q	A	S	S	Yes	KW Extraction
199-K-171	A	S	A	--	A	Yes	KX Extraction
199-K-173	S	S	A	S	S	Yes	--
199-K-178	S	S	S	--	S	Yes	KX Extraction
199-K-181	S	S	S	--	S	Yes	--
199-K-182	A	A	A	--	A	Yes	--
199-K-183	Q	Q	Q	Q	Q	Yes	--
199-K-184	Q	Q	Q	Q	Q	Yes	--
199-K-185	Q	Q	Q	Q	Q	Yes	--
199-K-186	Q	Q	Q	A	Q	Yes	--
199-K-187	Q	Q	Q	A	Q	Yes	--
199-K-188	A	A	A	A	A	Yes	--
199-K-189	Q	Q	Q	--	Q	Yes	--

Table 2-2. Monitoring Wells and Constituents for the 100-KR-4 Operable Unit

Well	Carbon-14	Hexavalent Chromium	Strontium-90	TCE	Tritium	Sampled as Scheduled in 2012?	Comment
199-K-190	Q	Q	Q	A	Q	Yes	--
199-K-191	Q	Q	Q	A	Q	Yes	--
199-K-192	Q	Q	Q	A	Q	Yes	--
199-K-193	Q	Q	Q	Q	Q	Yes	--
199-K-194	Q	Q	Q	Q	Q	Yes	--
199-K-196	Q	Q	Q	Q	Q	Yes	--
199-K-197	Q	--	Q	--	Q	Yes	--
199-K-198	Q	--	Q	--	Q	Yes	--
199-K-199	Q	--	Q	--	Q	Yes	--
199-K-200	Q	Q	Q	A	Q	Yes	--
199-K-201	Q	Q	Q	A	Q	Yes	Well scheduled 3 out of 4 quarters for carbon-14, strontium-90, and tritium
699-78-62	--	A	--	--	A	Yes	--

A = to be sampled annually
Q = to be sampled quarterly
S = to be sampled semiannually
TCE = trichloroethene

Table 2-3. Monitoring Wells and Constituents for 100-NR-2

Well Name	Field Parameters	Alkalinity	Gross Alpha	Anions	Gross Beta	Gamma	Metals	Oil and Grease	VOA/SVOA	Strontium-90	Total Petroleum Hydrocarbons	Tritium	Sampled as Planned in 2012?	Comments
199-N-2	A	--	--	A	A	--	A	--	--	A	--	A	No	Not sampled for gross beta.
199-N-3	S	--	--	S	S	--	S	--	--	S	--	S	No	Sampled once for anions, gross beta, metals, strontium-90, and tritium.
199-N-14	S	--	--	S	S	--	S	--	--	S	--	S	No	Sampled only once for field parameters, anions, gross beta, metals, strontium-90, and tritium
199-N-16	A	--	--	A	A	--	A	A	--	A	A	--	Yes	--
199-N-18	A	--	--	--	--	--	--	A	--	--	A	--	No	Not sampled in 2012; used for removal of TPH free product.
199-N-19	A	--	--	A	--	--	A	--	--	A	A	--	Yes	
199-N-21	A	--	--	A	--	--	A	--	--	--	--	--	Yes	--
199-N-26	A	A	--	A	--	--	A	--	--	--	A	--	No	Decommissioned in 2011.
199-N-27	A	--	A	A	--	A	A	--	--	--	--	A	Yes	--
199-N-28		A	A	A	A		A			A		A	Yes	
199-N-32	S	--	--	S	S	S	S	--	--	S	--	S	No	Sampled 1 of 2 events for gamma, strontium-90, and tritium.
199-N-34	A	A	--	A	A	A	A	--	--	A	--	A	Yes	
199-N-41	A	A	--	A	--	--	A	--	--	A	--	A	Yes	
199-N-46	A	A	--	A	--	--	A	--	--	A	--	A	No	Sampled twice in 2012.
199-N-50	A	--	--	--	A	--	--	--	--	--	--	A	Yes	
199-N-51	A	--	--	--	A	--	--	--	--	--	--	A	Yes	
199-N-56	A	A	A	A	--	A	A	--	A	A	A	A	Yes	

Table 2-3. Monitoring Wells and Constituents for 100-NR-2

Well Name	Field Parameters	Alkalinity	Gross Alpha	Anions	Gross Beta	Gamma	Metals	Oil and Grease	VOA/SVOA	Strontium-90	Total Petroleum Hydrocarbons	Tritium	Sampled as Planned in 2012?	Comments
199-N-57	A	A	A	A	--	A	A	--	--	A	A	A	Yes	
199-N-64	A	--	--	A	A	--	A	--	--	A	--	A	Yes	--
199-N-67	S	--	S	S	S	--	S	--	--	S	--	--	No	Sampled 1 of 2 events.
199-N-69	A	--	--	--	--	--	--	--	--	A	--	A	Yes	
199-N-70	A	--	A	A	A	A	A	--	--	A	--	A	Yes	--
199-N-71	A	A		A			A						Yes	
199-N-73	A	A	--	A	--	--	A	--	--	--	--	--	Yes	
199-N-74	A	--	A	--	A	A	A	--	--	--	--	--	Yes	--
199-N-75	S	--	--	S	S	--	S	--	--	S	--	S	No	Sampled 1 of 2 events.
199-N-76	S	--	--	S	S	S	S	--	--	S	--	S	Yes	--
199-N-80	A	--	A	A	A	A	A	--	--	A	--	A	Yes	--
199-N-81	A	--	--	A	A	--	A	--	--	A	--	A	Yes	--
199-N-92A	A	--	--	A	A	--	A	--	--	A	--	A	Yes	
199-N-96A	A	--	--	A	A	--	A	--	--	A	--	A	Yes	--
199-N-99A	A	--	--	A	A	--	A	--	--	A	--	A	Yes	--
199-N-103A	A	A	A	A	A	A	A	--	--	A	--	A	Yes	
199-N-104A	A		A	A	A		A			A		A	Yes	
199-N-105A	A	A	A	A	A	A	A	--	--	A	--	A	Yes	
199-N-106A	A	A	A	A	A	A	A	--	--	A	--	A	Yes	
199-N-119	A	A	A	A	A	A	A	--	--	A	--	A	Yes	

Table 2-3. Monitoring Wells and Constituents for 100-NR-2

Well Name	Field Parameters	Alkalinity	Gross Alpha	Anions	Gross Beta	Gamma	Metals	Oil and Grease	VOA/SVOA	Strontium-90	Total Petroleum Hydrocarbons	Tritium	Sampled as Planned in 2012?	Comments
199-N-120	A	A	A	A	A	A	A	--	--	A	--	A	Yes	
199-N-121	A	A	A	A	A	A	A	--	--	A	--	A	Yes	
199-N-122	A	--	--	A	--	--	A	--	--	A	--	A	Yes	
199-N-123	A	--	--	A	--	--	A	--	--	A	--	A	Yes	
199-N-146	A	--	--	A	--	--	A	--	--	A	--	A	Yes	
199-N-147	A	--	--	A	--	--	A	--	--	A	--	A	Yes	
199-N-173	A	A		A	A	--	A	A	A	A	A	A	Yes	
199-N-182	A	A		A	A		A			A		A	Yes	Sampled twice in 2012, once for extended analyte list.
199-N-183	A	A		A			A	A	A	A	A		Yes	Sampled twice in 2012, once for extended analyte list.
199-N-184	A	A		A	A		A			A		A	Yes	Sampled twice in 2012, once for extended analyte list.
199-N-185	A	A		A	A		A			A		A	Yes	Sampled twice in 2012, once for extended analyte list.
199-N-186	Q		Q	Q	Q	Q	Q		Q	Q	Q	Q	Yes	Sampled 6 times in 2012 (one sample was the December 2011 sample; one sample was a duplicate collected on a separate day) for an extended analyte list.

Table 2-3. Monitoring Wells and Constituents for 100-NR-2

Well Name	Field Parameters	Alkalinity	Gross Alpha	Anions	Gross Beta	Gamma	Metals	Oil and Grease	VOA/SVOA	Strontium-90	Total Petroleum Hydrocarbons	Tritium	Sampled as Planned in 2012?	Comments
199-N-187	Q		Q	Q	Q	Q	Q		Q	Q	Q	Q	Yes	Sampled 5 times in 2012 (one sample was a duplicate collected on a separate day) for an extended analyte list.
199-N-188	Q		Q	Q	Q	Q	Q		Q	Q	Q	Q	Yes	Sampled 6 times in 2012 (one sample was the December 2011 sample; one sample was a duplicate collected on a separate day) for an extended analyte list.
199-N-189	A	A		A	A		A			A		A	Yes	Sampled twice in 2012, once for extended analyte list.
699-84-59	A			A			A						Yes	

Notes:

Monitoring requirements have been modified from *Remedial Design/Remedial Action Work Plan for the 100-NR-2 Operable Unit* (DOE/RL-2001-27).

TPA-CN-256, *Change Notice for Modifying Approved Documents/Workplans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: DOE/RL-2001-27, Rev 0, Remedial Design Report/Remedial Action Work Plan for the 100-NR-2 Operable Unit and the Interim Action Waste Management Plan for the 100-NR-2 Operable Unit, DOE/RL-2000-41, Rev. 1*, modified the monitoring requirements, including updating analyses and removing decommissioned wells.

Wells 199-N-182 through 199-N-189 were installed in 2011 during the remedial investigation. Wells 199-N-182, 199-N-183, 199-N-184, 199-N-185, and 199-N-189 were sampled once for the list of constituents in Table 2-7 of DOE/RL-2009-42 (*Sampling and Analysis Plan for the 100-NR-1 and 100-NR-2 Operable Units Remedial Investigation/Feasibility Study*). Wells 199-N-186, 199-N-187, and 199-N-188 were sampled quarterly for this extended analyte list.

TPA-CN-478, *Tri-Party Agreement Change Notice Form: Sampling and Analysis Plan for the 100-NR-1 and 100-NR-2 Operable Units Remedial Investigation/Feasibility Study, DOE/RL-2009-42, Rev. 0*, modified the monitoring requirements, adding quarterly sampling for wells 199-N-186, 199-N-187, and 199-N-188.

Field parameters include pH, temperature, conductivity, and turbidity; with dissolved oxygen and oxidation-reduction potential on some wells.

A = to be sampled annually

Q = to be sampled quarterly

S = to be sampled semiannually

SVOA = semivolatile organic analyte

VOA = volatile organic analyte

Table 2-4. Monitoring Wells and Constituents for the 100-NR-2 Apatite Permeable Reactive Barrier

Well Name*	Well Type	Field Para-meters	Anions	Beta	Metals	Strontium-90	TPH	Sampled as Planned in 2012?
199-N-96A	Compliance	S	S	S	S	S	A	Yes
199-N-122	Compliance	S	S	S	S	S	A	Yes
199-N-123	Compliance	S	S	S	S	S	A	Yes
199-N-146	Compliance	S	S	S	S	S	A	Yes
199-N-147	Compliance	S	S	S	S	S	A	Yes
199-N-347	Compliance	S	S	S	S	S	A	Yes
199-N-348	Compliance	S	S	S	S	S	A	Yes
199-N-349	Compliance	S	S	S	S	S	A	Yes
199-N-350	Compliance	S	S	S	S	S	A	Yes
199-N-351	Compliance	S	S	S	S	S	A	Yes
199-N-352	Compliance	S	S	S	S	S	A	Yes
199-N-353	Compliance	S	S	S	S	S	A	Yes
APT1	Aquifer Tube	S	S	S	S	S	A	Yes
APT5	Aquifer Tube	S	S	S	S	S	A	Yes
C7881	Aquifer Tube	S	S	S	S	S	A	Yes
N116mArray-1A	Aquifer Tube	S	S	S	S	S	A	Yes
N116mArray-2A	Aquifer Tube	S	S	S	S	S	A	Yes
N116mArray-3A	Aquifer Tube	S	S	S	S	S	A	Yes
N116mArray-4A	Aquifer Tube	S	S	S	S	S	A	Yes
N116mArray-6A	Aquifer Tube	S	S	S	S	S	A	Yes
N116mArray-8A	Aquifer Tube	S	S	S	S	S	A	Yes
NVP2-116.3 (high river); NVP2-116.0 (low river)	Aquifer Tube	S	S	S	S	S	A	Yes

* Wells sampled under SAF F12-003 for 2012 sampling events.

A = sampled once a year

S = sampled twice each year (at high and low river stages)

TPH = total petroleum hydrocarbon

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
199-D2-6	S	S	--	S	--	--	--	Yes	--
199-D2-11	Q	A	--	A	--	A	--	Yes	--
199-D3-2	Q	Q	--	Q	--	Q	A	Yes	--
199-D4-1	A	A	--	A	--	A	A	Yes	--
199-D4-4	A	A	--	A	--	A	A	Yes	--
199-D4-5	A	A	--	A	--	A	A	Yes	--
199-D4-6	A	A	--	A	--	A	A	Yes	--
199-D4-7	A	A	--	A	--	A	A	Yes	--
199-D4-13	A	A	--	A	--	A	A	Yes	--
199-D4-14	Q	Q	--	Q	--	A	A	Yes	--
199-D4-15	A	A	--	A	--	A	A	Yes	--
199-D4-19	Q	Q	--	Q	--	A	A	Yes	--
199-D4-20	A	A	--	A	--	A	A	Yes	--
199-D4-22	Q	Q	--	Q	--	A	A	No	Fourth quarter sample collected in January 2013
199-D4-23	A	A	--	A	--	A	A	Yes	--
199-D4-31	A	A	--	A	--	--	A	Yes	--
199-D4-32	A	A	--	A	--	--	A	Yes	--
199-D4-36	A	A	--	A	--	--	A	Yes	--
199-D4-38	Q	Q	--	Q	--	--	--	Yes	DX extraction well
199-D4-39	A	Q	A	Q	A	A	A	Yes	DX extraction well
199-D4-48	A	A	--	A	--	--	A	Yes	--
199-D4-62	Q	Q	--	Q	--	--	A	Yes	--
199-D4-78	A	A	--	A	--	A	A	Yes	--
199-D4-83	A	A	--	A	A	A	A	Yes	DX extraction well
199-D4-86	Q	Q	A	Q	A	A	A	Yes	--
199-D4-95	Q	A	A	A	A	A	--	Yes	DX extraction well
199-D4-96	Q	A	A	A	A	A	--	Yes	DX extraction well

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
199-D4-97	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D4-98	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D4-99	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D5-13	Q	A	--	A	--	A	--	Yes	--
199-D5-14	Q	A	--	A	--	A	--	Yes	--
199-D5-15	Q	A	--	A	--	S	--	Yes	--
199-D5-16	Q	A	--	A	--	S	--	Yes	--
199-D5-17	A	A	--	A	--	A	--	Yes	--
199-D5-18	S	S	--	S	--	S	--	Yes	--
199-D5-19	A	--	--	--	--	A	--	Yes	--
199-D5-20	Q	A	S	A	A	S	A	Yes	DX extraction well; hexavalent chromium scheduled for 3 out of 4 quarters
199-D5-32	Q	A	S	A	A	S	A	Yes	DX extraction well
199-D5-33	Q	Q	--	Q	--	--	--	Yes	--
199-D5-34	Q	Q	--	Q	--	--	--	Yes	--
199-D5-36	Q	Q	A	Q	A	A	A	Yes	--
199-D5-37	Q	Q	A	Q	--	--	A	Yes	--
199-D5-38	Q	Q	--	Q	--	A	A	Yes	--
199-D5-39	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D5-40	Q	Q	--	Q	A	A	--	Yes	Quarterly samples scheduled for 3 out of 4 quarters
199-D5-43	Q	Q	--	Q	--	A	A	Yes	--
199-D5-92	Q	A	S	A	A	S	A	Yes	DX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-D5-93	Q	Q	--	Q	--	--	--	Yes	--
199-D5-97	Q	Q	--	Q	--	--	--	Yes	--
199-D5-98	Q	Q	--	Q	--	--	--	Yes	Nitrate and sulfate sampling scheduled 3 out of 4 quarters

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
199-D5-99	Q	Q	--	Q	--	--	--	Yes	--
199-D5-101	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D5-102	A	S	--	2	--	--	--	Yes	--
199-D5-103	A	S	--	S	--	--	--	Yes	--
199-D5-104	Q	Q	A	Q	A	A	A	Yes	DX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-D5-106	A	A	S	A	A	A	A	Yes	--
199-D5-119	Q	Q	--	Q	--	--	--	Yes	--
199-D5-120	Q	A	--	A	--	--	--	Yes	--
199-D5-121	Q	A	--	A	--	--	--	Yes	--
199-D5-122	Q	A	--	A	--	--	--	Yes	--
199-D5-123	Q	--	--	--	--	--	--	Yes	--
199-D5-125	Q	--	--	--	--	--	--	Yes	--
199-D5-126	Q	--	--	--	--	--	--	Yes	--
199-D5-127	A	A	A	A	A	A	A	Yes	DX extraction well
199-D5-130	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D5-131	Q	A	A	A	A	A	A	Yes	DX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-D5-132	Q	Q	S	Q	--	S	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-D5-133	Q	Q	S	Q	--	A	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-D5-141	A	A	--	A	--	A	--	Yes	--
199-D5-143	Q	A	S	A	--	A	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-D6-3	Q	Q	S	Q	--	S	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-D7-3	Q	A	A	A	A	A	A	Yes	Quarterly samples scheduled 3 out of 4 quarters

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
199-D7-6	Q	A	A	A	A	A	A	Yes	DX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-D8-4	Q	A	--	A	--	A	--	Yes	--
199-D8-5	Q	A	--	A	--	A	--	Yes	--
199-D8-6	S	A	A	A	A	A	A	Yes	DX extraction well
199-D8-69	Q	A	A	A	A	A	A	Yes	DX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-D8-70	Q	S	S	S	A	A	A	Yes	--
199-D8-71	Q	--	S	--	--	--	--	Yes	--
199-D8-73	S	--	--	--	--	--	--	Yes	DX extraction well
199-D8-88	Q	A	A	A	A	A	A	Yes	--
199-D8-89	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D8-90	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D8-91	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D8-95	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D8-96	Q	A	A	A	A	A	A	Yes	--
199-D8-97	Q	A	A	A	A	A	A	Yes	DX extraction well
199-D8-98	Q	A	A	A	A	A	A	Yes	--
199-D8-101	Q	A	--	A	--	A	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H1-1	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-2	Q	A	A	A	A	A	A	Yes	HX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-H1-3	A	A	A	A	A	A	A	Yes	HX extraction well
199-H1-4	A	A	A	A	A	A	A	Yes	HX extraction well
199-H1-5	Q	A	A	A	A	A	A	Yes	DX extraction well; quarterly samples scheduled 3 out of 4 quarters

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
199-H1-6	Q	A	A	A	A	A	A	Yes	HX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-H1-7	Q	A	A	A	A	A	A	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H1-25	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-27	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-32	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-33	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-34	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-35	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-36	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-37	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-38	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-39	Q	A	A	A	A	A	A	Yes	HX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-H1-40	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-42	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-43	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H1-45	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H2-1	Q	A	A	A	A	A	A	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H3-2A	Q	A	A	A	--	A	--	Yes	--
199-H3-2C	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H3-3	Q	A	A	A	--	A	--	Yes	--
199-H3-4	Q	S	A	S	A	A	A	Yes	HX extraction well
199-H3-5	Q	A	S	A	--	--	--	Yes	--
199-H3-6	Q	Q	S	Q	--	A	--	Yes	Quarterly samples scheduled 3 out of 4 quarters

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
199-H3-7	Q	A	S	A	--	A	--	Yes	--
199-H3-9	Q	A	A	A	A	A	A	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H3-10	S	A	A	A	A	A	A	Yes	--
199-H4-3	S	S	S	S	A	A	A	Yes	HX extraction well
199-H4-4	Q	S	S	S	S	S	S	Yes	HX extraction well
199-H4-5	Q	A	A	A	A	A	A	Yes	--
199-H4-6	Q	A	--	A	--	A	--	Yes	--
199-H4-7	A	A	A	A	--	--	--	Yes	--
199-H4-8	A	A	A	A	A	A	A	Yes	--
199-H4-9	A	A	--	A	A	A	--	Yes	--
199-H4-10	Q	A	A	A	A	A	A	Yes	--
199-H4-11	Q	A	A	A	A	A	A	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H4-12A	Q	A	A	A	A	A	A	Yes	--
199-H4-12C	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-13	Q	Q	Q	Q	A	A	A	Yes	--
199-H4-14	A	A	--	A	--	--	--	Yes	HX injection well
199-H4-15A	Q	S	S	S	S	S	S	Yes	HX extraction well
199-H4-15CP	A	A	--	A	--	--	--	Yes	--
199-H4-15CQ	A	A	--	A	--	A	--	Yes	--
199-H4-15CR	A	A	--	A	--	A	--	Yes	--
199-H4-15CS	A	A	--	A	--	A	--	Yes	--
199-H4-16	Q	A	S	A	--	--	--	Yes	--
199-H4-45	Q	A	S	A	--	A	--	Yes	--

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
199-H4-46	Q	S	S	S	--	A	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H4-48	Q	A	--	A	--	--	--	Yes	--
199-H4-49	Q	--	--	--	--	--	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H4-63	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-64	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-65	Q	--	--	--	--	--	--	Yes	--
199-H4-69	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-70	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-75	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-76	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-77	Q	A	A	A	A	A	A	Yes	HX extraction well
199-H4-80	Q	A	A	A	A	A	A	Yes	DX extraction well; quarterly samples scheduled 3 out of 4 quarters
199-H4-81	Q	A	A	A	A	A	A	Yes	DX extraction well
199-H4-82	Q	A	A	A	A	A	A	Yes	DX extraction well
199-H4-84	Q	Q	Q	Q	--	--	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
199-H5-1A	Q	A	--	A	--	--	--	Yes	--
199-H6-1	S	S	S	S	--	A	--	Yes	--
199-H6-3	S	S	S	S	--	--	--	Yes	--
199-H6-4	S	S	S	S	S	--	--	Yes	--
699-88-41	A	--	--	--	--	--	--	Yes	--
699-90-45	A	--	A	--	--	--	--	Yes	--
699-91-46A	A	--	--	--	--	--	--	Yes	--
699-93-48A	Q	--	--	--	--	--	--	Yes	--
699-94-41	Q	A	--	A	--	A	--	Yes	--

Table 2-5. Monitoring Wells and Constituents for the 100-HR-3 Operable Unit

Well	Hexavalent Chromium	Nitrate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium	Sampled as Scheduled?	Comment
699-94-43	Q	A	--	A	--	A	--	Yes	--
699-95-45	Q	A	--	A	--	A	--	Yes	--
699-95-48	Q	A	--	A	--	A	--	Yes	--
699-95-51	Q	A	--	A	--	A	--	Yes	--
699-96-43	A	A	--	A	--	A	--	Yes	--
699-96-52B	Q	A	A	A	A	--	A	Yes	--
699-97-41	Q	A	--	A	--	A	--	Yes	Quarterly samples scheduled 3 out of 4 quarters
699-97-43B	A	A	--	A	--	A	--	Yes	--
699-97-43C	A	A	--	A	--	A	--	Yes	--
699-97-45	A	A	--	A	--	A	--	Yes	--
699-97-45B	A	A	--	A	--	A	--	Yes	--
699-97-48B	A	A	--	A	--	A	--	Yes	--
699-97-48C	A	A	--	A	--	A	--	Yes	--
699-97-51A	Q	A	--	A	--	A	--	Yes	--
699-98-43	A	A	--	A	--	A	--	Yes	--
699-98-46	Q	A	--	A	--	A	--	Yes	--
699-98-49A	Q	--	--	--	--	--	--	Yes	--
699-98-51	Q	A	--	A	--	A	--	Yes	--
699-99-41	Q	A	--	A	--	A	--	Yes	--
699-99-44	Q	A	--	A	--	A	--	Yes	--
699-100-43B	Q	Q	--	Q	--	A	--	Yes	--
699-101-45	Q	Q	--	Q	--	A	--	Yes	--

Note: Wells were sampled to monitor 100-HX and 100-DX interim action pump-and-treat systems.

A = to be sampled annually

Q = to be sampled quarterly

S = to be sampled semiannually

-- = not applicable

Table 2-6. Monitoring Wells and Constituents for the 100-FR-3 Operable Unit

Well	Field Parameters	Alkalinity	Alpha/Beta	Anions	Hexavalent Chromium[a]	Metals	Strontium-90	Tritium	Trichloroethene (VOA)	Uranium	Sampled as Planned in 2012?	Comment
199-F1-2	BO	BO	--	BO	--	BO	--	--	--	--	Yes	--
199-F5-1	A	A	BE	A	--	A	BE	BE	--	--	Yes	--
199-F5-4	BO	BO	BO	BO	--	BO	--	BO	BO	--	Yes	--
199-F5-6	A	A	BE	A	--	A	BE	BE	--	--	Yes	--
199-F5-42	BO	BO	BO	BO	--	BO	BO	BO	--	--	Yes	--
199-F5-43A	BE	BE	BE	BE	--	BE	BE	BE	--	--	Not Scheduled	--
199-F5-43B	BE	BE	BE	BE	--	BE	BE	--	--	--	Not Scheduled	--
199-F5-44	BE	BE	BE	BE	--	BE	BE	BE	--	--	Not Scheduled	--
199-F5-45	BO	BO	BO	BO	--	BO	BO	BO	BO	BO	Yes	--
199-F5-46	BE	BE	A	BE	--	BE	BE	A	BE	A	Yes	--
199-F5-47	BE	BE	BE	BE	--	BE	--	BE	--	BE	Yes	--
199-F5-48	BO	BO	BO	BO	--	BO	--	BO	--	BO	Yes	Sampled SA in 2012[b]
199-F5-52[c]	--	A	--	A	A	A	A	--	--	--	Yes	--
199-F5-53[c]	--	A	--	A	A	A	A	--	--	--	Yes	--
199-F5-54[c]	--	A	A	A	A	A	A	A	--	A	Yes	--
199-F5-55[d]	--	--	--	SA	SA	--	SA	--	A	A	Yes	
199-F5-56[d]	--	--	--	SA	SA	--	SA	--	A	A	Yes	
199-F6-1	BO	BO	BO	BO	--	BO	BO	BO	--	--	Yes	--
199-F7-1	BE	BE	--	BE	--	BE	--	--	BE	--	Not scheduled	Sampled in 2012 to track TCE[e]
199-F7-2	BE	BE	BE	BE	--	BE	--	BE	BE	--	Not scheduled	--
199-F7-3	BE	BE	BE	BE	--	BE	--	BE	BE	--	Not scheduled	Sampled in 2012 to track TCE[e]
199-F8-2	BO	BO	BO	BO	--	BO	--	BO	--	BO	Yes	--

Table 2-6. Monitoring Wells and Constituents for the 100-FR-3 Operable Unit

Well	Field Parameters	Alkalinity	Alpha/Beta	Anions	Hexavalent Chromium[a]	Metals	Strontium-90	Tritium	Trichloroethene (VOA)	Uranium	Sampled as Planned in 2012?	Comment
199-F8-3	BE	BE	BE	BE	--	BE	BE	BE	BE	BE	Not scheduled	--
199-F8-4	BE	BE	BE	BE	--	BE	--	BE	--	BE	Not scheduled	--
199-F8-7	A	A	--	A	A	A	A	A	A	A	Yes	--
699-58-24	BE	BE	--	BE	--	BE	--	--	--	--	Not scheduled	--
699-60-32	BO	BO	--	BO	--	BO	--	--	--	--	Yes	--
699-62-31	BO	BO	--	BO	--	BO	--	--	--	--	Yes	--
699-62-43F	BE	BE	--	BE	--	BE	--	BE	--	--	Not scheduled	--
699-63-25A	BO	BO	--	BO	--	BO	--	BO	--	--	Yes	--
699-63-55	BO	BO	--	BO	--	BO	--	BO	--	--	Yes	--
699-64-27	BE	BE	--	BE	--	BE	--	--	--	--	Not scheduled	--
699-66-23	BE	BE	--	BE	--	BE	--	BE	--	--	Not scheduled	--
699-67-51	BO	BO	--	BO	--	BO	--	BO	--	--	Yes	--
699-71-30	BO	BO	BO	BO	--	BO	--	BO	--	--	Yes	--
699-74-44	BO	BO	--	BO	--	BO	--	--	BO	--	Yes	--
699-77-36	BE	BE	--	BE	--	BE	--	--	BE	--	Not scheduled	Sampled in 2012 to track TCE[e]
699-77-54	BO	BO	--	BO	--	BO	--	--	--	--	Yes	
699-81-38	BE	BE	--	BE	--	BE	--	--	--	--	Not scheduled	--
699-83-47	BE	BE	--	BE	--	BE	--	--	BE	--	Not scheduled	--
Spring SF-187-1	A		A	A	A			A			Yes	

Table 2-6. Monitoring Wells and Constituents for the 100-FR-3 Operable Unit

Well	Field Parameters	Alkalinity	Alpha/Beta	Anions	Hexavalent Chromium[a]	Metals	Strontium-90	Tritium	Trichloroethene (VOA)	Uranium	Sampled as Planned in 2012?	Comment
Spring SF-190-4	A		A	A	A			A			Yes	
Spring SF-207-1	A		A	A	A			A			Yes	

Notes: Sampling requirements are from *100-FR-3 Operable Unit Sampling and Analysis Plan* (DOE/RL-2003-49), as modified by TPA-CN-241, *Change Notice for Modifying Approved Documents/Workplans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: 100-FR-3 Operable Unit Sampling and Analysis Plan, DOE/RL-2003-49, Rev. 1 and TPA-CN-228 (July 14, 2008)*.

All wells are screened in the unconfined aquifer, except wells 199-F5-43B and 199-F5-53, which are screened in the Ringold Formation aquitard.

a. TPA-CN-241 does not require hexavalent chromium (total chromium in filtered samples is equivalent). However, hexavalent chromium was analyzed in most 100-F wells in 2012.

b. The frequency was increased to semiannual in 2011 and 2012 because of excavation activities at nearby waste site 100-F-57.

c. New wells installed for the 100-F remedial investigation/feasibility study; not included in DOE/RL-2003-49 or TPA-CN-241.

d. Temporary wells constructed from vadose boreholes for the remedial investigation/feasibility study; not included in DOE/RL-2003-49 or TPA-CN-241.

e. Biennial sampling in even fiscal years is required, but the wells were sampled in fiscal year 2013 (October 2012) to follow previous increases in TCE.

A = to be sampled annually

BE = to be sampled biennially, even fiscal years

BO = to be sampled biennially, odd fiscal years (fiscal year 2013 sampling was scheduled for October 2012; sampling occurred in late September or October 2012)

SA = to be sampled semiannually

TCE = trichloroethene

VOA = volatile organic analyte

Table 2-7. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit, 300 Area

Well Name	Hydrologic Unit Monitored	*cis*-1,2-Dichloroethene	Trichloroethene	Uranium, Total (Unfiltered)	Tetrachloroethene	Strontium-90	Tritium	Nitrate	Anions	Alkalinity	Metals	Volatile Organic Compounds	Alpha/Beta	Uranium, Isotopic	Sampled as Scheduled in 2012?
Near-River Well Group															
399-1-1	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-10A[a]	TU	S	S	M	S	--	A	M	M	M	S	S	S	A	Yes
399-1-10B	LU	S	S	S	S	--	--	S	S	S	S	S	--	--	Yes
399-1-16A[a]	TU	S	S	M	S	--	A	M	M	M	S	S	S	A	Yes
399-1-16B	LU	S	S	S	S	--	--	S	S	S	S	S	--	--	Yes
399-1-16C	C	A	A	A	A	--	--	A	A	A	A	A	--	--	Yes
399-2-1	TU	S	S	Q	S	--	A	Q	Q	Q	S	S	S	A	Yes
399-2-2	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-3-1	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-3-9	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Sampled once
399-3-10	TU	S	S	Q	S	--	A	Q	Q	Q	S	S	S	A	Yes
399-3-18[b]	TU	S	S	M	S	--	A	M	M	M	S	S	S	A	Sampled 9 months, as scheduled
399-4-7	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-4-9	TU	Q	Q	Q	Q	--	--	Q	Q	Q	Q	Q	Q	--	Sampled 3 times
399-4-10	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes

Table 2-7. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit, 300 Area

Well Name	Hydrologic Unit Monitored	*cis*-1,2-Dichloroethene	Trichloroethene	Uranium, Total (Unfiltered)	Tetrachloroethene	Strontium-90	Tritium	Nitrate	Anions	Alkalinity	Metals	Volatile Organic Compounds	Alpha/Beta	Uranium, Isotopic	Sampled as Scheduled in 2012?
Central Region – Uranium Plume Transport Corridor Well Group															
399-1-2	TU	S	S	Q	S	--	--	Q	Q	Q	S	S	Q	--	Yes
399-1-6	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-7	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-8	LU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-9	C	A	A	A	A	--	--	A	A	A	A	A		--	Yes
399-1-11	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-12	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-17A[a]	TU	S	S	M	S	--	A	M	M	M	M	S	S	A	Yes
399-1-17B	LU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-17C	C	A	A	A	A	--	--	A	A	A	A	A	--	--	Yes
399-1-21A	TU	S	S	Q	S		A	Q	Q	Q	S	S	Q	A	Yes
399-1-21B	LU	S	S	S	S	--		S	S	S	S	S	S	--	Yes
399-1-23	TU	S	S	Q	S	--	A	Q	Q	Q	S	S	S	A	Yes
399-2-5	TU	Q	Q	Q	Q	--	A	Q	Q	Q	Q	Q	Q	A	Yes
399-3-12	TU	S	S	S	S	--	--	S	S	S	S	S	--	--	Yes
399-3-20	TU	S	S	Q	S	A	A	Q	Q	Q	S	S	S	A	Yes
399-3-21	LU	Q	Q	Q	Q	--	A	Q	Q	Q	Q	Q	Q	--	Yes

Table 2-7. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit, 300 Area

Well Name	Hydrologic Unit Monitored	*cis*-1,2-Dichloroethene	Trichloroethene	Uranium, Total (Unfiltered)	Tetrachloroethene	Strontium-90	Tritium	Nitrate	Anions	Alkalinity	Metals	Volatile Organic Compounds	Alpha/Beta	Uranium, Isotopic	Sampled as Scheduled in 2012?
399-3-22	LU	Q	Q	Q	Q	--	A	Q	Q	Q	Q	Q	Q	--	Missed 1 quarter
399-4-11	TU	S	S	S	S			S	S	S	S	S	S		Yes
Northwest Region – Upgradient Conditions Well Group															
399-1-15	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-1-18A	TU	--	--	S	--	--	S	S	S	S	S	--	--	--	Yes
399-1-18B	LU	--	--	S	--	--	S	S	S	S	S	--	--	--	Yes
399-1-18C	C	--	--	A	--	--	--	A	A	A	A	--	--	--	Yes
399-8-1[c]	TU	Q	Q	Q	Q	--	--	Q	Q	Q	Q	Q	Q	--	Yes
399-8-3	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
399-8-5A[c]	TU	S	S	S	S	--	--	S	S	S	S	S	S	--	Yes
699-S20-E10	TU	--	--	S	--	--	S	S	S	S	S	--	--	--	Yes
Southwest Region – Upgradient Conditions Well Group															
399-3-2	TU	S	S	S	S	--	--	S	S	S	S	S	--	--	Second sample delayed until February 2013
399-3-6	TU	S	S	S	S	--	--	S	S	S	S	S	--	--	Yes
399-3-19	TU	S	S	Q	S	--	A	Q	Q	Q	S	S	S	A	Yes
399-4-1	TU	S	S	S	S	--	--	S	S	S	S	S	--	--	Yes

Table 2-7. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit, 300 Area

Well Name	Hydrologic Unit Monitored	*cis*-1,2-Dichloroethene	Trichloroethene	Uranium, Total (Unfiltered)	Tetrachloroethene	Strontium-90	Tritium	Nitrate	Anions	Alkalinity	Metals	Volatile Organic Compounds	Alpha/Beta	Uranium, Isotopic	Sampled as Scheduled in 2012?
399-4-12	TU	S	S	S	S	--	--	S	S	S	S	S	--	--	Second sample delayed until February 2013
399-4-14	LU	Q	Q	Q	Q	--	A	Q	Q	Q	Q	Q	Q	--	Yes
399-5-4B	TU	S	S	S	S	--	--	S	S	S	S	S	--	--	Yes
699-S27-E14	TU	A	A	A	A	--	--	A	A	A	A	A	--	--	Sample delayed until January 2013
Wells Installed in 2010-2011[e]															
399-1-54	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-55	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-56	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-57	MU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-58	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-59	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-61	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-62	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-1-63	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Sampled twice
399-1-64	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-2-32	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes

Table 2-7. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit, 300 Area

Well Name	Hydrologic Unit Monitored	*cis*-1,2-Dichloroethene	Trichloroethene	Uranium, Total (Unfiltered)	Tetrachloroethene	Strontium-90	Tritium	Nitrate	Anions	Alkalinity	Metals	Volatile Organic Compounds	Alpha/Beta	Uranium, Isotopic	Sampled as Scheduled in 2012?
399-3-33	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-3-38	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Yes
399-4-15[d]	TU	M	M	Q/M	M	A	A	Q/M	Q/M	Q/M	Q/M	M	M	A	Yes, sampled 9 times as scheduled
399-6-3	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Sampled 3 times
399-6-5	TU	S	S	Q	S	--	A	Q	Q	Q	Q	S	S	A	Sampled 3 times

Note: Sampling requirements are from *300-FF-5 Operable Unit Sampling and Analysis Plan* (DOE/RL-2002-11).

a. Monthly sampling is for 8 months each year.

b. Special sampling frequency at near-river well to provide more detailed record of seasonal fluctuations in uranium.

c. Additional well coverage and sampling frequency to monitor plume that developed downgradient of former 618-7 Burial Ground.

d. Additional sampling initiated in May to monitor potential impacts of water line breaks.

e. Wells installed for the 300 Area Remedial Investigation/Feasibility Study; not in DOE/RL-2002-11.

A = to be sampled annually

C = uppermost confined aquifer

LU = lower portion of unconfined aquifer

MU= middle portion of unconfined aquifer

M = to be sampled monthly

Q = to be sampled quarterly

S = to be sampled semiannually during seasonal high water table and seasonal low water table

TU = upper portion of unconfined aquifer, including water table

Table 2-8. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit, 618-10/316-4 Subregion

Well	Uranium, Total (Unfiltered)	Tributyl Phosphate	Gross Alpha	Gross Beta	Nitrate	Alkalinity	Metals	VOA and SVOA	Tritium	Technetium-99	Uranium, Isotopic	Sampled as Scheduled in 2012?
Downgradient of 618-10 Burial Ground (Near-Field)												
699-S6-E4K	Q	S	Q	Q	Q	S	Q	Q	S	S	A	Yes
699-S6-E4L	Q	S	Q	Q	Q	S	Q	Q	S	S	A	Yes; uranium sampled monthly for 6 months
Downgradient of 618-10 Burial Ground, Within 316-4 Crib Footprint (Near-Field)												
699-S6-E4A	Q	S	Q	Q	Q	S	S	S	S	S	A	Yes
Background, 618-10 Burial Ground/316-4 Cribs												
699-S6-E4D	A		A	A	A	A	A	--	A	A	--	Yes
Downgradient of 618-10 Burial Ground/316-4 Crib												
699-S6-E4B	S	--	S	S	S	S	S	--	S	--	--	Sampled once
699-S6-E4E	S	--	S	S	S	S	S	--	S	--	--	2nd delayed until January 2013

Notes: Sampling requirements are from *300-FF-5 Operable Unit Sampling and Analysis Plan* (DOE/RL-2002-11).

Wells were completed at the top of the unconfined aquifer.

A = to be sampled annually

Q = to be sampled quarterly

S = to be sampled semiannually

VOA = volatile organic analyte

SVOA = semivolatile organic analyte

Table 2-9. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit, 618-11 Subregion

Well	Tritium	Gross Alpha/Beta	Uranium, Total (Unfiltered)	Technetium-99	Nitrate	Alkalinity	Anions	Metals	Sampled as Scheduled in 2012?
Downgradient of 618-11 Burial Ground (Near Field)									
699-12-2C	Q	Q	S	S	S	S	S	S	Yes
699-13-2D	Q	Q	S	S	S	S	S	S	Yes
699-13-3A	Q	Q	S	S	S	S	S	S	Missed one quarter
Upgradient Conditions (Near Field)									
699-12-4D	A	A	A	A	A	A	A	A	Yes
Downgradient of 618-11 Burial Ground (Far Field)									
699-13-0A	S	S	--	--	S	S	S	S	Yes
699-13-1E	S	S	--	--	S	S	S	S	Yes

Note: Sampling requirements are from *300-FF-5 Operable Unit Sampling and Analysis Plan* (DOE/RL-2002-11).

A = to be sampled annually

Q = to be sampled quarterly

S = to be sampled semiannually

Table 2-10. Monitoring Wells and Constituents for the Former 1100-EM-1 Operable Unit

Well	1,1-Dichloroethene	Trichloroethene	Vinyl Chloride	Anions*	Sampled as Scheduled in 2012?
699-S28-E12	A	A	A	A	Yes
699-S31-E10A	A	A	A	A	Yes
699-S31-E10C	A	A	A	A	Yes

Note: Sampling requirements are from TPA-CN-163, *Change Notice for Modifying Approved Documents/Workplans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: PNNL-12220, "Sampling and Analysis Plan Update for Groundwater Monitoring – 1100-EM-1 Operable Unit"*.

* supplemental analyses

A = to be sampled annually

Table 2-11. Monitoring Wells, Constituents, and Sampling Frequency for the 200-ZP-1 Operable Unit in 2012

Well Name	Carbon Tetrachloride	Chromium	Hexavalent Chromium	Iodine-129	Nitrate	Techneitum-99	Trichloroethene	Tritium	Uranium	Sampled as Scheduled in 2012?
299-W10-1	A	A	A	A	A	A	A	A	A	Yes
299-W10-14	A	A	A	A	A	A	A	A	A	Yes
299-W10-27	A	A	A	A	A	A	A	A	A	Yes
299-W10-30	A	A	A	A	A	A	A	A	A	Yes
299-W10-31	A	A	A	A	A	A	A	A	A	Yes
299-W10-33	A	A	A	A	A	A	A	A	A	Yes
299-W10-4	A	A	A	A	A	A	A	A	A	Yes
299-W11-13	A	A	A	A	A	A	A	A	A	Yes
299-W11-18	A	A	A	A	A	A	A	A	A	Yes
299-W11-33Q	A	A	A	A	A	A	A	A	A	Yes
299-W11-37	A	A	A	A	A	A	A	A	A	Yes
299-W11-43	A	A	A	A	A	A	A	A	A	Yes
299-W11-45*	A	A	A	A	A	A	A	A	A	No
299-W11-47	A	A	A	A	A	A	A	A	A	Yes
299-W11-48	A	A	A	A	A	A	A	A	A	Yes
299-W11-87	A	A	A	A	A	A	A	A	A	Yes
299-W11-88	A	A	A	A	A	A	A	A	A	Yes
299-W12-1	A	A	A	A	A	A	A	A	A	Yes
299-W13-1	A	A	A	A	A	A	A	A	A	Yes
299-W14-11	A	A	A	A	A	A	A	A	A	Yes
299-W14-13	A	A	A	A	A	A	A	A	A	Yes
299-W14-14	A	A	A	A	A	A	A	A	A	Yes
299-W14-71	A	A	A	A	A	A	A	A	A	Yes
299-W14-72	A	A	A	A	A	A	A	A	A	Yes
299-W15-11	A	A	A	A	A	A	A	A	A	Yes
299-W15-152	A	A	A	A	A	A	A	A	A	Yes

Table 2-11. Monitoring Wells, Constituents, and Sampling Frequency for the 200-ZP-1 Operable Unit in 2012

Well Name	Carbon Tetrachloride	Chromium	Hexavalent Chromium	Iodine-129	Nitrate	Techneitum-99	Trichloroethene	Tritium	Uranium	Sampled as Scheduled in 2012?
299-W15-17	A	A	A	A	A	A	A	A	A	Yes
299-W15-33	A	A	A	A	A	A	A	A	A	Yes
299-W15-37	A	A	A	A	A	A	A	A	A	Yes
299-W15-42	A	A	A	A	A	A	A	A	A	Yes
299-W15-46	A	A	A	A	A	A	A	A	A	Yes
299-W15-49	A	A	A	A	A	A	A	A	A	Yes
299-W15-50	A	A	A	A	A	A	A	A	A	Yes
299-W15-7	A	A	A	A	A	A	A	A	A	Yes
299-W15-763	A	A	A	A	A	A	A	A	A	Yes
299-W15-765	A	A	A	A	A	A	A	A	A	Yes
299-W15-83	A	A	A	A	A	A	A	A	A	Yes
299-W15-94	A	A	A	A	A	A	A	A	A	Yes
299-W18-1	A	A	A	A	A	A	A	A	A	Yes
299-W18-15	A	A	A	A	A	A	A	A	A	Yes
299-W18-16	A	A	A	A	A	A	A	A	A	Yes
299-W18-21	A	A	A	A	A	A	A	A	A	Yes
299-W18-22	A	A	A	A	A	A	A	A	A	Yes
299-W18-40	A	A	A	A	A	A	A	A	A	Yes
299-W19-105	A	A	A	A	A	A	A	A	A	Yes
299-W19-107	A	A	A	A	A	A	A	A	A	Yes
299-W19-18	A	A	A	A	A	A	A	A	A	Yes
299-W19-34A	A	A	A	A	A	A	A	A	A	Yes
299-W19-34B	A	A	A	A	A	A	A	A	A	Yes
299-W19-36	A	A	A	A	A	A	A	A	A	Yes
299-W19-4	A	A	A	A	A	A	A	A	A	Yes
299-W19-41	A	A	A	A	A	A	A	A	A	Yes

Table 2-11. Monitoring Wells, Constituents, and Sampling Frequency for the 200-ZP-1 Operable Unit in 2012

Well Name	Carbon Tetrachloride	Chromium	Hexavalent Chromium	Iodine-129	Nitrate	Techneitum-99	Trichloroethene	Tritium	Uranium	Sampled as Scheduled in 2012?
299-W19-47	A	A	A	A	A	A	A	A	A	Yes
299-W19-48	A	A	A	A	A	A	A	A	A	Yes
299-W19-49	A	A	A	A	A	A	A	A	A	Yes
299-W19-6	A	A	A	A	A	A	A	A	A	Yes
299-W21-2	A	A	A	A	A	A	A	A	A	Yes
299-W22-24P*	A	A	A	A	A	A	A	A	A	No
299-W22-24Q*	A	A	A	A	A	A	A	A	A	No
299-W22-24R*	A	A	A	A	A	A	A	A	A	No
299-W22-24S*	A	A	A	A	A	A	A	A	A	No
299-W22-24T*	A	A	A	A	A	A	A	A	A	No
299-W22-47	A	A	A	A	A	A	A	A	A	Yes
299-W22-72	A	A	A	A	A	A	A	A	A	Yes
299-W22-86	A	A	A	A	A	A	A	A	A	Yes
299-W22-87	A	A	A	A	A	A	A	A	A	Yes
299-W22-88	A	A	A	A	A	A	A	A	A	Yes
299-W23-19	A	A	A	A	A	A	A	A	A	Yes
299-W23-4	A	A	A	A	A	A	A	A	A	Yes
299-W26-13	A	A	A	A	A	A	A	A	A	Yes
299-W27-2	A	A	A	A	A	A	A	A	A	Yes
299-W6-3	A	A	A	A	A	A	A	A	A	Yes
299-W6-6	A	A	A	A	A	A	A	A	A	Yes
299-W7-3	A	A	A	A	A	A	A	A	A	Yes
699-30-66	A	A	A	A	A	A	A	A	A	Yes
699-32-62	A	A	A	A	A	A	A	A	A	Yes
699-32-72A	A	A	A	A	A	A	A	A	A	Yes
699-33-75	A	A	A	A	A	A	A	A	A	Yes

Table 2-11. Monitoring Wells, Constituents, and Sampling Frequency for the 200-ZP-1 Operable Unit in 2012

Well Name	Carbon Tetrachloride	Chromium	Hexavalent Chromium	Iodine-129	Nitrate	Techneitum-99	Trichloroethene	Tritium	Uranium	Sampled as Scheduled in 2012?
699-34-61	A	A	A	A	A	A	A	A	A	Yes
699-35-66A	A	A	A	A	A	A	A	A	A	Yes
699-35-78A	A	A	A	A	A	A	A	A	A	Yes
699-36-61A	A	A	A	A	A	A	A	A	A	Yes
699-36-66B	A	A	A	A	A	A	A	A	A	Yes
699-36-70A	A	A	A	A	A	A	A	A	A	Yes
699-36-70B	A	A	A	A	A	A	A	A	A	Yes
699-37-66	A	A	A	A	A	A	A	A	A	Yes
699-38-61	A	A	A	A	A	A	A	A	A	Yes
699-38-65	A	A	A	A	A	A	A	A	A	Yes
699-38-68A	A	A	A	A	A	A	A	A	A	Yes
699-38-70B	A	A	A	A	A	A	A	A	A	Yes
699-38-70C	A	A	A	A	A	A	A	A	A	Yes
699-40-62	A	A	A	A	A	A	A	A	A	Yes
699-40-65	A	A	A	A	A	A	A	A	A	Yes
699-43-69	A	A	A	A	A	A	A	A	A	Yes
699-44-64	A	A	A	A	A	A	A	A	A	Yes
699-45-69A	A	A	A	A	A	A	A	A	A	Yes
699-45-69C	A	A	A	A	A	A	A	A	A	Yes
699-47-60	A	A	A	A	A	A	A	A	A	Yes
699-48-71	A	A	A	A	A	A	A	A	A	Yes
699-50-74	A	A	A	A	A	A	A	A	A	Yes
699-51-63	A	A	A	A	A	A	A	A	A	Yes

* Wells were not successfully sampled as scheduled. Former extraction well 299-W11-45 was offline, and wells 299-W22-24P-T cannot be sampled as currently configured.

Note: Requirements are from DOE/RL-2009-124, *200 West Area Pump-and-Treat Facility Operations and Maintenance Plan*, and DOE/RL-2009-115, *Performance Monitoring Plan for the 200-ZP-1 Groundwater Operable Unit Remedial Action*.

Table 2-12. 200-ZP-1 Operable Unit Hydraulic Monitoring Well Network (Annual Sampling)

Well Name	Easting (m)	Northing (m)	Surface Elev. (m)	Depth to Screen Top (m)	Depth to Screen Bottom (m)	Date Drilled	Trans-ducer Equip-ment	Mid-Screen Elev.* (m)
299-W10-1	566663	136735	207.5	57.91	82.3	08/07/47	No	137.4
299-W10-27	566844	136442	205.6	67.36	78.02	03/23/01	No	132.9
299-W10-30	566083	136739	211.6	73.86	84.53	03/14/06	No	132.4
299-W10-31	566266	136968	210.4	73.13	83.82	04/20/06	No	131.9
299-W10-33	566773	136610	206.0	118.87	124.96	06/15/07	No	84.1
299-W10-4	566735	136578	205.5	57.91	74.68	11/10/52	Yes	139.2
299-W11-13	567099	136424	211.9	66.45	143.86	07/31/61	No	106.7
299-W11-18	567182	137161	216.5	69.19	89.916	03/01/67	No	136.9
299-W11-33Q	567185	136844	217.2	74.41	91.17	09/09/94	No	134.4
299-W11-43	567270	136971	217.5	129.44	134.01	05/23/05	Yes	85.8
299-W11-45	566993	136776	213.6	85.73	90.18	09/02/05	No	125.7
299-W11-47	566934	136681	210.4	83.58	92.89	01/06/06	Yes	122.2
299-W11-48	566882	136846	209.7	84.56	112.01	11/29/06	Yes	111.4
299-W11-87	568141	136609	223.6	116.36	120.94	03/01/07	Yes	105.0
299-W11-88	567875	137113	221.9	135.66	147.85	10/03/07	Yes	80.1
299-W13-1	568149	136049	223.5	119.15	129.81	02/10/04	Yes	99.1
299-W14-11	566902	136288	205.1	79.77	82.81	04/26/05	No	123.8
299-W14-14	566898	136181	205.4	66.13	76.81	11/12/98	Yes	134.0
299-W14-17	567007	136218	205.9	67.64	78.32	10/24/00	No	132.9
299-W14-71	567733	135568	219.4	125.17	129.74	07/27/06	Yes	92.0
299-W14-72	567328	135941	216.3	126.18	130.76	08/15/06	Yes	87.9
299-W15-1	566554	135943	207.0	57.91	82.3	05/02/47	No	136.9
299-W15-11	566412	136001	208.3	55.78	90.53	03/08/68	Yes	135.1
299-W15-152	566309	135550	209.9	71.94	82.61	09/15/05	No	132.6
299-W15-17	566307	135719	209.8	128.77	131.82	10/28/87	No	79.5
299-W15-3	566729	136371	205.4	60.96	71.93	09/30/52	No	139.0
299-W15-30	566305	135749	210.2	66.47	78.63	05/05/95	Yes	137.7

Table 2-12. 200-ZP-1 Operable Unit Hydraulic Monitoring Well Network (Annual Sampling)

Well Name	Easting (m)	Northing (m)	Surface Elev. (m)	Depth to Screen Top (m)	Depth to Screen Bottom (m)	Date Drilled	Trans-ducer Equip-ment	Mid-Screen Elev.* (m)
299-W15-31A	566377	135856	208.5	64.76	76.93	05/26/95	No	137.7
299-W15-37	566716	135248	203.0	64.74	77.98	05/16/96	No	131.68
299-W15-42	566582	135627	207.4	69.50	84.74	02/26/02	No	130.3
299-W15-46	566752	135587	204.2	63.86	88.23	10/03/03	No	128.2
299-W15-49	566307	135973	209.1	71.86	82.52	11/01/04	No	131.9
299-W15-50	566793	135791	203.2	74.19	84.85	02/28/05	No	123.7
299-W15-7	566676	135920	204.2	55.47	106.68	03/30/66	Yes	123.1
299-W17-1	565311	135039	199.2	58.99	69.67	12/17/03	No	134.9
299-W18-1	566422	135465	209.1	59.44	111.89	01/12/59	No	123.4
299-W18-15	566380	134733	202.2	51.82	74.07	04/25/80	No	139.3
299-W18-16	566605	135426	208.5	71.47	82.13	10/20/04	No	131.8
299-W18-22	566089	134990	204.9	126.94	136.39	09/25/87	No	73.2
299-W18-40	566723	134996	203.4	66.53	77.20	09/28/01	No	131.6
299-W19-107	567998	135206	217.4	94.65	99.22	03/31/06	Yes	120.5
299-W19-18	567361	135012	214.0	67.06	109.12	12/12/85	No	125.90
299-W19-34A	567674	135012	215.1	98.82	103.51	05/18/94	No	113.9
299-W19-34B	567663	135011	215.5	125.46	128.41	12/12/85	No	88.6
299-W19-35	567992	135015	213.6	73.13	82.3	04/20/94	No	135.9
299-W19-4	567950	135351	219.0	77.72	135.03	02/15/60	No	112.3
299-W19-41	566897	135005	206.5	67.07	77.76	09/23/98	No	134.1
299-W19-6	567133	134694	210.3	115.82	125.27	12/13/68	No	89.79
299-W21-2	568124	134574	214.9	79.29	89.96	11/22/04	No	130.2
299-W22-24	567648	134411	212.2	67.06	163.07	09/08/60	No	97.1
299-W22-24P	567648	134411	212.2	48.6	87.84	09/08/60	No	144.0
299-W22-24R	567648	134411	212.2	86.7	130.82	09/08/60	No	103.4
299-W22-24T	567648	134411	212.2	123.2	90.68	09/08/60	No	105.3
299-W22-47	566909	134076	206.3	69.70	80.37	01/19/05	No	131.3
299-W23-20	566718	134446	203.8	65.68	76.35	08/21/00	No	132.8

Table 2-12. 200-ZP-1 Operable Unit Hydraulic Monitoring Well Network (Annual Sampling)

Well Name	Easting (m)	Northing (m)	Surface Elev. (m)	Depth to Screen Top (m)	Depth to Screen Bottom (m)	Date Drilled	Trans-ducer Equip-ment	Mid-Screen Elev.* (m)
299-W26-14	566683	133539	205.4	68.08	78.75	04/03/03	No	132.0
299-W27-2	566908	133670	207.4	123.79	126.87	12/18/92	No	82.1
299-W6-3	567118	137299	214.4	124.82	127.95	10/15/91	No	87.9
299-W6-6	567319	137639	217.5	127.58	130.84	10/24/91	No	88.3
299-W7-3	566292	137639	207.2	136.85	145.29	11/23/87	No	66.1
699-25-70	568545	131172	193.0	53.34	134.11	08/31/48	No	99.24
699-25-80	565676	131106	189.0	273.41	370.03	11/30/48	No	-132.7
699-30-66	569991	132739	210.5	117.35	120.4	10/13/04	No	91.6
699-32-62	571010	133216	216.6	83.82	103.63	04/06/60	No	122.9
699-32-62P	571010	133216	216.6	83.82	146.3	04/06/60	No	101.5
699-32-70B	568462	133242	204.2	63.09	100.58	08/09/57	No	122.37
699-32-72A	567943	133363	204.7	65.42	74.56	07/31/57	No	134.7
699-32-72B	567935	133362	205.1	65.41	74.56	05/18/94	No	135.1
699-34-88	563012	133950	194.0	146.0	127.02	12/20/48	No	136.5
699-35-59	571956	134096	222.1	94.48	106.67	10/31/85	No	121.5
699-35-66A	569858	134099	222.5	79.25	98.15	06/13/57	No	133.76
699-35-78A	566064	134271	202.4	54.86	85.04	08/17/50	Yes	132.02
699-36-70B	568428	134626	215.2	80.51	91.17	06/09/04	No	129.4
699-38-61	571219	134997	228.2	101.83	107.92	11/16/93	No	123.3
699-38-65	570090	135040	230.7	152.4	155.45	12/31/59	Yes	76.8
699-38-68A	569180	134932	219.0	81.59	90.74	06/21/94	No	132.8
699-38-70B	568469	135331	222.6	123.96	128.53	02/03/04	No	96.3
699-38-70C	569084	135326	226.7	120.60	125.18	02/17/04	No	103.8
699-39-79	565891	135412	206.5	54.44	73.152	09/07/48	Yes	142.7
699-40-62	571164	135764	228.9	102.11	114.0	01/17/49	No	120.8
699-40-65	570057	135881	231.0	100.0	111.5	02/03/04	Yes	125.3
699-43-69	568967	136488	227.4	121.98	132.64	12/11/07	Yes	100.1
699-43-89	562917	136620	197.7	43.28	60.35	01/16/51	No	145.9

Table 2-12. 200-ZP-1 Operable Unit Hydraulic Monitoring Well Network (Annual Sampling)

Well Name	Easting (m)	Northing (m)	Surface Elev. (m)	Depth to Screen Top (m)	Depth to Screen Bottom (m)	Date Drilled	Trans-ducer Equip-ment	Mid-Screen Elev.* (m)
699-44-64	570391	136897	222.2	96.32	134.72	01/31/60	Yes	106.67
699-45-69A	568729	137183	222.1	83.52	111.56	06/22/48	No	124.6
699-45-69C	568947	137234	222.6	111.86	116.43	07/13/07	Yes	108.4
699-47-60	571474	137969	199.6	71.63	84.43	07/20/48	No	121.6
699-47-80AP	565562	137693	218.26	198.12	204.83	11/30/83	No	16.8
699-47-80AQ	565562	137693	218.26	153.31	156.36	11/30/83	No	63.4
699-48-71	568388	138057	210.9	138	156.36	09/26/56	Yes	63.7
699-48-77C	566469	138087	206.6	88.39	94.49	04/01/94	No	115.42
699-49-79	565771	138271	211.1	65.58	80.77	07/03/48	Yes	137.9
699-50-74	567360	138647	201.4	68.07	78.74	07/12/05	No	128.0
699-51-63	570664	139148	175.3	47.85	55.78	11/06/56	No	123.49
699-51-75	566978	138906	196.6	57.91	68.58	10/31/57	No	133.4
699-55-76	566723	140226	178.7	42.98	67.36	01/18/59	No	123.5

* Mid-screen elevations were obtained from the 2008 carbon tetrachloride plume shell dataset and are included in this table because the top and bottom screen elevation were not available. Top and bottom screen elevations are not available from the Hanford Environmental Information System database but are likely available from other data sources and/or databases because they were available to construct the plume shell dataset.

Table 2-13. Monitoring Wells and Constituents for the 200-UP-1 Operable Unit

Well	Arsenic[a]	Cadmium	Carbon-14	Chromium	Iodine-129	Iron	Manganese	Nitrate and Fluoride	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium	Volatile Organic Analytes	Sampled as Scheduled in 2012?
299-W15-37	A	A	--	--	--	--	--	A	--	--	--	--	A	A	Yes
299-W18-15	S	--	--	--	--	--	--	S/A[b]	--	--	--	--	S/A	S/A	Yes
299-W18-21	A	--	--	--	--	--	--	A	--	--	A	--	A	A	Yes
299-W18-22	A	--	--	--	--	--	--	A	--	--	A	--	A	A	Yes
299-W18-30	A	--	--	--	A	--	--	A	--	--	--	--	A	A	Yes
299-W19-4	--	--	--	--	BO	--	--	BO	--	--	BO	--	BO	BO	Not scheduled
299-W19-18[c]	--	--	--	--	A	--	--	A	--	--	A	--	A	A	Yes
299-W19-34A	A	--	--	--	A	--	--	A	--	--	A	--	A	A	Yes
299-W19-34B	BE	--	--	--	BE	--	--	BE	--	--	BE	--	BE	BE	Yes
299-W19-35	--	S	--	--	S	--	--	S	--	--	S	--	S	S	Yes
299-W19-36	--	--	--	--	A	--	--	A	--	--	A	--	A	A	Yes
299-W19-43	--	--	--	--	S	--	--	S	--	--	S	--	S	S	No; first event missed; former extraction well reconfigured as a monitoring well later in the year
299-W19-46	--	S	--	--	S	--	S	S	--	--	S	S	S	S	Yes
299-W19-48	--	--	--	--	S	--	--	S	--	--	S	S	S	S	Yes
299-W19-49[d]	--	--	--	--	S	--	--	S	--	--	S	S	S	S	Yes
299-W19-101[e]	--	--	--	--	A	--	--	A	--	--	A	A	A	A	Yes
299-W19-105	--	--	--	--	S	--	--	S	--	--	S	S	S	S	Yes

Table 2-13. Monitoring Wells and Constituents for the 200-UP-1 Operable Unit

Well	Arsenic[a]	Cadmium	Carbon-14	Chromium	Iodine-129	Iron	Manganese	Nitrate and Fluoride	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium	Volatile Organic Analytes	Sampled as Scheduled in 2012?
299-W19-107	--	--	--	--	S/A	--	--	S/A	--	--	S/A	--	S/A	S/A	Yes
299-W21-2	--	--	--	--	S/A	--	--	S/A		S/A	S/A	S/A	S/A	S/A	Yes
299-W22-26	--	A	--	--	A	--	--	A	A	--	A	A	A	A	No; maintenance issue during 2012 (found to be dry during Feb 2013)
299-W22-45	--	A	--	--	A	--	--	A	--	A	--	A	A	A	Yes
299-W22-48	S	S	--	--	S	--	S	S	--	S	--	S	S	S	Yes (now dry)
299-W22-49	--	S	--	--	S	S	S	S	--	S	S	S	S	S	Yes
299-W22-69	--	--	--	--	A	--	--	A	--	--	A	A	--	A	Yes
299-W22-72	--	--	S/A	--	S/A	--	--	S/A	--	S/A	S/A	S/A	S/A	S/A	Yes
299-W22-83	--	Q/S	--	--	Q/S	--	--	Q/S	Q/S	Q/S	Q/S	Q/S	Q/S	Q/S	Yes
299-W22-86	--	--	--	S	S	--	--	S	S	--	--	S	--	S	Yes
299-W22-87	--	--	--	--	S/A	--	--	S/A	--	--	S/A	S/A	S/A	S/A	Yes
299-W22-88	--	--	--	--	S/A	--	--	S/A	--	--	S/A	S/A	S/A		Yes
299-W22-96				Q	Q			Q			Q	Q		Q	Yes
299-W23-4	S	--	--	--	--	--	--	S/A	--	--	--	S/A	S/A	S/A	Yes
299-W23-15	--	--	--	--	--	S/A	--	S/A	--	--	S/A	S/A	S/A	S/A	Yes
299-W23-21	--	--	--	--	--	--	--	Q/A	--	--	Q/A	Q/A	Q/A	Q/A	Yes
299-W26-13	--	--	--	--	BO	--	--	BO	--	--	--	BO	BO	BO	Not scheduled
299-W26-14	--	--	--	--	BE	--	BE	BE	--	--	BE	BE	BE	BE	Yes
699-30-66	--	--	--	S	S	--	--	S	--	--	--	S	S	S	Yes

Table 2-13. Monitoring Wells and Constituents for the 200-UP-1 Operable Unit

Well	Arsenic[a]	Cadmium	Carbon-14	Chromium	Iodine-129	Iron	Manganese	Nitrate and Fluoride	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium	Volatile Organic Analytes	Sampled as Scheduled in 2012?
699-32-62	--	--	--	BO	BO	--	--	BO	--	--	--	BO	--	--	Yes
699-32-72A	--	--	--	--	BO	--	--	BO	--	--	--	BO	--	BO	Not scheduled
699-32-76	--	--	--	BO	BO	--	--	BO	--	--	--	--	--	BO	Yes
699-33-74	--	--	--	A	A	--	--	A	--	--	A	A	A	A	Yes
699-33-75	--	--	--	S	S	--	--	S	--	--	--	S	S	S	Yes
699-33-76	--	--	--	A	A	--	--	A	--	--	--	--	--	A	Yes
699-34-72	--	--	S/A	--	S/A	--	--	S/A	--	S/A	S/A	S/A	S/A	S/A	Yes
699-35-66A	--	--		BO	BO	--	--	BO	--	--	--	BO	--	BO	Not scheduled
699-35-78A	A	--	--	--	--	--	--	A	--	--	--	--	A	A	Yes
699-36-61A	--	--	--	BE	BE	--	--	BE	--	--	--	BE	--	--	Yes
699-36-70A	--	--	--	--	A	--	--	A	--	--	A	A	A	A	Yes
699-36-70B	--	--	--	--	S/A	--	--	S/A	--	--	S/A	S/A	S/A	S/A	Yes
699-38-65	--	--	--	--	A	--	--	A	--	--	--	A	--	--	Yes
699-38-68A	--	--	--	--	BO	--	--	BO	--	--	BO	BO	BO	BO	Not scheduled
699-38-70B	--	--	--	--	S/A	--	--	S/A	--	--	S/A	S/A	S/A	S/A	Yes
699-38-70C	--	--	--	--	S/A	--	--	S/A	--	--	S/A	S/A	S/A	S/A	Yes
699-40-62	--	--	--	--	BO	--	--	BO	--	--	BO	BO	BO	BO	Not scheduled
699-40-65	--	--	--	--	S/A	--	--	S/A	--	--	--	S/A	--	S/A	Yes

Table 2-13. Monitoring Wells and Constituents for the 200-UP-1 Operable Unit

Well	Arsenic[a]	Cadmium	Carbon-14	Chromium	Iodine-129	Iron	Manganese	Nitrate and Fluoride	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium	Volatile Organic Analytes	Sampled as Scheduled in 2012?

Notes: Sampling requirements have been modified from *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit* (DOE/RL-92-76).

Wells listed in DOE/RL-92-76 that are now dry include the following: 299-W18-33, 299-W19-37, 299-W19-40, 299-W22-9, 299-W22-20, 299-W22-26, 299-W22-48, 299-W239, 299-W23-10, 299-W23-14 (replaced with well 299-W23-21), 699-35-70, and 699-38-70.

Well 299-W19-39 is included in DOE/RL-92-76 but is no longer sampled; the well is configured as an extraction well but is not operating and cannot be sampled (currently configured as a monitoring well for sampling during 2013).

a. Arsenic is no longer a required analyte beginning in fiscal year 2013.

b. The sample frequency for many wells was changed beginning in fiscal year 2013 (i.e., October 2012); these are denoted in this table by listing two frequencies, such as 'S/A' for semiannual changed to annual.

c. Not listed in DOE/RL-92-76 but sampled annually for monitoring of the uranium plume from the 216-U-1/2 Cribs.

d. Listed as "299-W19-47 (new well 'M')" in DOE/RL-92-76; assumed to be a typographical error. New well "M" is 299-W19-49.

e. Listed as "299-W19-50 (new well 'L')" in DOE/RL-92-76; was abandoned during drilling and replaced by 299-W19-101.

A = to be sampled annually

BE = to be sampled biennially, even fiscal years

BO = to be sampled biennially, odd fiscal years

Q = to be sampled quarterly

S = to be sampled semiannually

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	
299-E24-8	3-13	3-13		3-13	3-13	--	--	--	3-13	--	--	3-13		3-13	--	--	--	Not required
299-E26-10	--	--	--	A	A	--	--	--	A	--	--	--	--	--	--	--	--	Yes
299-E26-11	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	3-13	--	--	--	Not required but sampled under Liquid Effluent Retention Facility Permit
299-E27-7	--	--	--	A	A	--	--	A	A	--	--	--	--	A	--	--	--	Yes, except arsenic
299-E27-10	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	3-13	--	--	--	Not required, but sampled under LLWMA-2 and AEA
299-E27-14	--	--	--	A	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes
299-E27-15	--	--	--	--	A	--	--	A	--	--	A	--	--	--	A	--	--	Yes
299-E27-17	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	3-13	--	--	--	Not required, but some constituents sampled under 216-B-63 and modified CERCLA schedule
299-E27-18	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	3-13	--	--	--	Not required, but nitrate sampled under 216-B-63 plan
299-E27-155[a]	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
299-E28-2	A	--	--	A	A	A	A	A	A	--	A	A	--	--	A		--	Yes, except Cs-137
299-E28-5	A	--	--	3-13	3-13	A	A	--	3-13	A	--	3-13	--	3-13	--	--	--	Yes, except Cs-137 and Pu-239/240
299-E28-6	A	A	--	3-13	3-13	A	A	--	3-13	A	--	3-13	--	3-13	--	--	--	Yes, except Co-60, Pu-239, Sr-90
299-E28-8	A	--	--	--	--	A	A	A		A	--	--	--	--	--	--	--	Yes, except Pu-239/240
299-E28-13	--	--	--	3-13	3-13	--	3-13	--	3-13	3-13		3-13	--	--	--	--	--	Not required, but sampled

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	
299-E28-17	A	--	--	--	A	A	A	--	--	A	--	--	--	--	--	--	--	Yes, except Pu-239/240 and Sr-90
299-E28-18	--	--	--	A	A	--	--	--	A	A	--	A	--	A	--	--	--	Yes, except As, Gross Beta, and I-129
299-E28-21	--	--	--	--	--	--	--	--	--	A	--	--	--	--	--	--	--	Yes
299-E28-23	A	--	--	--	--	A	A	--	--	A	--	A	A	--	--	A	--	Scheduled, but not sampled
299-E28-24	A	--	--	--	--	A	A	--	A	A	--	A	A	--	--	A	--	Yes, except Am-241, Np-237
299-E28-25	A	--	--	A	A	A	A	--	A	A	--	A	A	A	--	A	--	Yes, except arsenic, Am-241, Np-237
299-E28-26	--	--	--	3-13	A	--	--	A	3-13	A	--	--	--	3-13	--	--	--	Yes
299-E28-27	A	--	--	A	A	A	A	A	3-13	A	--	--	--	--	--	--	--	Yes, except Cs-137 and Pu-239/240
299-E28-28	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under LLWMA-1
299-E32-2	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under LLWMA-1
299-E32-4	--	--	--	A	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes
299-E32-5	--	--	--	3-13	3-13	--	--	--	3-13	3-13	--	--	--	--	--	--	--	Not required but sampled under LLWMA-1
299-E32-6	--	--	--	3-13	A	--	--	A	3-13	3-13	--	--	--	--	--	--	--	Yes
299-E32-7	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under LLWMA-1
299-E32-8	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under LLWMA-1

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	
299-E32-9	--	--	3-13	A	A	--	--	--	3-13	--	--	--	--	--	--	--	--	Yes
299-E32-10	--	A	A	3-13	3-13	--	--	A	3-13	A	--	--	--	3-13	--	--	--	Yes
299-E33-7	A	A	A	A	A	--	--	A	A	A	--	A	--	--	--	--	--	Yes
299-E33-12	--	--	--	--	--	--	--	3-13	--	--	--	--	--	--	--	--	--	Not required but sampled under AEA program
299-E33-13	--	--	A	--	--	--	--	--	--	A	--	--	--	--	--	--	--	No, sampled for tritium based on flow reversal
299-E33-15	--	--	--	--	A	--	--	A	--		--	--	--	--	--	--	--	Yes
299-E33-16	--	--	--	A	A	--	--	A	--	A	--	--	--	--	--	--	--	Yes
299-E33-18	--	--	--	A	A	--	--	A	--	A	--	--	--	--	--	--	--	Yes, except for I-129
299-E33-26	--	A	A	3-13	3-13	--	--	A	3-13	A	--	3-13	--	--	--	--	--	Yes
299-E33-28	--	--	--	--	A	--	--	A	--	--	--	--	--	--	--	--	--	Yes
299-E33-29	--	--	--	3-13	3-13	--	--	3-13	3-13		--	--	--	--	--	--	--	Not required but sampled under LLWMA-1
299-E33-30	--	--	--	--	A	--	--	A	--	--	--	--	--	--	--	--	--	Yes
299-E33-32	--	--	--	3-13	3-13	--	--	3-13	3-13	--	--	--	--	--	--	--	--	Not required but sampled under WMA-B/BX/BY
299-E33-33	--	--	--	3-13	3-13	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	Not required but sampled under 216-B-63
299-E33-34	--	A	A	A	A	--	--	A	A	A	--	--	--	--	--	--	--	Yes

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	
299-E33-35	3-13	3-13	A	3-13	A	--	--	A	3-13	A	--	--	--	--	--	--	--	Yes
299-E33-37	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under 216-B-63
299-E33-38	--	A	A	A	A	A	A	A	A	A	--	A	--	A	--	--	--	Yes, except I-129, Pu-239/240, and Sr-90
299-E33-39	--	--	A	A	A	--	--	A	A	A	--	--	--	--	--	--	--	Yes
299-E33-41	3-13	3-13	3-13	3-13	3-13	--	--	A	3-13	A	--	--	--	--	--	--	--	Yes
299-E33-42	--	--	--	A	--	--	--	A	--	A	--	--	--	--	--	--	--	Yes, except I-129
299-E33-43	--	--	--	A	--	--	--	A	--	A	--	--	--	--	--	--	--	Yes, except I-129
299-E33-44	--	A	--	--	--	--	--	A	--	A	--	--	--	--	--	--	--	Yes
299-E33-50*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		No[b]
299-E33-205*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
299-E33-334	--	--	--	--	A	--	--	A	--	A	--	--	--	--	--	--	--	Yes
299-E33-335	--	--	--	--	--	A	--	A	--	--	--	--	--	--	--	--	--	Yes, except PU-239/240
299-E33-338	--	--	--	--	--	--	--	A	--	A	--	--	--	--	--	--	--	Yes
299-E33-340*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
299-E33-341*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
299-E33-342*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
299-E33-343*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	
299-E33-344*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
299-E33-345*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
299-E34-2	--	--	--	A	A	--	--	--	A	--	--	--	--	--	--	--	--	Yes
299-E34-9	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under LLWMA-2
699-44-39B	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under B Pond and modified CERCLA schedule
699-45-42	--	--	--	3-13	3-13	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under B Pond and modified CERCLA schedule
699-47-60	--	--	--	A	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes
699-48-50B*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
699-49-55A	A	A	A	A	A	A	A	A	A	A	--	A	--	--	--	--	--	Scheduled, but not sampled
699-49-57A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	--	--	--	Yes
699-49-57B	A	A	A	A	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes
699-50-56*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	Scheduled, but sample event shifted from October 2012 to April 2013
699-50-59*	--	--	A	A	A	--	--	A	A	A	A		--	--		--	--	Yes
699-52-55*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	Scheduled, but sample event shifted from December 2012 to April 2013
699-52-55B*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--	No[b]
699-53-47A	--	--	--	--	A	--	A	--	A	--	--	A	--	--	--	--	--	Scheduled, but sample collection unsuccessful

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	
699-53-47B	--	--	--	--	3-12	--	3-12	--	--	--	--	--	--	--	--	--	--	Yes
699-53-48A	--	--	--	A	A	--	A	--	A	--	--	A	--	--	A	--	--	Yes
699-53-55A	--	A	A	--	A	--	--	A	A	--	--	--	--	--	--	--	--	Not scheduled; possible conduit of downward contamination into Lower Rattlesnake Interbed and on list to decommission
699-53-55B	--	A	A	--	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes; except Co-60
699-53-55C	--	A	A	A	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes
699-54-45A	--	--	--	--	3-12	--	--	--	--	--	--	--	--	--	--	--	--	Yes
699-54-45B	--	--	--	--	3-12	--	--	--	--	--	--	--	--	--	--	--	--	Yes
699-54-48	--	--	--	--	--	--	3-12	--	--	--	--	--	--	--	--	--	--	Yes
699-54-49	--	--	--	--	A	--	A	--	A	--	--	A	--	--	--	--	--	Yes
699-55-50C	--	--	--	A	A	--	A	A	A	--	--	--	--	--	--	--	--	Yes
699-55-57	--	A	A	A	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes
699-55-60A	--	A	A	A	A	--	--	A	A	--	--	--	--	--	--	--	--	Yes
699-57-59	A	A	A	A	A	A	A	A	A	A	A	A	--	--	A	--	A	Yes, except Cs-137, Co-60, Pu-239/240, Sr-90, and TOC/TOX
699-59-58	A	A	A	A	A	A	A	A	A	A	A	A	--	--	A	--	A	Yes, except Cs-137, Co-60, Pu-239/240, Sr-90, and TOC/TOX
699-60-60	A	A	A	A	A	A	A	A	A	A	A	A	--	--	A	--	A	Yes, except Cs-137, Co-60, Pu-239/240, Sr-90, and TOC/TOX

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	
699-61-62	A	A	A	A	A	A	A	A	A	A	A	A	--	--	A	--	A	Yes, except Cs-137, Co-60, Cyanide, Pu-239/240, Sr-90, U, and TOC/TOX
699-61-66	A	A	A	A	A	A	A	A	A	A	A	A	--	--	A	--	A	Yes, except Cs-137, Co-60, Cyanide, Pu-239/240, Sr-90, U, and TOC/TOX
699-64-62	A	A	A	A	A	A	A	A	A	A	A	A	--	--	A	--	A	Yes, except Cs-137, Co-60, Cyanide, Pu-239/240, Sr-90, U, and TOC/TOX
699-65-50	--	--	--	--	--	--	--	3-13	--	--	--	--	--	--	--	--	--	Not required but sampled under modified CERCLA schedule
699-65-72	--	--	--	--	--	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under modified CERCLA schedule
699-66-58	--	--	--	--	--	--	--	3-13	3-13	--	--	--	--	--	--	--	--	Not required but sampled under modified CERCLA schedule
699-66-64	--	--	--	--	--	--	--	3-13	3-13	--	--	--	--	--	--	--	--	Not required but sampled under modified CERCLA schedule
699-70-68	--	--	--	--	--	--	--	3-13	3-13	--	--	--	--	--	--	--	--	Not required but sampled under modified CERCLA schedule
699-72-73	--	--	--	--	3-13	--	--	3-13	3-13	--	--	--	--	--	--	--	--	Not required but sampled under modified CERCLA schedule
699-73-61	--	--	--	--	--	--	--	--	3-13	--	--	--	--	--	--	--	--	Not required but sampled under modified CERCLA schedule

Table 2-14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit

Well	Contaminants of Concern										Supporting Constituents							Sampled as Scheduled in 2012?
	Cesium-137	Cobalt-60	Cyanide	Iodine-129	Nitrate	Plutonium-239/240	Strontium-90	Technetium-99	Tritium	Uranium	Alkalinity	Alpha/Beta	Americium-241	Arsenic	Metals (Filtered)	Neptunium-237	TOC/TOX	

Note: Sampling requirements are from *Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit* (DOE/RL-2001-49).

a. Well was not listed in DOE/RL-2001-49 but was added to the sampling schedule per *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit* (DOE/RL-2007-18). Wells were also sampled and analyzed for volatile organic analytes and semivolatile organic analytes.

b. Required under DOE/RL-2007-18; however, Am-241, As, Cs-137, Co-60, cyanide, Gross alpha, Gross Beta, Np-237, Pu-239/240, and Sr-90 are not scheduled. In addition, VOAs and semi VOAs are not scheduled.

3-xx = to be sampled triennially (every 3 years); xx indicates the fiscal year of sampling for a specified analyte
A = to be sampled annually
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
LLWMA = low-level waste management area
TOC = total organic carbon
TOX = total organic halides
VOA = volatile organic analyte

Table 2-15. Monitoring Wells and Constituents for 200-PO-1 Operable Unit Near-Field Wells

Well Number	Contaminants of Concern					Supporting Constituents					Sampled as Planned in 2012?	Comments
	Field Parameters	Iodine-129	Strontium-90	Technetium-99	Tritium	Gross Alpha	Anions[a]	Gross Beta	Metals[b]	Uranium		
299-E16-2	A	A	A	--	A	A	A	A	A	--	Yes	--
299-E17-1	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E17-12	A	A	A	--	A	A	A	A	A	--	Yes	--
299-E17-13	A	A	A	--	A	A	A	A	A	--	Yes	--
299-E17-14	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E17-16	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E17-18	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E17-19	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E17-23	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E17-25	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E18-1	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E23-1	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E24-16	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E24-18	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E24-20	A	A	A	A	A	A	A	A	A	--	Yes	--

Table 2-15. Monitoring Wells and Constituents for 200-PO-1 Operable Unit Near-Field Wells

Well Number	Contaminants of Concern					Supporting Constituents					Sampled as Planned in 2012?	Comments
	Field Parameters	Iodine-129	Strontium-90	Technetium-99	Tritium	Gross Alpha	Anions[a]	Gross Beta	Metals[b]	Uranium		
299-E24-22	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E24-23	A	A	A	A	A	A	A	A	A	A	Yes	--
299-E24-33	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E24-5	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-17	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E25-18	A	A	A	--	A	A	A	A	A	--	Yes	--
299-E25-19	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E25-2	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E25-20	A	A	A	--	A	A	A	A	A	--	Yes	--
299-E25-22	A	A	A	--	A	A	A	A	A	--	Yes	--
299-E25-28	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-29P	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-29Q	A	A	--	--	A	--	--	A	A	--	Yes	--
299-E25-236	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E25-3	A	A	A	--	A	A	A	A	A	--	Yes	--

Table 2-15. Monitoring Wells and Constituents for 200-PO-1 Operable Unit Near-Field Wells

Well Number	Contaminants of Concern					Supporting Constituents					Sampled as Planned in 2012?	Comments
	Field Parameters	Iodine-129	Strontium-90	Technetium-99	Tritium	Gross Alpha	Anions[a]	Gross Beta	Metals[b]	Uranium		
299-E25-32P	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-32Q	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-34	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-35	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-36	A	A	A	--	A	A	A	A	A	A	Yes	--
299-E25-37	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-39	A	A	A	A	A	A	A	--	A	A	No	Not Scheduled
299-E25-40	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E25-41	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E25-42	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E25-43	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-44	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-47	A	A	--	--	A	A	A	A	A	--	Yes	--
299-E25-6	A	A	A	--	A	A	A	A	A	--	Yes	--
299-E25-93	A	A	A	A	A	A	A	A	A	--	Yes	--

Table 2-15. Monitoring Wells and Constituents for 200-PO-1 Operable Unit Near-Field Wells

Well Number	Contaminants of Concern					Supporting Constituents					Sampled as Planned in 2012?	Comments
	Field Parameters	Iodine-129	Strontium-90	Technetium-99	Tritium	Gross Alpha	Anions[a]	Gross Beta	Metals[b]	Uranium		
299-E25-94	A	A	A	A	A	A	A	A	A	--	Yes	--
299-E26-4	A	A	A	--	A	A	A	A	A	--	Yes	--
699-37-47A	A	A	A	A	A	A	A	A	A	A	Yes	--
699-39-39	A	A	--	--	A	A	A	A	A	--	Yes	--
699-41-42	A	A	--	--	A	A	A	A	A	--	Yes	--
699-42-40A	A	A	--	--	A	A	A	A	A	--	Yes	--
699-42-42B	A	A	--	--	A	A	A	A	A	--	Yes	--
699-43-45	A	A	--	--	A	A	A	A	A	--	Yes	--
699-44-39B	A	A	--	--	A	A	A	A	A	--	Yes	--

Note: Sampling requirements are from *Sampling and Analysis Plan for the 200-PO-1 Groundwater Operable Unit* (DOE/RL-2003-04), as amended by TPA-CN-205, *Change Notice for Modifying Approved Documents/Workplans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: DOE/RL-2003-4, Revision 1, Sampling and Analysis Plan for the 200-PO-1 Operable Unit*, and *Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Operable Unit* (DOE/RL-2007-31), as amended by TPA-CN-2-253, *Change Notice for Modifying Approved Documents/Workplans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: DOE/RL-2007-31 Rev 0, Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Operable Unit*.

a. Anions; analytes include, but are not limited to, chloride, nitrate, and sulfate.

b. Metals; analytes include, but are not limited to, chromium, manganese, and vanadium.

A = to be sampled annually

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern				Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium	Field Parameters	Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
BC Cribs																		
299-E13-14	--	A	A	A	A	A	A	--	A	A	A	A	A	A	--	--	Yes	--
299-E13-5	--	A	A	A	A	A	A	--	A	A	A	A	A	A	--	--	Yes	--
299-E13-11	--	A	A	A	A	A	A	--	A	A	A	A	A	A	--	--	Yes	--
299-E13-19	--	A	A	A	A	A	A	--	A	A	A	A	A	A	--	--	Yes	--
Southeast Transect																		
699-10-54A	--	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-24-46	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-26-33	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-31-31	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	No	Not scheduled
699-32-22A	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-32-43	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-41-23	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-46-21B	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
River Transect																		
699-10-E12	--	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern				Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium	Field Parameters	Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
699-20-E12O	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-41-1A	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-46-4	A	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-S3-E12	--	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
699-S19-E13	--	A	A	A	A	A	A	--	--	A	A	A	--	--	--	A	Yes	--
Basalt-Confined Aquifer																		
299-E16-1	T	T	T	T	T	T	T	--	--	--	T	--	--	--	--	--	Not Scheduled	Sampled in May 2011, but not sampled for Iodine-129
699-13-1C	--	T	T	T	T	T	T	--	--	--	T	--	--	--	--	--	Yes	--
699-24-1P	--	T	T	T	T	T	T	--	--	--	T	--	--	--	--	--	Yes	--
699-32-22B	T	T	T	T	T	T	T	--	--	--	T	--	--	--	--	--	Yes	--
699-42-40C	T	T	T	T	T	T	T	--	--	--	T	--	--	--	--	--	Not Scheduled	Sampled in June 2011
699-S2-34B	--	T	T	T	T	T	T	--	--	--	T	--	--	--	--	--	Not Scheduled	Sampled in June 2011

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern				Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium	Field Parameters	Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
699-S11-E12AP	--	T	T	T	T	T	T	--	--	--	T	--	--	--	--	--	Yes	--
Far-Field General																		
499-S0-7	A	A	A	A	A	A	A	--	--	A	A	A	A	A	A	A	Yes	--
499-S0-8	A	A	A	A	A	A	A	--	--	A	A	A	A	A	A	A	Yes	--
499-S1-8J	A	A	A	A	A	A	A	--	--	A	A	A	A	A	A	A	Yes	--
699-12-4D	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Yes	Sampling for FY13 completed in Oct 2012
699-13-1A	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-13-3A	--	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-14-38	--	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-17-5	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern			Field Parameters	Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium		Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
699-19-43	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-20-20	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-20-E12S	--	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-20-E5A	--	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-21-6	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-2-3	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Yes	Sampling for FY13 completed in Dec 2012
699-22-35	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Yes	Sampling for FY13 completed in Oct 2012
699-24-34C	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-25-33A	A	A	A	A	A	A	--	--	--	A	A	A	A	A	A	A	No	Not Scheduled
699-26-15A	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern			Field Parameters	Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium		Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
699-26-35A	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Yes	Sampling for FY13 completed in Oct 2012
699-2-6A	--	A	A	A	--	A	--	--	--	--	--	--	--	--	--	--	Yes	--
699-2-7	--	A	A	A	--	A	--	--	--	--	--	--	--	--	--	--	Yes	--
699-28-40	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Yes	Sampling for FY13 completed in Dec 2012
699-29-4	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-31-11	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-33-56	--	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-34-41B	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-34-42	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-35-9	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-37-43	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern			Field Parameters	Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium		Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
699-37-E4	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-38-15	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-40-1	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-40-33A	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Not scheduled	Next scheduled sampling event FY13
699-40-36	T	T	T	T	--	T	--	--	--	--	--	--	--	--	--	--	Yes	Sampling for FY13 completed in Oct 2012
699-41-40	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-41-42	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-42-12A	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-42-39A	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-42-39B	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern			Field Parameters	Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium		Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
699-42-40A	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not Scheduled	Next scheduled sampling event FY13
699-43-3	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-45-42	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Yes	Sampling for FY13 completed in Oct 2012
699-47-5	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-48-7A	--	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-49-13E	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-50-28B	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-52-19	--	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-8-17	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Yes	Sampling for FY13 completed in Oct 2012

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern			Field Parameters	Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium		Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
699-8-25	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-9-E2	T	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-S12-3	--	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-S19-E14	--	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-S3-25	--	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-S6-E14A	--	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-S6-E4A	--	T	T	T	--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
699-S6-E4B	--	T	T		--	T	--		--	--	--	--	--	--		--	Yes	Sampling for FY13 completed in Dec 2012
699-S8-19	--	T	T		--	T	--		--	--	--	--	--	--		--	Not scheduled	Next scheduled sampling event FY13
Aquifer Tubes																		
85-D	A	--	A	A	A	A	A	--	--	--	--	--	A	--	--	--	Yes	--

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern				Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium	Field Parameters	Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		
86-D	A	--	A	A	A	A	A	--	--	--	--	--	A	--	--	--	Yes	--
C6353	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--
C6356	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--
C6359	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--
C6362	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--
C6365	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	No	No; cannot be located
C6368	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--
C6371	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	No	No yield 10/15/12; attempted to unplug but no yield again 11/5/12
C6374	--	--	--	A	--	--	--	--	--	--	--	--	--	--	--	--	Yes	--
C6375	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--
C6380	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--
C6383	--	--	--	A	--	--	--	--	--	--	--	--	--	--	--	--	Yes	--
C6384	A	--	A	A	A	A	A	A	--	--	--	--	A	--	--	--	Yes	--

Table 2-16. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit Far-Field Wells

Well or Aquifer Tube Name	Contaminants of Concern			Field Parameters	Supporting Constituents												Sampled as Planned in 2012?	Comments
	Iodine-129	Nitrate	Tritium		Gross Alpha	Anions[a]	Gross Beta	Hexavalent Chromium	Cyanide	Gamma	Metals[b]	Strontium-90	Technetium-99	Uranium	Ammonia	Volatile Organic Analytes		

Note: Sampling requirements for wells are from *Sampling and Analysis Plan for the 200-PO-1 Groundwater Operable Unit* (DOE/RL-2003-04), and *Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Operable Unit* (DOE/RL-2007-31), as amended by TPA-CN-2-253, *Change Notice for Modifying Approved Documents/Workplans In Accordance with the Tri-Party Agreement Action Plan, Section 9.0, Documentation and Records: DOE/RL-2007-31 Rev 0, Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Operable Unit*.

a. Anions; analytes include, but are not limited to, chloride, nitrate, and sulfate.

b. Metals; analytes include, but are not limited to, chromium, manganese, and vanadium.

A = to be sampled annually

FY = fiscal year

T = to be sampled triennially

3 Supporting Information for RCRA and Other Monitored Facilities

This chapter provides supplemental information for the *Resource Conservation and Recovery Act of 1976* (RCRA) and other regulated units on the Hanford Site that require groundwater monitoring, excluding CERCLA operable units (discussed in Chapter 2). Site-specific information for each facility included in this chapter is provided in DOE/RL-2013-22, under the respective groundwater interest area in which the facility is located.

Groundwater monitoring under RCRA continued during the reporting period at 26 waste management areas. Estimates of groundwater velocity, hydrologic properties, and associated references are shown in Table 3-1 for the RCRA sites.

To determine if a waste site has adversely affected groundwater quality under RCRA interim status regulations (WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards;" 40 CFR 265.93, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Preparation, Evaluation, and Response"), concentrations of indicator parameters in downgradient wells are compared to statistically derived critical mean values. The indicator parameters under interim status are specific conductance, pH, total organic carbon (TOC), and total organic halides (TOX). The critical values to which the indicator parameters are compared represent 99 percent prediction limits, which are calculated for each facility based on samples from upgradient wells. The methodology used to calculate the critical value is the Student's t-test in accordance with 40 CFR 265.93(b). The formula and individual parameters for the test are provided in Section 7.1 of PNNL-13080, *Hanford Site Groundwater Monitoring: Setting, Sources and Methods*. The upper prediction limits (and lower limit in the case of pH) also are known as critical mean values.

Critical mean values are recalculated annually or if the number of analyses changes. Annual recalculation accounts for changing background conditions. Changes in the number of analyses are usually the result of changes in monitoring well networks (e.g., wells are added or deleted). If changes occur in a monitoring well network, critical mean values for that facility are recalculated for subsequent semiannual sampling events using the new well network. Details for the critical mean values for RCRA sites, and comparison values for other monitored facilities, are provided in Appendix B of DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*.

Table 3-2 lists the comparison values (critical mean values and limits of quantitation) used during the reporting period. Tables 3-3 through 3-44 provide supporting information for the RCRA sites.

This chapter also provides constituent lists, well network configurations, and other ancillary information for regulated facilities that fall outside of the RCRA program. Some network wells in these facilities are shared with RCRA facilities. Tables 3-45 through 3-51 list the constituents and/or the results summaries for these facilities.

Table 3-1. Estimates of Groundwater Flow Rates at Hanford Site RCRA Facilities

Site	Flow Direction	Flow Rate (m/day)	Method	Hydraulic Conductivity (m/day) (Source)	Effective Porosity[a]	Gradient[b]	Comments
116-N-1 LWDF	North-northwest	0.04 to 0.71	Darcy	6.1 to 37 (PNL-8335)	--	1.9×10^{-3}	Trend surface analysis.
120-N-1 and 120-N-2	North-northwest	0.02 to 0.31	Darcy	6.1 to 37 (PNL-8335)	--	8.3×10^{-4}	Trend surface analysis. Approximation; gradient variable due to injection wells south and west.
116-N-3 LWDF	North	0.03 to 0.46	Darcy	6.1 to 37 (PNL-8335)	--	1.2×10^{-3}	Trend surface analysis.
116-H-6 Evaporation Basins	East	0.07 to 2.0	Darcy	15 to 140 (PNL-6728)	--	1.4×10^{-3}	Trend surface analysis, wells 199-H4-5, 199-H4-6, 199-H4-1.
216-A-29 Ditch	Southeast	0.001 to 0.004	Darcy	18 (WHC-SD-EN-DP-047)	--	2.4×10^{-5}	Gradient assumed same as 216-A-36B and IDF. Flow direction inferred from plume maps.
216-A-36B Crib	East	0.001 to 0.7	Darcy	18 to 3,000 (PNNL-11523)	--	2.4×10^{-5}	Trend surface analysis.
216-A-37-1 Crib	Southeast	0.001 to 0.7	Darcy	18 to 3,000 (PNNL-11523)	--	2.4×10^{-5}	Gradient assumed same as 216-A-36B and IDF.
216-B-3 Pond	Southwest	0.006	Darcy	1.0 (WHC-SD-EN-EV-002, PNL-10195)	0.25	0.00154	Gradient based on trend surface analysis using wells 699-42-42B, 699-43-44, 699-43-45, 699-44-39B, and 699-45-42. Trend surface derived by least squares regression of a plane to points in 3-dimensional space (Davis, 2002, *Statistics and Data Analysis in Geology*).

Table 3-1. Estimates of Groundwater Flow Rates at Hanford Site RCRA Facilities

Site	Flow Direction	Flow Rate (m/day)	Method	Hydraulic Conductivity (m/day) (Source)	Effective Porosity[a]	Gradient[b]	Comments
216-B-63 Trench	Southeast	0.05 to 0.06 (Darcy) 0.5 (Plume Movement)	Darcy and Plume Movement	180 to 230	0.1	2.8×10^{-5}	Gradient based on monthly average between January 2012 and October 2012 at 14 well low-gradient networks (ECF-200EAST-12-0086). Effective porosity based on discussion in SGW-54508. Hydraulic conductivity based on field tests documented in SGW-44329. Note migrating plume towards this area suggests much greater hydraulic conductivity values, possibly as great as 2,000 m/day.
216-S-10 Pond and Ditch	May 2012: East-southeast	0.18	Darcy	10.4 (WHC-SD-EN-DP-052)	0.15	2.6×10^{-3}	Trend surface analysis.
316-5 Process Trenches	Southeast	11	Darcy	9,000 (PNNL-17708)	0.17	2.1×10^{-4}	Trend surface analysis.
IDF	East	0.005 to 0.02	Darcy	68 to 75 (PNNL-13652, PNNL-11957)	--	2.4×10^{-5}	Trend surface analysis.
Liquid Effluent Retention Facility	Southeast-south-southwest	0.1	Darcy and Plume Movement	36.2 to 39.8 (PNNL-14804)	0.1	2.8×10^{-4} 2012 Average	Gradient based on monthly average from February 2012 to December 2012. Calculations through September 2012 are provided in ECF-200EAST-12-0086. Gradient calculation derived a south-southeast azimuth of 187° from north. The gradient reduced near wells 299-E26-10, 299-E26-77, and 299-E26-79. These wells also appear to be effected by plume migration from the northwest. Thus, gradient determinations may be suspect. The effective porosity derived by PNNL-14804 was questionable. Therefore, effective porosity derived in SGW-54508 is

Table 3-1. Estimates of Groundwater Flow Rates at Hanford Site RCRA Facilities

Site	Flow Direction	Flow Rate (m/day)	Method	Hydraulic Conductivity (m/day) (Source)	Effective Porosity[a]	Gradient[b]	Comments
							used because it was derived from pumping tests which stressed the aquifer more significantly.
LLWMA-1	Southeast	Variable. Ranges from 0.5 near northwest corner to 0.07 near southwest corner.	Darcy and Plume Movement	Variable Ranges from 1,785 near northwest corner to 240 (PNL-8337) near southwest corner	0.1	2.8×10^{-5} 2012 Average	Gradient (G) based on monthly average between January 2012 and October 2012 at 14 well low-gradient networks (ECF-200EAST-12-0086). Effective porosity (n_e) based on discussion in SGW-54508. Flow rate in northwest corner of LLWMA-1 based on nitrate and technetium-99 migration from BY Cribs between August 2011 and August 2012. Hydraulic conductivity (K) derived from the three parameters discussed using the formula $V=(K*G)/n_e$ (Driscoll, 1986, *Groundwater and Wells*) and other field tests discussed in PNL-8337.
LLWMA-2	Southeast	Variable. Ranges from 0.5 near west side of LLWMA-2 to uncertain on east side as low-gradient network is not sufficient to derive a gradient.	Darcy and Plume Movement	1,100 to 2,100	0.1	Variable. Ranges from 2.8×10^{-5} 2012 average on west side of WMA to uncertain on east side as low-gradient network is not sufficient to derive a gradient.	Gradient (G) based on monthly average between January 2012 and Octobrer 2012 at 14 well low-gradient networks (ECF-200EAST-12-0086). Effective porosity (n_e) based on discussion in SGW-54508. Flow rate near west LLWMA-2 boundary based on nitrate and technetium-99 migration from BY Cribs between August 2011 and August 2012. Hydraulic conductivity (K) derived from the three previous hydraulic parameters discussed using the formula $V=(K*G)/n_e$ (Driscoll, 1986, *Groundwater and Wells*) and from pumping tests discussed in SGW-54508.

Table 3-1. Estimates of Groundwater Flow Rates at Hanford Site RCRA Facilities

Site	Flow Direction	Flow Rate (m/day)	Method	Hydraulic Conductivity (m/day) (Source)	Effective Porosity[a]	Gradient[b]	Comments
LLWMA-3	East-northeast	0.04 to 0.15	Darcy	2.5 to 10 (PNNL-14753)	0.1 (PNNL-14753)	1.5×10^{-3}	Trend surface analysis.
LLWMA-4	East-northeast	0.07 to 0.27	Darcy	2.5 to 10 (PNNL-14753)	0.1 (PNNL-14753)	2.7×10^{-3}	Trend surface analysis.
NRDWL	East-southeast	0.21 to 1.9	Darcy	518 to 1,524 (WHC-EP-0021)	--	1.8×10^{-5}	Trend surface analysis.
WMA A-AX	Southeast	Indeterminate	NA	1,981 (PNL-8337, WHC-SD-EN-TI-019)	NA	Indeterminate	Uncertainty with gradient and rate of flow due to lack of corrected groundwater level measurements. Flow direction inferred from plume maps.
WMA B-BX-BY	Southeast	0.5	Darcy and Plume movement	1,785	0.1	2.8×10^{-5} 2012 Average	Gradient (G) based on monthly average between January 2012 and October 2012 at 14 well low-gradient networks. Effective porosity (n_e) based on discussion in SGW-54508. Flow rate based on nitrate and technetium-99 migration from BY Cribs between August 2011 and August 2012. Hydraulic conductivity (K) derived from the three parameters discussed using the formula $V=(K*G)/n_e$ (Driscoll, 1986, *Groundwater and Wells*).

Table 3-1. Estimates of Groundwater Flow Rates at Hanford Site RCRA Facilities

Site	Flow Direction	Flow Rate (m/day)	Method	Hydraulic Conductivity (m/day) (Source)	Effective Porosity[a]	Gradient[b]	Comments
WMA C	Southeast	0.014 to 0.95 Best estimate for 2012: 0.08 to 0.12	See comment	100 to 2,100	0.1	Range: 1.4×10^{-5} to 4.5×10^{-5} 2012 Average 2.8×10^{-5}	See SGW-54675 for detailed discussion of hydraulic parameter selection criteria.
WMA S-SX	East	0.096	Darcy	6.1 (PNNL-13514, PNNL-14113, PNNL-14186)	0.12	1.9×10^{-3}	Trend surface analysis.
WMA T	East	0.12 to 0.20	Darcy	6.11 to 9.69 (PNNL-17732)	0.1	2.0×10^{-3}	Trend surface analysis. Approximation. Flow direction and gradient influenced by groundwater extraction south and west of the WMA.
WMA TX-TY	Variable	NA	NA	0.07 to 19.9 (PNNL-18279)	0.18 (DOE/RL-2009-38)	NA	Not calculated. Flow direction and rate influenced by 200 West pump-and-treat system.
WMA U	Early 2012: East-northeast	0.089	Darcy	6.12 (PNNL-13378)	0.17	2.5×10^{-3}	Trend surface analysis.

Table 3-1. Estimates of Groundwater Flow Rates at Hanford Site RCRA Facilities

Site	Flow Direction	Flow Rate (m/day)	Method	Hydraulic Conductivity (m/day) (Source)	Effective Porosity[a]	Gradient[b]	Comments
	July 2012: East	Not estimated	NA	NA	NA	1.8×10^{-3}	Trend surface analysis.

a. Effective porosity assumed to be between 0.1 and 0.3, a representative range for the unconfined aquifer system, unless otherwise noted.

b. March or April 2012.

c. Flow direction is based on those determined on a regional basis.

IDF = Integrated Disposal Facility

LLWMA = low-level waste management area

LWDF = Liquid Waste Disposal Facility

NA = not applicable

NRDWL = Nonradioactive Dangerous Waste Landfill

RCRA = *Resource Conservation and Recovery Act of 1976*

WMA = waste management area

Table 3-2. Monitoring Wells and Constituents for 100-N Area Units

Well Number[a]	Comment	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters				Sampled as Scheduled in 2012?
			Specific Cond. (Field)	pH (Field)	TOC	TOX	Alkalinity	Alpha[c]	Anions	Metals (Filtered)	
116-N-1 (1301-N) Liquid Waste Disposal Facility											
199-N-105A	--	C	S	S	S	S	A	--	A	A	Yes
199-N-2	--	P	S	S	S	S	A	--	A	A	Yes
199-N-3	--	P	S	S	S	S	A	--	A	A	Yes
199-N-34	--	P	S	S	S	S	A	--	A	A	Yes
199-N-57	--	C	S	S	S	S	A	--	A	A	Yes
120-N-1 and 120-N-2 (1324-N/NA) Facilities											
199-N-71	--	C	S	S	S	S	A	--	A	A	Yes
199-N-72	--	C	S	S	S	S	A	--	A	A	Yes
199-N-73	--	C	S	S	S	S	A	--	A	A	Yes
199-N-77	Bottom of aquifer; no statistics	C	S	S	S	S	A	S	A	A	Yes
199-N-165	--	C	S	S	S	S	A	A	A	A	Yes
116-N-3 (1325-N) Liquid Waste Disposal Facility											
199-N-28	Information only; no statistics	P	S	S	S	S	A	--	A	A	Yes
199-N-32	--	P	S	S	S	S	S	--	S	S	Yes
199-N-41	--	P	S	S	S	S	A	--	A	A	Yes
199-N-74	--	C	S	S	S	S	A	--	A	A	Yes
199-N-81	--	C	S	S	S	S	A	--	A	A	Yes

Notes: Requirements are from *Groundwater Monitoring Plan for the 1301-N, 1324-N/NA, and 1325-N RCRA Facilities* (PNNL-13914) and the Hanford Facility RCRA Permit modification (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italics*** indicate upgradient well.

b. Quadruplicate samples collected during each sampling event.

c. Monitored for the *Atomic Energy Act of 1954.*

A = to be sample annually

C = constructed as a resource protection well in accordance with WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells”

P = constructed prior to WAC requirements

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-3. 116-N-1 (1301-N) Liquid Waste Disposal Facility Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	5.31 - 10.17	7.07 to 8.27	No	None
Specific conductance (µS/cm)	2215	447 to 1281	No	None
Total organic carbon (µg/L)	2398	224 to 1330	No	None
Total organic halides (µg/L)	26.1	<5 to 16.6	No	None

Table 3-4. 120-N-1 and 120-N-2 Facilities (1324-N/NA) Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.60 - 8.43	8.02 to 8.59	No*	None
Specific conductance (µS/cm)	585	395 to 967	Yes	199-N-72, 199-N-73, 199-N-165
Total organic carbon (µg/L)	679 (LOQ = 930 1^{st} quarter; 850 3^{rd} quarter)	208 to 918	No	None
Total organic halides (µg/L)	12.9 (LOQ = 25.8 1^{st} quarter; 22.2 3^{rd} quarter)	<5 to 19.1	No	None

*Average of quadruplicates is below critical mean value.

LOQ = limit of quantitation

Table 3-5. 116-N-3 (1325-N) Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.48 - 8.63	7.77 to 8.31	No	None
Specific conductance (µS/cm)	463	412 to 573	Yes	199-N-32, 199-N-41, 199-N-81
Total organic carbon (µg/L)	NC (LOQ = 930 1^{st} quarter; 850 3^{rd} quarter)	140 to 544	No	None
Total organic halides (µg/L)	18.7 (LOQ = 25.8 1^{st} quarter; 22.2 3^{rd} quarter)	ND to 7.31	No	None

LOQ = limit of quantitation

NC = not calculated because proportion non-detects is greater than 50%

Table 3-6. Monitoring Wells and Constituents for 183-H (116-H-6) Evaporation Basins

Well Number	Comment	WAC-Compliant	Permit-Specified					Other Parameters			Sampled as Scheduled in 2012?
			Chromium (Filtered)	Nitrate	Technetium-99[a]	Fluoride	Uranium[a]	Alkalinity	Anions	Metals (Filtered)	
199-H4-12A	Extraction well	C	A	A	A	A	A	A	A	A	Yes
199-H4-12C	Extraction well; Ringold Formation Upper Mud	C	A	A	A	A	A	A	A	A	Yes
199-H4-3/ 199-H4-84[b]	Extraction well	P	A	A	A	A	A	A	A	A	Yes
199-H4-8	--	C	A	A	A	A	A	A	A	A	Yes

Notes:

Requirements are from *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins* (PNNL-11573) and the 2008 Hanford Facility RCRA Permit modification (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. Radionuclides are not typically subject to RCRA monitoring but are included in the current Hanford Facility RCRA Permit (WA7890008967) for this facility.

b. Permit modification was submitted to Washington State Department of Ecology to replace 199-H4-3 (being decommissioned) with 199-H4-84. 199-H4-3 was sampled as scheduled for 183-H in 2012. 199-H4-84 was not sampled for all 183-H constituents.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

WAC = *Washington Administrative Code*

Table 3-7. Monitoring Wells and Constituents for 216-A-29 Ditch

Well Number[a]	Comment	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters				Sampled as Scheduled in 2012?
			Specific. Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Anions	Metals	Phenols	
299-E25-26	--	C	S	S	S	S	S	S	A	A	No[c]
299-E25-28	Deep unconfined; no statistics	C	A	A	A	A	A	A	A	A	Yes
299-E25-32P	--	C	S	S	S	S	S	S	A	A	Yes
299-E25-34		C	A	A	A	A	A	A	A	A	Yes
299-E25-35	--	C	S	S	S	S	S	S	A	A	Yes
299-E25-48	--	C	S	S	S	S	S	S	A	A	Yes
299-E26-12	--	C	A	A	A	A	A	A	A	A	Yes
299-E26-13	--	C	S	S	S	S	S	S	A	A	Yes
699-43-45	--	C	S	S	S	S	S	S	A	A	Yes

Notes: Requirements are from *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch* (DOE/RL-2008-58).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. Upgradient well(s) are noted in ***bold italics***.

b. Quadruplicate samples were collected during each sampling event.

c. Well was not sampled since 2009 due to pump issues and work restrictions related to overhead power lines.

A = to be sampled annually

C = constructed as a resource protection well in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-8. 216-A-29 Ditch Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.58 - 8.82	7.95 to 8.38	No	None
Specific conductance (µS/cm)	387	231 to 763	Yes	299-E25-35, 299-E25-48
Total organic carbon (µg/L)	664	<100 to 436	No	None
Total organic halides (µg/L)	NC (LOQ = 22.5 2nd quarter; 21.8 4th quarter)	<5 to 15.4	No	None

LOQ = limit of quantitation

NC = not calculated because proportion non-detects is greater than 50%

Table 3-9. Monitoring Wells and Constituents for 216-A-36B Crib

Well Number[a]	WAC-Compliant	Contamination Indicator Parameters[b]				Supporting Constituents				Sampled as Scheduled in 2012?
		pH	Specific Conductance	TOC	TOX	Anions[c]	Metals[c]	Alkalinity	Phenols	
299-E17-14	C	S	S	S	S	A	A	A	A	Yes
299-E17-16	C	S	S	S	S	A	A	A	A	Yes
299-E17-18	C	S	S	S	S	A	A	A	A	Yes
299-E17-19	C	S	S	S	S	A	A	A	A	Yes

Notes: Requirements for 216-A-36B Crib are from *Interim Status Groundwater Monitoring Plan for the 216-A-36B PUREX Plant Crib* (DOE/RL-2010-93).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italic*** indicates upgradient well.

b. Quadruplicate replicates were collected during each sampling event.

c. Anions analysis includes, at a minimum, nitrate and the groundwater quality parameters chloride and sulfate. Metals analysis includes, at a minimum, calcium, magnesium, potassium, and sodium, as well as the groundwater quality parameters iron and manganese.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-10. 216-A-36B Crib Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.64 - 8.19	7.89 to 8.06	No	None
Specific conductance (µS/cm)	795	540 to 688	No	None
Total organic carbon (µg/L)	1479	<100 to 400	No	None
Total organic halides (µg/L)	69.8	<5 to 18.8	No	None

Table 3-11. Monitoring Wells and Constituents for 216-A-37-1 Crib

Well Number[a]	WAC-Compliant	Contamination Indicator Parameters[b]				Supporting Constituents				Sampled as Scheduled in 2012?
		pH	Specific Conductance	TOC	TOX	Anions[c]	Metals[c]	Alkalinity	Phenols	
299-E25-17	P	S	S	S	S	A	A	A	A	Yes
299-E25-19	P	S	S	S	S	A	A	A	A	Yes
299-E25-20	P	S	S	S	S	A	A	A	A	Yes
299-E25-47	C	S	S	S	S	A	A	A	A	Missed October 2012

Notes: Requirements for 216-A-37-1 Crib are from *Interim Status Groundwater Monitoring Plan for the 216-A-37-1 PUREX Plant Crib* (DOE/RL-2010-92).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italic*** indicates upgradient well.

b. Quadruplicate samples were collected during each sampling event.

c. Anions analysis includes, at a minimum, the groundwater quality parameters chloride and sulfate. Metals analysis includes, at a minimum, calcium, magnesium, potassium, and sodium, as well as the groundwater quality parameters iron and manganese.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-12. 216-A-37-1 Crib Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.63 – 9.16	7.4 to 8.5	Yes (low)	299-E25-19
Specific conductance (µS/cm)	633	350 to 471	No	None
Total organic carbon (µg/L)	3402	<100 to 258	No	None
Total organic halides (µg/L)	32.9	<5 to 6.65	No	None

Table 3-13. Monitoring Wells and Constituents for 216-B-3 Pond

Well Number[a]	Comment	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters						Sampled as Scheduled in 2012?
			Specific Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Arsenic	Anions	Cadmium	Metals	Phenols	
699-42-42B	Bottom of aquifer	C	S	S	S	S	A	A	A	A	A	A	Yes
699-43-44	--	C	S	S	S	S	A	A	A	A	A	A	Yes
699-43-45	--	C	S	S	S	S	A	A	A	A	A	A	Yes
699-44-39B	--	C	S	S	S	S	A	A	A	A	A	A	Yes

Notes: Requirements are from *Interim Status Groundwater Monitoring Plan for the 216-B-3 Pond* (DOE/RL-2008-59).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. Upgradient well is noted by ***bold italic***.

b. Quadruplicate samples were collected during each sampling event.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-14. 216-B-3 Pond Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.38 - 8.72	7.69 to 8.38	No	None
Specific conductance (µS/cm)	344	245 to 303	No	None
Total organic carbon (µg/L)	NC (LOQ = 930 1st quarter; 850 3rd quarter)	<100 to 212	No	None
Total organic halides (µg/L)	NC (LOQ = 25.8 1st quarter; 22.2 3rd quarter)	<5 to 20.9	No	None

LOQ = limit of quantitation

NC = not calculated because proportion non-detects is greater than 50%

Table 3-15. Monitoring Wells and Constituents for 216-B-63 Trench (April Semiannual Event)

Well Number[a]	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters				Sampled as Scheduled in 2012?
		Specific Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Anions	Metals	Phenols	
299-E27-11	C	S	S	S	S	A	A	A	A	Yes
299-E27-16	C	S	S	S	S	A	A	A	A	Yes
299-E27-17	C	S	S	S	S	A	A	A	A	Yes
299-E27-18	C	S	S	S	S	A	A	A	A	Yes
299-E27-19	C	S	S	S	S	A	A	A	A	Yes
299-E33-37	C	S	S	S	S	A	A	A	A	Yes
299-E34-10	C	S	S	S	S	A	A	A	A	Yes

Table 3-15. Monitoring Wells and Constituents for 216-B-63 Trench (April Semiannual Event)

Well Number[a]	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters				Sampled as Scheduled in 2012?
		Specific Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Anions	Metals	Phenols	

Notes: Requirements are from *Interim Status Groundwater Monitoring Plan for the 216-B-63 Trench* (DOE/RL-2008-60, Rev. 0).

Wells completed at the top of the unconfined aquifer.

a. Upgradient wells are noted by ***bold italics***.

b. Quadruplicate samples were collected during each sampling event.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-16. Monitoring Wells and Constituents for 216-B-63 Trench (October Semiannual Event)

Well Number[a]	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters				Sampled as Scheduled in 2012?
		Specific Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Anions	Metals	Phenols	
299-E27-16	C	S	S	S	S	A	S	S	S	Yes
299-E27-18	C	S	S	S	S	A	S	S	S	Yes
299-E27-19	C	S	S	S	S	A	S	S	S	Yes
299-E33-33	C	S	S	S	S	A	S	S	S	Yes
299-E34-8	C	S	S	S	S	A	S	S	S	Yes[c]
299-E34-12	C	S	S	S	S	A	S	S	S	Yes

Table 3-16. Monitoring Wells and Constituents for 216-B-63 Trench (October Semiannual Event)

Well Number[a]	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters				Sampled as Scheduled in 2012?
		Specific Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Anions	Metals	Phenols	

Notes: Requirements are from *Interim Status Groundwater Monitoring Plan for the 216-B-63 Trench* (DOE/RL-2008-60, Rev. 1).

Wells completed at the top of the unconfined aquifer.

a. Upgradient wells are noted by ***bold italics***.

b. Quadruplicate samples were collected during each sampling event.

c. Added to well network in November 2012 after assessment of the well and paperwork documenting acceptance to the well access list as required by CH2M HILL Plateau Remediation Company procedures.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells”

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-17. 216-B-63 Trench Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.61 - 8.51	7.89 to 8.27	No	None
Specific conductance (µS/cm)	1151	418 to 547	No	None
Total organic carbon (µg/L)	996	101 to 302	No	None
Total organic halides (µg/L)	NC (LOQ = 22.5 2nd quarter; 21.8 4th quarter)	<5 to 8.95	No	None

LOQ = limit of quantitation

NC = not calculated because proportion non-detects is greater than 50%

Table 3-18. Monitoring Wells and Constituents for 216-S-10 Pond and Ditch

Well Number[a]	Comment	WAC-Compliant	Contamination Indicator Parameters[b]				Other Parameters								Sampled as Scheduled During 2012?
			Specific Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Anions	Metals	Hexavalent Chromium	Mercury	VOAs	PCBs	Phenols	
299-W26-13	--	C	S	S	S	S	S	S	S	S	S	A	A	A	Yes
299-W26-14	--	C	A	A	A	A	A	A	A	A	A	A	A	A	Yes
299-W27-2	Bottom of aquifer; no statistics	C	A	A	A	A	A	A	A	A	A	A	A	A	Yes
699-32-76	--	C	S	S	S	S	S	S	S	S	S	A	A	A	Yes
699-33-75	--	C	S	S	S	S	S	S	S	S	S	A	A	A	Yes
699-33-76	--	C	S	S	S	S	S	S	S	S	S	A	A	A	Yes

Notes: Requirements are from *Interim Status Groundwater Monitoring Plan for the 216-S-10 Pond and Ditch* (DOE/RL-2008-61).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. Upgradient well is noted by ***bold italic***.

b. Quadruplicate samples were collected during each sampling event.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-19. 216-S-10 Pond and Ditch Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	6.54 - 8.93	7.44 to 8.19	No	None
Specific conductance (µS/cm)	351	247 to 352	No*	None
Total organic carbon (µg/L)	2,638	<100 to 196	No	None
Total organic halides (µg/L)	60	<5 to 19.6	No	None

*Average of quadruplicates below critical mean value.

Table 3-20. Monitoring Wells and Constituents for 316-5 Process Trenches

Well Number	Comment	WAC-Compliant	*cis*-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Uranium*	Sampled as Scheduled in 2012?
399-1-10A	--	C	S	S	S	S	Yes
399-1-10B	Lower unconfined	C	S	S	S	S	Yes
399-1-16A	--	C	S	S	S	S	Yes
399-1-16B	Lower unconfined	C	S	S	S	S	Yes
399-1-17A	--	C	S	S	S	S	Yes
399-1-17B	Lower unconfined	C	S	S	S	S	Yes
399-1-18A	--	C	S	S	S	S	Yes
399-1-18B	Lower unconfined	C	S	S	S	S	Yes

Notes: Requirements are from *Groundwater Monitoring Plan for the 300 Area Process Trenches* (WHC-SD-EN-AP-185) and the Hanford Facility RCRA Permit modification (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*, *Dangerous Waste Portion*, *Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

* Radionuclides are not typically subject to RCRA monitoring but are included in the current Hanford Facility RCRA Permit (WA7890008967) for this facility.

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled four times semiannually (8 months)

WAC = *Washington Administrative Code*

Table 3-21. Monitoring Wells and Constituents for the Integrated Disposal Facility

Well Number[a]	WAC-Compliant	Indicator Parameters					Other Parameters								Sampled as Planned in 2012?
		Chromium (Filtered)	Specific Conductance (Field)	pH (Field)	TOC	TOX	Alkalinity	Turbidity (Field)	Anions	Metals	Alpha[b]	Beta[b]	Iodine-129[b]	Technetium-99[b]	
299-E17-22	C	A	A	A	A	A	A	A	A	A	S	S	S	S	No
299-E17-23	C	A	A	A	A	A	A	A	A	A	S	S	S	S	No
299-E17-25	C	A	A	A	A	A	A	A	A	A	S	S	S	S	No
299-E17-26	C	A	A	A	A	A	A	A	A	A	S	S	S	S	No

Table 3-21. Monitoring Wells and Constituents for the Integrated Disposal Facility

299-E18-1	C	A	A	A	A	A	A	A	A	A	S	S	S	S	No
299-E24-21	C	A	A	A	A	A	A	A	A	A	S	S	S	S	No
299-E24-24	C	A	A	A	A	A	A	A	A	A	S	S	S	S	No

Notes: Requirements are from *Hanford Facility Dangerous Waste Permit Application Integrated Disposal Facility* (DOE/RL-2003-12) and *Integrated Disposal Facility Operational Monitoring Plan to Meet DOE Order 435.1* (RPP-PLAN-26534). Per June 30, 2010 Class 1 Modification of RCRA Permit WA7890008967, Part III Operating Unit 11, Integrated Disposal Facility, groundwater sampling under the permit will continue annually during the pre-active life of the facility.

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italics*** indicate upgradient well.

b. Operational parameters are monitored for DOE O 435.1, *Radioactive Waste Management*.

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-22. Integrated Disposal Facility RCRA Indicator Parameter Results

Constituent (Unit)	Historical Range	2012 Range	Standard	Standard Type	2012 Exceedance?
Chromium – filtered (µg/L)	< 1.9 to 32.1	< 5 to 19.9	48*	MTCA Method B	No
pH	< 1.9 to 32.1	7.8 to 8.7	--	--	--
Specific Conductance (µg/L)	316 to 812	408 to 585	--	--	--
Total Organic Carbon (µg/L)	< 100 to 16,100	153 to 453	--	--	--
Total Organic Halides (mg/L)	< 1 to 61.9	< 5 to 9.5	--	--	--

* Groundwater cleanup level is for hexavalent chromium. Filtered chromium was included in the permit list of constituents since hexavalent chromium is a mobile regulated metal expected to be disposed of at the Integrated Disposal Facility.

MTCA = "Model Toxics Control Act—Cleanup" (WAC 173-340)

Table 3-23. Monitoring Wells and Constituents for Liquid Effluent Retention Facility

Well Number[a]	WAC-Compliant	Alkalinity	Alpha[b]	Ammonium	Anions	Beta[b]	Metals	Phenols	VOA	Sampled as Scheduled in 2012?
299-E26-10	C	A	S	S	A	S	A	A	S	Yes
299-E26-11	C	A	S	S	A	S	A	A	S	Yes
299-E26-77[c]	C	A	S	S	A	S	A	A	S	Yes
299-E26-79[c]	C	A	S	S	A	S	A	A	S	Yes

Notes:

1. Requirements are from *Liquid Effluent Retention Facility Final-Status Groundwater Monitoring Plan* (PNNL-11620) and the Hanford Facility RCRA Permit modification (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*).

2. Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italic*** indicates upgradient well.

b. Monitored for the *Atomic Energy Act of 1954*.

c. Well was installed after permit modification but sampled to permit requirements. Also, wells are screened mainly within fractured basalt.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

VOA = volatile organic analyte

WAC = *Washington Administrative Code*

Table 3-24. Liquid Effluent Retention Facility Indicator Constituent Results

Constituent (Unit)	2012 Range in Upgradient Well	2012 Range in Downgradient Wells
Total organic carbon (µg/L)	318 to 322	448 to 1,560
Total organic halides (µg/L)	8.6 to 9.2	9.6 to 15.8
Tritium (pCi/L)	700 to 740	ND
Gross alpha (pCi/L)	ND	ND to 6.4
Gross beta (pCi/L)	ND to 7.9	ND to 31
Nitrate (mg/L as NO_3)	15.4 to 16.3	38.4 to 53.6

ND = not detected

Table 3-25. January 2012 Semiannual Monitoring Wells and Constituents for Low-Level Waste Management Area 1

Well Name[a]	WAC Compliant	RCRA Required Constituents										Supporting Constituents				Sampled as Scheduled?
		Contaminant Indicator Parameters[b]				Groundwater Quality Parameters										
						Anions[c]			Metals, Unfiltered, Filtered[c]							
		pH	Specific Conductance	TOC	TOX	Chloride	Sulfate	Phenols	Iron	Manganese	Sodium	Alkalinity	Dissolved Oxygen	Temperature	Turbidity	
299-E28-26	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E28-27	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E28-28	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-2	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-3	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-4	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-5	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-6	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-7	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-8	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-9	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E32-10	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E33-28	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E33-29	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes

Table 3-25. January 2012 Semiannual Monitoring Wells and Constituents for Low-Level Waste Management Area 1

Well Name[a]	WAC Compliant	RCRA Required Constituents										Supporting Constituents				Sampled as Scheduled?
		Contaminant Indicator Parameters[b]				Groundwater Quality Parameters										
						Anions[c]			Metals, Unfiltered, Filtered[c]							
		pH	Specific Conductance	TOC	TOX	Chloride	Sulfate	Phenols	Iron	Manganese	Sodium	Alkalinity	Dissolved Oxygen	Temperature	Turbidity	
299-E33-34	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E33-35	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E33-265	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E33-266	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes

Note: Requirements are from *Interim Status Groundwater Monitoring Plan for the LLBG WMA-1* (DOE/RL-2009-75).

a. Upgradient wells are noted in ***bold italics***.

b. Quadruplicate samples were collected during each sampling event.

c. For anions, analytes include chloride, fluoride, nitrate, nitrite, and sulfate. For metals, analytes include (but are not limited to) calcium, chromium, iron, manganese, potassium, and sodium.

d. Site monitored under groundwater quality assessment program during part of 2012.

A = to be sampled annually

C = well is constructed in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

RCRA = *Resource Conservation and Recovery Act of 1976*

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-26. July 2012 Assessment Monitoring Wells and Constituents for Low-Level Waste Management Area 1 (Non-target Wells)

Well Name	WAC Compliant	RCRA Required Constituents										Supporting Constituents			Sampled as Scheduled?
		Contaminant Indicator Parameters*				Groundwater Quality Parameters									
						Anions*			Metals, Unfiltered, Filtered*						
		pH	Specific Conductance	TOC	TOX	Chloride	Sulfate	Phenols	Iron	Manganese	Sodium	Alkalinity	Temperature	Turbidity	
299-E28-26	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E28-27	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E28-28	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-2	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-3	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-4	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-5	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-6	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-7	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-8	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-9	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E32-10	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E33-28	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E33-29	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes

Table 3-26. July 2012 Assessment Monitoring Wells and Constituents for Low-Level Waste Management Area 1 (Non-target Wells)

Well Name	WAC Compliant	RCRA Required Constituents										Supporting Constituents			Sampled as Scheduled?
		Contaminant Indicator Parameters*				Groundwater Quality Parameters									
						Anions*			Metals, Unfiltered, Filtered*						
		pH	Specific Conductance	TOC	TOX	Chloride	Sulfate	Phenols	Iron	Manganese	Sodium	Alkalinity	Temperature	Turbidity	
299-E33-34	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes
299-E33-35	C	S	S	S	S	S	S	A	S	S	S	S	S	S	Yes

Note: Requirements are from *First Determination RCRA Groundwater Quality Assessment Plan for Low-Level Burial Grounds Low-Level Waste Management Area-1* (DOE/RL-2012-35).

* Samples were collected in accordance with Table 5 of DOE/RL-2012-35 during sampling event.

A = to be sampled annually (sampled in January 2012; therefore, not required in July)

C = well is constructed in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

RCRA = *Resource Conservation and Recovery Act of 1976*

S = sample collected and analyzed

TOC = total organic carbon

TOX = total organic halides

WAC = *Washington Administrative Code*

Table 3-27. July 2012 Assessment Monitoring Wells and Constituents for Low-Level Waste Management Area 1 (Target Wells)

Well Name[a]	WAC Compliant	RCRA Required Constituents												Supporting Constituents				Sampled as Scheduled?
		Field Parameters		40 CFR 264 Appendix IX Assessment Parameters														
		pH	Specific Conductance	Metals	Trace Metals	VOAs	SVOAs	PCDD & PCDF	Pesticides	PCBs	TOC	TOX	Herbicides	COD	Coliform Bacteria	Cyanide	Sulfide	
299-E33-30	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-265	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-266	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes

Note: Requirements are from *First Determination RCRA Groundwater Quality Assessment Plan for Low-Level Burial Grounds Low-Level Waste Management Area-1* (DOE/RL-2012-35).

a. Constituents and analysis methods are provided in Table 4 of DOE/RL-2012-35.

C = well is constructed in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"
COD = chemical oxygen demand
PCB = polychlorinated biphenyl
PCDD = polychlorinated dibenzo-p-dioxins
PCDF = polychlorinated dibenzofurans
RCRA = *Resource Conservation and Recovery Act of 1976*
S = sample collected and analyzed
SVOA = semivolatile organic analyte
TOC = total organic carbon
TOX = total organic halides
VOA = volatile organic analyte
WAC = *Washington Administrative Code*

Table 3-28. October 2012 Assessment Monitoring Wells and Constituents for Low-Level Waste Management Area 1

Well Name	WAC Compliant	RCRA Required Constituents														Supporting Constituents				Sampled as Scheduled?
		Field Parameters		40 CFR 264 Appendix IX Assessment Parameters														
		pH	Specific Conductance	Metals*	Trace Metals*	VOAs*	SVOAs*	PCDD and PCDF*	Pesticides*	PCBs*	TOC	TOX	Herbicides*	COD	Coliform Bacteria	Cyanide	Sulfide	
299-E28-26	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E28-27	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E28-28	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-2	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-3	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-4	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-5	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-6	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-7	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-8	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-9	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E32-10	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-28	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-29	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-30	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes

Table 3-28. October 2012 Assessment Monitoring Wells and Constituents for Low-Level Waste Management Area 1

		RCRA Required Constituents												Supporting Constituents				
		Field Parameters		40 CFR 264 Appendix IX Assessment Parameters														
Well Name	WAC Compliant	pH	Specific Conductance	Metals*	Trace Metals*	VOAs*	SVOAs*	PCDD and PCDF*	Pesticides*	PCBs*	TOC	TOX	Herbicides*	COD	Coliform Bacteria	Cyanide	Sulfide	Sampled as Scheduled?
299-E33-34	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-35	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-265	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
299-E33-266	C	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes

Note: Requirements are from *First Determination RCRA Groundwater Quality Assessment Plan for Low-Level Burial Grounds Low-Level Waste Management Area-1* (DOE/RL-2012-35).

* Constituents and analysis methods are provided in Table 4 of DOE/RL-2012-35.

C = well is constructed in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

COD = chemical oxygen demand

PCB = polychlorinated biphenyl

PCDD = polychlorinated dibenzo-p-dioxins

PCDF = polychlorinated dibenzofurans

RCRA = *Resource Conservation and Recovery Act of 1976*

S = sample collected and analyzed

SVOA = semivolatile organic analyte

TOC = total organic carbon

TOX = total organic halides

VOA = volatile organic analyte

WAC = *Washington Administrative Code*

Table 3-29. Low-Level Waste Management Area 1 Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.42 – 8.64	7.67 to 8.34	No	None
Specific conductance (µS/cm)	1306	416 to 1704	Yes	299-E33-34 and 299-E33-35*
Total organic carbon (µg/L)	587 (LOQ = 930 1st quarter; 850 3rd quarter)	<100 to 2740	Yes	299-E33-265
Total organic halides (µg/L)	NC (LOQ = 25.8 1st quarter; 22.2 3rd quarter)	<5 to 8.67	No	None

*Upgradient well

LOQ = limit of quantitation

NC = not calculated because proportion non-detects is greater than 50%

Table 3-30. Monitoring Wells and Constituents for Low-Level Waste Management Area 2

		RCRA Required Constituents										Supporting Constituents				
		Contaminant Indicator Parameters[b]				Groundwater Quality Parameters										
						Anions[c]			Metals, Unfiltered, Filtered[c]							
Well Name[a]	WAC Compliant	pH	Specific Conductance	TOC	TOX	Chloride	Sulfate	Phenols	Iron	Manganese	Sodium	Alkalinity	Dissolved Oxygen	Temperature	Turbidity	Sampled as Scheduled in 2012?
299-E27-8	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E27-9	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E27-10[a]	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes

Table 3-30. Monitoring Wells and Constituents for Low-Level Waste Management Area 2

Well Name[a]	WAC Compliant	RCRA Required Constituents										Supporting Constituents				Sampled as Scheduled in 2012?
		Contaminant Indicator Parameters[b]				Groundwater Quality Parameters										
						Anions[c]			Metals, Unfiltered, Filtered[c]							
		pH	Specific Conductance	TOC	TOX	Chloride	Sulfate	Phenols	Iron	Manganese	Sodium	Alkalinity	Dissolved Oxygen	Temperature	Turbidity	
299-E27-11	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E27-17	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E34-2	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E34-9	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E34-10	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes
299-E34-12	C	S	S	S	S	S	S	A	S	S	S	S	S	S	S	Yes

Note: Requirements are from *Interim Status Groundwater Monitoring Plan for the LLBG WMA-2* (DOE/RL-2009-76).

a. Network currently has no upgradient wells. Well 299-E27-10 is cross-gradient and is used to establish critical mean values. Additional wells are planned for drilling.

b. Quadruplicate samples were collected during each sampling event.

c. For anions, analytes include chloride, fluoride, nitrate, nitrite, and sulfate. For metals, analytes include (but are not limited to) calcium, chromium, iron, manganese, potassium, and sodium.

A = to be sampled annually

C = well is constructed in accordance with requirements of WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

RCRA= *Resource Conservation and Recovery Act of 1976*

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

Table 3-31. Low-Level Waste Management Area 2 Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	6.82 - 8.75	7.69 to 8.26	No	None
Specific conductance (µS/cm)	1396	458 to 1062	No	None
Total organic carbon (µg/L)	1905	129 to 770	No	None
Total organic halides (µg/L)	10.2 (LOQ = 22.5 2nd quarter; 21.8 4th quarter)	<5 to 10.7	No	None

LOQ = limit of quantitation

Table 3-32. Monitoring Wells and Constituents for Low-Level Waste Management Area 3

Well Number[a]	WAC-Compliant	Contamination Indicator Parameters[b]				Other Chemical Parameters				Sampled as Scheduled in 2012?
		pH (Field)	Specific Conductance (Field)	TOC	TOX	Alkalinity	Anions[c]	Metals[c]	Phenols	
299-W9-2	C	S	S	S	S	A	A	A	A	Yes
299-W10-29	C	S	S	S	S	A	A	A	A	Yes
299-W10-30	C	S	S	S	S	A	A	A	A	Yes
299-W10-31	C	S	S	S	S	A	A	A	A	Yes

Notes: Requirements are from *Interim Status Groundwater Monitoring Plan for the LLBG WMA-3* (DOE/RL-2009-68, Rev. 1). Revision 2 was released in 2012.

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. Upgradient well is noted in ***bold italic***.

b. Quadruplicate samples were collected during each sampling event.

c. For anions, analytes include chloride, fluoride, nitrate, nitrite, and sulfate. For metals, analytes include (but are not limited to) calcium, chromium, iron, manganese, potassium, and sodium.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

Table 3-33. Monitoring Wells and Constituents for Low-Level Waste Management Area 4

Well Number[a]	Comment	WAC Compliant	Contamination Indicator Parameters[b]				Other Chemical Parameters				Sampled as Scheduled in 2012?
			pH (Field)	Specific Conductance (Field)	TOC	TOX	Alkalinity	Anions[c]	Metals[c]	Phenols	
299-W15-17	Deep unconfined; no statistics	C	S	S	S	S	S	A	A	A	Yes
299-W15-30	--	C	S	S	S	S	S	A	A	A	Yes
299-W15-83	--	C	S	S	S	S	S	A	A	A	Yes
299-W15-94	--	C	S	S	S	S	S	A	A	A	Yes
299-W15-152	--	C	S	S	S	S	S	A	A	A	Yes
299-W15-224	--	C	S	S	S	S	S	A	A	A	Yes
299-W18-22	Deep unconfined; no statistics	C	S	S	S	S	S	A	A	A	Yes

Notes: Requirements are from *Interim Status Groundwater Monitoring Plan for the LLBG WMA-4* (DOE/RL-2009-69).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. Upgradient well is noted in ***bold italic***.

b. Quadruplicate samples were collected during each sampling event.

c. For anions, analytes include chloride, fluoride, nitrate, nitrite, and sulfate. For metals, analytes include (but are not limited to) calcium, chromium, iron, manganese, potassium, and sodium.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

Table 3-34. Low-Level Waste Management Area 4 Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	7.38 – 8.34	7.5 to 8.17	No	None
Specific conductance (µS/cm)	810	536 to 559	No	None
Total organic carbon (µg/L)	697 (LOQ = 930 1st quarter; 850 3rd quarter)	117 to 6900*	Yes	299-W15-83**
Total organic halides (µg/L)	NC (LOQ = 25.8 1st quarter; 22.2 3rd quarter)	8.65 to 34.9	Yes	299-W15-30

*Data are under review.
**LOQ exceeded in July 2012; verification sampling in September was inconclusive (results from two labs did not agree). Results for January 2013 were below the LOQ.
LOQ = limit of quantitation
NC = not calculated because proportion non-detects is greater than 50%

Table 3-35. Monitoring Wells and Constituents for the Nonradioactive Dangerous Waste Landfill

Well Number[a]	Comment	WAC-Compliant	Contamination Indicator Parameters[b]				Other Chemical Parameters				Sampled as Scheduled in 2012?
			pH (field)	Specific Conductance (Field)	TOC	TOX	Anions	Metals	Phenols	VOA	
699-25-33A	Top of LPU; no statistics	C	S	S	S	S	S	A	A	S	Yes
699-25-34A	--	C	S	S	S	S	S	A	A	S	Yes
699-25-34B	--	C	S	S	S	S	S	A	A	S	Yes
699-25-34D	--	C	S	S	S	S	S	A	A	S	No[c]
699-26-33	--	C	S	S	S	S	S	A	A	S	Yes
699-26-34A	--	C	S	S	S	S	S	A	A	S	Yes
699-26-34B	--	C	S	S	S	S	S	A	A	S	Yes
699-26-35A	--	C	S	S	S	S	S	A	A	S	Yes
699-26-35C	Top of LPU; no statistics	C	S	S	S	S	S	A	A	S	Yes

Table 3-35. Monitoring Wells and Constituents for the Nonradioactive Dangerous Waste Landfill

Well Number[a]	Comment	WAC-Compliant	Contamination Indicator Parameters[b]				Other Chemical Parameters				Sampled as Scheduled in 2012?
			pH (field)	Specific Conductance (Field)	TOC	TOX	Anions	Metals	Phenols	VOA	

Notes: Requirements are from *Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill* (PNNL-12227) and corresponding Interim Change Notice 1 (PNNL-12227-ICN-1).

Wells completed at the top of the unconfined aquifer unless otherwise specified.

a. ***Bold italics*** indicate upgradient wells.

b. Quadruplicate samples were collected during each sampling event except in LPU wells.

c. There was no quadruplicate pH or specific conductance during first sampling event (January 2012).

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells”

LPU = low-permeability unit (in upper portion of Ringold Formation within member of Taylor Flat)

S = to be sampled semiannually

TOC = total organic carbon

TOX = total organic halides

VOA = volatile organic analyte

Table 3-36. Nonradioactive Dangerous Waste Landfill Indicator Parameter Results

Constituent (Unit)	2012 Critical Mean	2012 Concentration Range	2012 Exceedance?	Wells Exceeded
pH	6.36 - 8.61	7.25 to 7.49	No	None
Specific conductance (µS/cm)	713	521 to 630	No	None
Total organic carbon (µg/L)	1510	<100 to 2610*	Yes	699-25-34B*
Total organic halides (µg/L)	NC (LOQ = 25.8 1st quarter; 22.2 3rd quarter)	<5 to 12.8	No	None

*Exceedance was not confirmed during verification sampling. Laboratory flag “N” indicates an associated QC sample was out of acceptable range. TOC data from 699-25-34B subsequently flagged “Y” as suspected error.

LOQ = limit of quantitation

NC = not calculated because proportion non-detects is greater than 50%

Table 3-37. Monitoring Wells and Constituents for Waste Management Area A-AX

Well Number[a]	WAC-Compliant	Site-Specific Constituents						Supporting Constituents					Sampled as Scheduled in 2012?
		Nitrate	Sodium	Sulfate	TOC	Chromium	Lead	Alkalinity	Anions[b]	Metals[b]	Technetium-99[c]	Field Parameters	
299-E24-20	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E24-22	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E24-33	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E25-2	P	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E25-40	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E25-41	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E25-93	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E25-94	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
299-E25-236	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes

Notes: Requirements are from *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site* (PNNL-15315).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italics*** indicate upgradient wells.

b. Anions: analytes include, but not limited to, nitrate and sulfate. Metals: analytes include, but not limited to, chromium and sodium.

c. *Atomic Energy Act of 1954* parameter.

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

Q = to be sampled quarterly

TOC = total organic carbon

Table 3-38. Monitoring Wells and Constituents for Waste Management Area B-BX-BY (Quarters 1 Through 3)

Well Number[a]	WAC-Compliant	RCRA Parameters				AEA Parameters				Sampled as Scheduled in 2012?[b]
		Alkalinity	Anions	Cyanide	Metals	Gamma	Technetium-99	Tritium	Uranium	
299-E28-8	P	Q	Q	Q	Q	S	Q	Q	Q	Yes
299-E33-7	P	Q	Q	Q	Q	Q	Q	Q	Q	No uranium 2nd quarter
299-E33-9	P	A	A	A	A	A	A	A	A	No gamma
299-E33-15	P	S	S	S	S	S	S	S	S	Sampled once
299-E33-16	P	Q	Q	Q	Q	S	Q	Q	Q	Yes
299-E33-17	P	A	A	A	A	--	A	A	A	Yes
299-E33-18	P	Q	Q	Q	Q	S	Q	Q	Q	Yes
299-E33-20	P	S	S	S	S	--	S	S	S	Yes
299-E33-21	P	A	A	A	A	--	A	A	A	Yes
299-E33-26	C	Q	Q	Q	Q	S	Q	Q	Q	Sampled twice; maintenance needed
299-E33-31	C	Q	Q	Q	Q	S	Q	Q	Q	No uranium 2nd quarter
299-E33-32	C	Q	Q	Q	Q	S	Q	Q	Q	No uranium 2nd quarter
299-E33-38	C	Q	Q	Q	Q	S	Q	Q	Q	Yes
299-E33-39	C	Q	Q	Q	Q	S	Q	Q	Q	No uranium 2nd quarter
299-E33-41	C	Q	Q	Q	Q	S	Q	Q	Q	Yes
299-E33-42	C	Q	Q	Q	Q	S	Q	Q	Q	No uranium 2nd quarter
299-E33-43	C	Q	Q	Q	Q	S	Q	Q	Q	No uranium 2nd quarter
299-E33-44	C	Q	Q	Q	Q	S	Q	Q	Q	Yes
299-E33-47	C	Q	Q	Q	Q	--	Q	Q	Q	Yes
299-E33-48	C	Q	Q	Q	Q	--	Q	Q	Q	Yes
299-E33-49	C	Q	Q	Q	Q	--	Q	Q	Q	Yes
299-E33-334	C	Q	Q	Q	Q	--	Q	Q	Q	No uranium 2nd quarter
299-E33-335	C	Q	Q	Q	Q	--	Q	Q	Q	No uranium 2nd quarter
299-E33-337	C	Q	Q	Q	Q	--	Q	Q	Q	No uranium 2nd quarter
299-E33-338	C	Q	Q	Q	Q	--	Q	Q	Q	No uranium 2nd quarter
299-E33-339	C	Q	Q	Q	Q	--	Q	Q	Q	Yes

Table 3-38. Monitoring Wells and Constituents for Waste Management Area B-BX-BY (Quarters 1 Through 3)

Well Number[a]	WAC-Compliant	RCRA Parameters				AEA Parameters				Sampled as Scheduled in 2012?[b]
		Alkalinity	Anions	Cyanide	Metals	Gamma	Technetium-99	Tritium	Uranium	

Source: *Groundwater Quality Assessment Plan for Single-Shell Tank Waste Management Area B-BX-BY at the Hanford Site* (PNNL-13022-ICN-3).

Note: Wells completed at the top of the unconfined aquifer.

a. ***Bold italic*** well names are upgradient wells due to flow direction change to southeast.

b. New assessment plan went into effect in October 2012.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

Q = to be sampled quarterly

S = to be sampled semiannually

WAC = *Washington Administrative Code*

Table 3-39. October 2012 Assessment Monitoring Wells and Constituents for Waste Management Area B-BX-BY

		RCRA Required Constituents										Supporting Constituents				
		Field Parameters[b]		40 CFR 264 Appendix IX Assessment Parameters												
Well Name[a]	**WAC Compliant**	**pH**	**Specific Conductance**	**Metals[a]**	**Trace Metals[a]**	**VOAs[b]**	**SVOAs[c]**	**Pesticides[c]**	**TOC[d]**	**Sulfide[a]**	**Cyanide[a]**	**Alkalinity[d]**	**Anions[d]**	**Metals[d]**	**Cyanide[d]**	**Sampled as Scheduled**
299-E33-18	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-20	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-31	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-32	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-38	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-41	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-42	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-44	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-47	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-48	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-49	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-334	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-335	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-337	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-338	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]
299-E33-339	C	S	S	S	S	S	S	S	X	S	S	S	S	S	S	No TOC[e]

Table 3-39. October 2012 Assessment Monitoring Wells and Constituents for Waste Management Area B-BX-BY

		RCRA Required Constituents										Supporting Constituents				
		Field Parameters[b]		40 CFR 264 Appendix IX Assessment Parameters												
Well Name[a]	WAC Compliant	pH	Specific Conductance	Metals[a]	Trace Metals[a]	VOAs[b]	SVOAs[c]	Pesticides[c]	TOC[d]	Sulfide[a]	Cyanide[a]	Alkalinity[d]	Anions[d]	Metals[d]	Cyanide[d]	Sampled as Scheduled

Note: Requirements are from *First Determination RCRA Groundwater Quality Assessment Plan for Low-Level Burial Grounds Low-Level Waste Management Area-1* (DOE/RL-2012-35).

a. Constituents are provided in Table 3-4 of DOE/RL-2012-35.

b. Constituents are provided in Table 3-2 of DOE/RL-2012-35.

c. Constituents are provided in Table 3-3 of DOE/RL-2012-35.

d. Constituents are provided in Table 3-1 of DOE/RL-2012-35.

e. Not collected; constituent was added to plan after schedule cutoff. Scheduled for calendar year 2013 per Table 3-1 of DOE/RL-2012-35.

C = well is constructed in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

COD = chemical oxygen demand

RCRA = *Resource Conservation and Recovery Act of 1976*

S = sample collected and analyzed

SVOA = semivolatile organic analyte

TOC = total organic carbon

VOA = volatile organic analyte

WAC = *Washington Administrative Code*

Table 3-40. Monitoring Wells and Constituents for Waste Management Area C

Well Name[a]	Well Construction Standard	pH	Specific Conductance	Alkalinity	Anions	Cyanide	Metals[b], Unfiltered, Filtered	Sampled as Scheduled in 2012?
299-E27-4	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-7	N	Q	Q	Q	Q	Q	Q	Yes
299-E27-12	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-13	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-14	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-15	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-21	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-22	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-23	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-24	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-25	C	Q	Q	Q	Q	Q	Q	Yes
299-E27-155	C	S	S	S	S	S	S	Yes

Note: Requirements are from *Groundwater Quality Assessment Plan for the Single-Shell Waste Management Area C* (DOE/RL-2009-77).

a. ***Bold italics*** indicate upgradient determination based on recent data. The assessment plan defines different upgradient wells.

b. Metals for groundwater quality include iron, manganese, and sodium.

C = constructed as a WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells" resource protection well

N = well was constructed before WAC 173-160 requirements were applicable at the Hanford Site

Q = quarterly

S = semiannually

Table 3-41. Monitoring Wells and Constituents for Waste Management Area S-SX

Well Number[a]	WAC-Compliant	RCRA		Supporting Constituents				Sampled as Scheduled in 2012?
		Chromium	Nitrate	Alkalinity	Anions[b]	Metals[b]	Field Parameters	
299-W22-26	P	S	S	S	S	S	S	Missed December; needed maintenance (dry 2013)
299-W22-44	C	Q	Q	Q	Q	Q	Q	Yes
299-W22-45	C	S	S	S	S	S	S	Yes
299-W22-47	C	Q	Q	Q	Q	Q	Q	Yes
299-W22-48	C	S	S	S	S	S	S	Missed December; dry
299-W22-49	C	S	S	S	S	S	S	Yes
299-W22-50	C	Q	Q	Q	Q	Q	Q	Yes
299-W22-69	C	A	A	A	A	A	A	Yes
299-W22-72	C	A	A	A	A	A	A	Yes
299-W22-80	C	A	A	A	A	A	A	Yes
299-W22-81	C	A	A	A	A	A	A	Yes
299-W22-82	C	A	A	A	A	A	A	Yes
299-W22-83	C	A	A	A	A	A	A	Yes
299-W22-84	C	A	A	A	A	A	A	Yes
299-W22-85	C	S	S	S	S	S	S	Yes
299-W22-86	C	A	A	A	A	A	A	Yes
299-W22-89	C	A	A	A	A	A	A	Yes
299-W23-15	C	A	A	A	A	A	A	Yes
299-W23-19	C	Q	Q	Q	Q	Q	Q	Yes
299-W23-20	C	A	A	A	A	A	A	Yes
299-W23-21	C	A	A	A	A	A	A	Yes

Table 3-41. Monitoring Wells and Constituents for Waste Management Area S-SX

Well Number[a]	WAC-Compliant	RCRA	Nitrate	Supporting Constituents				Sampled as Scheduled in 2012?
		Chromium		Alkalinity	Anions[b]	Metals[b]	Field Parameters	

Notes: Requirements are from *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area S-SX* (DOE/RL-2009-73).

Wells completed at the top of the unconfined aquifer.

a. ***Bold italics*** indicate upgradient wells.

b. Anions include, but are not limited to, chloride, nitrate, and sulfate. Metals (filtered and unfiltered) include, but are not limited to, calcium, magnesium, potassium, and sodium.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

Q = to be sampled quarterly

RCRA = *Resource Conservation and Recovery Act of 1976*

S = to be sampled semiannually

WAC = *Washington Administrative Code*

Table 3-42. Monitoring Wells and Constituents for Waste Management Area T

Well Number[a]	WAC-Compliant	RCRA Dangerous Constituent	Supporting Parameters			Field-Measured Parameters					Sampled as Scheduled in 2012?
		Hexavalent Chromium	Nitrate and Other Anions	Alkalinity	Metals, Unfiltered	pH	Specific Conductance	Turbidity	Temperature	Dissolved Oxygen	
299-W10-1	P	A	A	A	A	A	A	A	A	A	Yes
299-W10-4	P	A	A	A	A	A	A	A	A	A	Yes
299-W10-8	P	A	A	A	A	A	A	A	A	A	Yes
299-W10-23	C	B	B	B	B	B	B	B	B	B	Yes
299-W10-24	C	A	A	A	A	A	A	A	A	A	Yes
299-W10-28	C	A	A	A	A	A	A	A	A	A	Yes
299-W11-39	C	A	A	A	A	A	A	A	A	A	Yes
299-W11-40	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes
299-W11-41	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes

Table 3-42. Monitoring Wells and Constituents for Waste Management Area T

Well Number[a]	WAC-Compliant	RCRA Dangerous Constituent	Supporting Parameters			Field-Measured Parameters					Sampled as Scheduled in 2012?
		Hexavalent Chromium	Nitrate and Other Anions	Alkalinity	Metals, Unfiltered	pH	Specific Conductance	Turbidity	Temperature	Dissolved Oxygen	
299-W11-42	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes
299-W11-45[b]	C	Q	S	A	S	S	S	S	S	S	No
299-W11-46[c]	C	Q	S	A	S	Q	Q	Q	Q	Q	No
299-W11-47[d]	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes

Notes: Requirements are from *Interim Status Groundwater Quality Assessment Plan for Single-Shell Tank Waste Management Area T* (DOE/RL-2009-66).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italics*** indicate upgradient wells.

b. Offline extraction well is scheduled for conversion to monitoring well in 2013.

c. Offline extraction well unavailable for sampling.

d. Screened 9 to 18 meters below water table.

A = to be sampled annually

B = to be sampled biennially

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed prior to WAC requirements

Q = to be sampled quarterly

RCRA = *Resource Conservation and Recovery Act of 1976*

S = to be sampled semiannually

WAC = *Washington Administrative Code*

Table 3-43. Monitoring Wells and Constituents for Waste Management Area TX-TY

Well Number[a]	WAC-Compliant	RCRA Dangerous Parameter	Supporting Parameters			Field-Measured Parameters					Sampled as Scheduled in 2012?
		Hexavalent Chromium	Nitrate and Other Anions	Alkalinity	Metals, Unfiltered	pH	Specific Conductance	Turbidity	Temperature	Dissolved Oxygen	
299-W10-26	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes
299-W10-27	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes
299-W14-11[b]	C	S	S	A	S	S	S	S	S	S	Yes
299-W14-13	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes
299-W14-14	C	S	S	A	S	S	S	S	S	S	Yes
299-W14-15	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes
299-W14-16	C	A	A	A	A	A	A	A	A	A	Yes
299-W14-17	C	A	A	A	A	A	A	A	A	A	Yes
299-W14-18	C	Q	S	A	S	Q	Q	Q	Q	Q	Yes
299-W14-19	C	S	S	A	S	S	S	S	S	S	Yes
299-W15-44	C	S	S	A	S	S	S	S	S	S	Yes
299-W15-763	C	S	S	A	S	S	S	S	S	S	Yes
299-W15-765[c]	C	S	S	A	S	S	S	S	S	S	No, one sample only in 2012

Notes: Requirements are from *Interim Status Groundwater Quality Assessment Plan for Single-Shell Tank Waste Management Area TX-TY* (DOE/RL-2009-67).

Wells completed at the top of the unconfined aquifer, unless specified otherwise.

a. ***Bold italic*** indicates upgradient well.

b. Screened 11 to 14.6 m below water table.

c. Well taken out of service as an extraction well and converted to a monitoring well in fourth quarter of calendar year 2012.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

Q = to be sampled quarterly

RCRA = *Resource Conservation and Recovery Act of 1976*

S = to be sampled semiannually

WAC = *Washington Administrative Code*

Table 3-44. Monitoring Wells and Constituents for Waste Management Area U

Well Number[a]	WAC-Compliant	RCRA	Supporting Parameters					Sampled as Scheduled in 2012?
		Chromium	Nitrate	Alkalinity	Anions[b]	Metals[b]	Field Parameters	
299-W18-30	C	Q	Q	Q	Q	Q	Q	Yes
299-W18-40	C	Q	Q	Q	Q	Q	Q	Yes
299-W19-12	C	Q	Q	Q	Q	Q	Q	Yes
299-W19-41	C	Q	Q	Q	Q	Q	Q	Yes
299-W19-42	C	Q	Q	Q	Q	Q	Q	Yes
299-W19-44	C	Q	Q	Q	Q	Q	Q	Yes
299-W19-45	C	Q	Q	Q	Q	Q	Q	Yes
299-W19-47	C	Q	Q	Q	Q	Q	Q	Yes

Notes: Requirement is from *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area U* (DOE/RL-2009-74).

Wells completed at the top of the unconfined aquifer.

a. ***Bold italic*** indicates upgradient well.

b. Anions include, but are not limited to, chloride, nitrate, and sulfate. Metals (filtered and unfiltered) include, but are not limited to, calcium, magnesium, potassium, and sodium.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

S = to be sampled semiannually

Q = to be sampled quarterly

RCRA = *Resource Conservation and Recovery Act of 1976*

WAC = *Washington Administrative Code*

Table 3-45. Monitoring Wells, Constituents, and Enforcement Limits for 200 Area Treated Effluent Disposal Facility

Well Number[a]	WAC-Compliant	Constituents with Enforcement Limits			Other Constituents									Sampled as Scheduled in 2012?[d]
		pH (6.5 to 8.5)	Cadmium (5 µg/L)	Lead (10 µg/L)	Specific Conductance	Alkalinity	Alpha	Anions[b]	Beta	Metals[b]	Total Dissolved Solids	Trace Metals[c]	Tritium	
699-40-36	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	A	Yes
699-41-35	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	A	Yes
699-42-37	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	A	Yes

Note: Requirements are from *Groundwater Monitoring Plan for the Hanford Site 200 Area Treated Effluent Disposal Facility* (PNNL-13032).

All wells completed at the top of the Ringold Formation confined aquifer.

a. ***Bold italic*** indicates upgradient well.

b. Anions include, but not limited to, chloride, fluoride, nitrate, and sulfate. Metals include, but not limited to, iron and manganese.

c. Trace metals include arsenic, cadmium, chromium, lead, and mercury.

d. Monitored for the first half of 2012. Requirements for groundwater monitoring were discontinued in July 2012 in accordance with a revision to Ecology, 2012, *State Waste Discharge Permit Number ST0004502*.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

Q = to be sampled quarterly

WAC = *Washington Administrative Code*

Table 3-46. Monitoring Wells and Constituents for Environmental Restoration Disposal Facility

Well Number[a]	WAC-Compliant	Alkalinity	Alpha	Anions	Beta	Carbon-14	Iodine-129	Metals	Radium[b]	Total Dissolved Solids	Technetium-99	TOX	Uranium	VOA	Sampled as Scheduled in 2012?
699-35-66A	P	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
699-36-66B	C	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
699-36-70A	C	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes
699-37-66	C	S	S	S	S	S	S	S	S	S	S	S	S	S	Yes

Table 3-46. Monitoring Wells and Constituents for Environmental Restoration Disposal Facility

Notes: Requirements are from *Groundwater Protection Plan for the Environmental Restoration Disposal Facility* (WCH-198).

Wells completed at the top of the unconfined aquifer.

a. ***Bold italic*** indicates upgradient well.

b. Total alpha energy emitted from radium.

C = well is constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

S = to be sampled semiannually

TOX = total organic halides

VOA = volatile organic analyte

WAC = *Washington Administrative Code*

Table 3-47. Monitoring Wells and Constituents for the KE and KW Basins

Well	WAC Compliant	Gross Alpha	Anions	Gross Beta	Carbon-14	Metals	Strontium-90	Technetium-99	Tritium	Sampled as Scheduled in 2012?
KE Basins										
199-K-11	P	A	A	A	A	--	--	A	A	Yes
199-K-13	P	A	A	A	A	A	A	A	A	Yes
199-K-23	P	A	A	A	A	A	A	A	A	Yes
199-K-32A	C	Q	Q	Q	A	--	--	A	Q	Yes
199-K-110A	C	S	S	S	--	A	--	--	S	Yes
199-K-111A	C	Q	Q	Q	A	A	--	A	Q	Yes
199-K-141	C	Q	Q	Q	A	S	A	A	Q	Yes
199-K-142	C	Q	Q	Q	A	S	A	A	Q	Sampled 3 times
KW Basins										
199-K-31	P	S	S	S	A	--	A	A	S	Yes
199-K-34	C	Q	Q	Q	A	S	A	A	Q	Yes
199-K-106A	C	Q	Q	Q	A	S	--	--	Q	Yes
199-K-107A	C	Q	Q	Q	A	S	A	A	Q	Yes
199-K-108A	C	S	S	S	--	S	--	--	S	Yes
199-K-132	C	S	S	S	A	S	--	--	S	Yes

Table 3-47. Monitoring Wells and Constituents for the KE and KW Basins

Well	WAC Compliant	Gross Alpha	Anions	Gross Beta	Carbon-14	Metals	Strontium-90	Technetium-99	Tritium	Sampled as Scheduled in 2012?

Note: Requirements are modified from *Groundwater Monitoring and Assessment Plan for the 100-K Area Fuel Storage Basins* (PNNL-14033). The following wells were listed in PNNL-14033 but were decommissioned before 2011: 199-K-27, 199-K-29, 199-K-30, and 199-K-109A (KE Basins) and 199-K-33 (KW Basins). Wells 199-K-11, 199-K-13, 199-K-23, 199-K-31, 199-K-132, 199-K-141, and 199-K-142 were added to the networks.

A = to be sampled annually

C = constructed as a resource protection well under WAC 173-160, “Minimum Standard for Construction and Maintenance of Wells”

P = constructed before WAC requirements

Q = to be sampled quarterly

S = to be sampled semiannually

WAC = *Washington Administrative Code*

Table 3-48. Monitoring Wells, Constituents, and Enforcement Limits for State-Approved Land Disposal Site

Well	Comment	WAC Compliant	Constituents with Enforcement Limits											Other Constituents					Sampled as Scheduled in 2012?
			pH	Acetone	Benzene	Cadmium*	Chloroform	Copper*	Lead*	Mercury*	Sulfate	Tetrahydrofuran	Total Dissolved Solids	Specific Conductance	Alpha	Beta	Strontium-90	Tritium	
299-W6-6	Bottom of unconfined	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A	Yes
299-W6-11	--	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A	Yes
299-W6-12	--	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A	Yes
299-W7-3	Bottom of unconfined	C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	S	Yes
699-48-71	Unconfined	P	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A	Yes
699-48-77C	Ringold Formation unit E, middle to lower	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-48-77D	Ringold Formation unit E, upper	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-49-79	--	P	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A	Yes
699-51-75	--	P	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	S	Yes
699-51-75P	Lower unconfined	P	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A	Yes

Table 3-48. Monitoring Wells, Constituents, and Enforcement Limits for State-Approved Land Disposal Site

Well	Comment	WAC Compliant	Constituents with Enforcement Limits											Other Constituents					Sampled as Scheduled in 2012?
			pH	Acetone	Benzene	Cadmium*	Chloroform	Copper*	Lead*	Mercury*	Sulfate	Tetrahydrofuran	Total Dissolved Solids	Specific Conductance	Alpha	Beta	Strontium-90	Tritium	

Notes: Requirements are from *Groundwater Monitoring and Tritium-Tracking Plan for the 200 Area State-Approved Land Disposal Site* (PNNL-13121). The following wells have gone dry: 299-W6-7, 299-W6-8, 299-W7-1, 299-W7-11, 299-W7-12, 299-W7-5, 299-W7-6, 299-W7-7, 299-W7-8, 299-W7-9, 299-W8-1, and 699-48-77A.

Wells are completed at the top of the aquifer, unless specified otherwise.

* Filtered and unfiltered samples.

A = to be sampled annually

C = constructed as a resource protection well under WAC-173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

Q = to be sampled quarterly

S = to be sampled semiannually

WAC = *Washington Administrative Code*

Table 3-49. Monitoring Wells and Constituents for Solid Waste Landfill

Well Number*	Comment	WAC- Compliant	Contamination Indicator Parameters														Other Parameters				Sampled as Scheduled in 2012?
			Ammonia/Ammonium Ion	Chemical Oxygen Demand	Chloride	Iron (Filtered)	Manganese (Filtered)	Zinc (Filtered)	Nitrate	Nitrite	pH	Specific Conductance	Sulfate	Temperature (Field)	Coliform Bacteria	TOC	Anions	Metals (Filtered)	Arsenic (Filtered)	VOA	
699-22-35	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-23-34A	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-23-34B	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-24-33	Information only; no statistics	P	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-24-34A	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-24-34B	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-24-34C	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	No; well is sample dry
699-24-35	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes
699-25-34C	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	No; well is sample dry
699-26-35A	--	C	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Yes

Notes:

Requirements are from *Groundwater Monitoring Plan for the Solid Waste Landfill* (PNNL-13014). Wells 699-24-34C and 699-25-34C have gone dry.

Wells completed at the top of the unconfined aquifer.

* ***Bold italics*** indicate upgradient well.

C = well is constructed as a resource protection well under WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

P = constructed before WAC requirements

Q = to be sampled quarterly

TOC = total organic carbon

VOA = volatile organic analyte

WAC = *Washington Administrative Code*

Table 3-50. Analytical Results for Required Constituents at the Solid Waste Landfill

Constituent[a]	Date	699-22-35	699-23-34A	699-23-34B	699-24-33	699-24-34A	699-24-34B	699-24-35	699-26-35A
Ammonium ion (µg/L) BTV = 90 µg/L[b]	January	<1.8	2.32	<1.8	<1.8	<1.8	<1.8	1.93	<1.8
	April	<1.8	1.80	<1.8	<1.8	<1.8	<1.8	3.22	<1.8
	July	<1.8	1.93	<1.8	<1.8	<1.8	<1.8	2.06	<1.8
	October	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Chemical oxygen demand (mg/L) BTV = 10 mg/L	January	<10	<10	<10	<10	<10	<10	<10	<10
	April	<10	<10	<10	<10	<10	<10	<10	<10
	July	<10	<10	<10	<10	<10	<10	<10	<10
	October	<10	<10	<10	<10	<10	<10	<10	<10
Chloride (mg/L) BTV = 7.82 mg/L	January	6.86	6.05	5.77	6.34	6.66	1.28	5.82	6.98
	April	701	6.40	5.89	6.46	6.86	6.64	5.85	7.11
	July	6.83	5.92	6.03	6.50	6.80	6.52	5.89	7.16
	October	6.36	6.18	5.50	5.93	6.30	6.05	5.69	6.82
Coliform bacteria (colonies/100mL) BTV = 1 col./100 ml	January	<1	≤1	≤1	≤1	<1	<1	≤1	
	April	≤1	≤1	≤1	≤1	≤1	≤1	≤1	<1
	July	≤1	<1	≤1	≤1	≤1	≤1	<1	<1
	October	≤1	≤1	≤1	≤1	≤1	≤1	<1	≤1
Iron (filtered) (µg/L) BTV = 160 µg/L	January	5.7	31.3	32.6	<19	<19	57.9	<19	67
	April	28.6	37.3	35.6	77.1	25.9	72.5	22.6	<19
	July	32.6	21.2	28.3	<19	23.4	86.0	<19	<`19
	October	<19	25.6	21.8	<19	<19	106.0	20.1	<19

Table 3-50. Analytical Results for Required Constituents at the Solid Waste Landfill

Constituent[a]	Date	699-22-35	699-23-34A	699-23-34B	699-24-33	699-24-34A	699-24-34B	699-24-35	699-26-35A
Manganese (filtered) (µg/L) BTV = 18 µg/L	January	<4	<4	<4	<4	<4	<4	<4	13.9
	April	<4	<4	<4	<4	<4	<4	<4	<4
	July	<4	<4	<4	<4	<4	<4	<4	<4
	October	<4	<4	<4	<4	<4	<4	<4	<4
Nitrate (mg/L) BTV = 29 mg/L	January	17.5	18.8	16.7	14.7	13.9	3.15	12.4	17.5
	April	19.0	20.0	17.4	15.0	14.5	16.4	12.8	17.9
	July	1.2	19.7	17.6	14.6	14.3	15.9	12.8	17.8
	October	18.1	19.3	17.1	14.6	14.1	15.4	13.0	18.1
Nitrite (µg/L) BTV = 266 µg/L	January	1,070	755	1,100	742	818	<125	598	378
	April	1,010	824	795	841	749	870	601	588
	July	851	719	746	808	535	617	647	466
	October	87	775	657	404	549	631	332	273
pH measurement BTV = 6.68-7.84	January	7.01	6.71	6.70	6.95	6.77	6.80	6.99	7.28
	April	7.00	7.74	6.73	6.97	6.78	6.82	6.78	7.28
	July	700	6.70	6.70	6.93	6.74	6.76	6.90	7.40
	October	697	6.71	6.69	6.90	6.75	6.75	6.92	7.40
Specific conductance (µS/cm) BTV = 583 µS/cm	January	824	759	747	759	663	687	574	549
	April	817	756	746	767	657	688	571	540
	July	807	750	744	740	648	675	564	534
	October	775	718	703	785	619	641	570	543

Table 3-50. Analytical Results for Required Constituents at the Solid Waste Landfill

Constituent[a]	Date	699-22-35	699-23-34A	699-23-34B	699-24-33	699-24-34A	699-24-34B	699-24-35	699-26-35A
Sulfate (mg/L) BTV = 47.2 mg/L	January	41.1	45.0	42.3	44.7	43.8	9.2	43.5	39.9
	April	43.8	48.5	44.3	45.9	46.5	48.4	44.7	41.2
	July	4.6	47.8	44.1	44.9	45.5	46.3	44.4	40.2
	October	41.5	46.6	42.9	44.6	44.9	45.1	45.9	41.3
Temperature (°C) BTV = 20.7°C	January	14.3	17.6	18.1	19.2	17.5	18.4	16.6	19.0
	April	17.4	18.7	17.9	19.3	18.2	18.6	17.5	19.2
	July	19.4	19.8	19.1	19.9	19.0	19.5	18.6	19.7
	October	18.4	19.5	19.2	19.7	19.5	20.3	18.2	19.5
TOC (µg/L) BTV = 1,200 µg/L	January	941	805	880	568	637	757	552	526
	April	636	573	637	539	531	514	329	206
	July	591	331	322	7,160	196	205	32	212
	October	812	661	705	742	510	474	485	433
Zinc (filtered) (µg/L) BTV = 42.3 µg/L	January	<5	<5	<5	8.7	<5	<5	7.7	<5
	April	<5	<5	<5	8.6	<5	<5	10.7	<5
	July	<5	<5	<5	8.3	<5	<5	11.3	<5
	October	<5	<5	<5	<5	<5	<5	11.7	<5

Note: Results in bold exceed background threshold values. Wells 699-24-34C and 699-25-34C are not included in table because wells sample dry, and no samples were collected in 2012.

a. WAC 173-304, "Minimum Functional Standards for Solid Waste Handling."

b. 2010 Background threshold values were obtained from Table C-41 of *Hanford Site Groundwater Monitoring and Performance Report for 2009: Volumes 1 & 2* (DOE/RL-2010-11).

BTV = background threshold value

TOC = total organic carbon

Table 3-51. Solid Waste Landfill Groundwater Monitoring Results

Constituent (Unit)	Background Threshold Value	2012 Range	2012 Exceedance?	Wells Exceeded
Ammonium (µg/L)	90	< 1 to 3.2	No	--
Chemical Oxygen Demand (µg/L)	10,000	< 10,000	No	--
Chloride (µg/L)	7,820	1,280 to 7,160	No	--
Coliform Bacteria (colonies/100 mL)	1	< 1 to 1	No	--
pH	6.68 to 7.84	6.69 to 7.74	No	--
Iron – dissolved (µg/L)	174	< 19 to 106	No	--
Manganese (µg/L)	27.5	< 4 to 13.9	No	--
Nitrate (µg/L)	29,000	3,150 to 20,000	No	--
Nitrite (µg/L)	165	< 125 to 1,100	Yes	699-22-35, 699-23-34A, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, 699-24-35, 699-26-35A
Specific Conductance (µS/cm)	583	290 to 824	Yes	699-22-35, 699-24-33, 699-23-34A, 699-23-34B, 699-24-34A, 699-24-34B
Sulfate (µg/L)	47,200	9,200 to 48,500	Yes	699-23-34A, 699-24-34B
Temperature (degrees C)	20.7	14.3 to 20.3	No	--
Total Organic Carbon (µg/L)	842	182 to 7,160	Yes	699-22-35, 699-23-34B, 699-24-33
Zinc – Dissolved (µg/L)	42.3	< 5 to 11.7	No	--

4 Supporting Information for Aquifer Sampling Tubes

Aquifer tubes are small-diameter, flexible tubes that have a screen on one end. The tubes are installed in the aquifer along the Columbia River shoreline by driving a temporary steel casing into the ground adjacent to the river. The temporary casing is filled with water to keep sediment from coming up into the casing, then the drive-tip on the casing end is knocked out and the screened end of a tube is inserted into the casing. The steel casing is then pulled out, leaving the tube in place. Water is withdrawn from the tube using a peristaltic pump. Most aquifer tube sites include two or three separately installed tubes monitoring different depths, from ~1 to 8 meters. The tube sites cover the Hanford Site shoreline, from just upstream of 100-BC to downstream at the 300 Area. Sites are more closely spaced along some segments where higher density spatial resolution of contaminant plumes is needed.

On the Hanford Site, 562 aquifer tubes were installed. A subset of tubes is selected for sampling. *Sampling and Analysis Plan for Aquifer Sampling Tubes* (DOE/RL-2000-59) contains a list of tubes and constituents scheduled to be sampled in fiscal year 2009. The same list of tubes and constituents were scheduled for sampling in fiscal years 2010 through 2013. Approximately 20 tubes that were installed after 2009 and not included in DOE/RL-2000-59 were sampled in 2012.

Table 4-1 summarizes the total number of tubes and sites (clusters) in each segment of shoreline, the number of tubes sampled, and the number of sampling trips in 2012. In total, 343 aquifer tubes were sampled in 2012 under the routine shoreline monitoring program (Table 4-2), and many of the tubes were sampled more than once, for a total of 681 sampling trips. Additional samples were collected from some 100-N aquifer tubes in support of the apatite barrier performance evaluation (Table 4-3).

Most of the aquifer tubes are scheduled to be sampled once per year, generally in the fall. As stated in the 2011 annual report (DOE/RL-2011-118), much of the fall 2011 sampling was delayed into calendar year (CY) 2012 because of competing priorities for sampling personnel. The fall 2012 sampling event was completed as scheduled for most segments of the River Corridor, but some of the 100-N and 300 Area tubes were delayed into January 2012 (Table 4-2).

Table 4-1. Inventory of Hanford Site Aquifer Tubes as of December 31, 2012

Segment	Total Tubes/Sites	Tubes Not in Service	Sites Sampled, 2012	Tubes Sampled, 2012	Tube Trips, 2012*
100-BC	53/21	3	16	31	47
100-K	70/28	2	27	61	135
100-N	84/40	11	26	52	163
100-D	97/37	11	30	70	143
100-H	97/41	13	28	60	96
100-F	81/29	22	15	31	34
200-PO-1	28/17	5	11	13	26
300 Area	52/25	3	12	25	37
Total	**562/238**	**70**	**165**	**343**	**681**

* Does not include sampling trips made for performance monitoring of the 100-N apatite barrier. See Table C-3 for additional information.

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
100-BC SEGMENT				
01-M	A	12/1/2012	12/4/2012	
03-D	A	11/1/2011	2/14/2012	
03-D	A	12/1/2012	12/4/2012	
04-D	A	12/1/2012	12/4/2012	
05-D	A	12/1/2012	12/6/2012	
05-M	A	12/1/2012	12/6/2012	
05-S	A	12/1/2012	12/6/2012	
06-D	A	11/1/2011	2/29/2012	Frozen line 12/9/2011
06-D	A	12/1/2012	12/7/2012	
06-M	A	11/1/2011	2/29/2012	Frozen line 12/9/2011
06-M	A	12/1/2012	12/7/2012	
06-S	A	12/1/2012	12/7/2012	
12-D	A	12/1/2012	12/10/2012	
AT-B-1-M	A	12/1/2012	12/4/2012	
AT-B-2-D	A	11/1/2011	1/11/2012	Under water 12/7/2011
AT-B-2-D	A	12/1/2012	12/4/2012	
AT-B-3-D	A	11/1/2011	1/11/2012	
AT-B-3-D	A	12/1/2012	12/6/2012	
AT-B-3-M	A	11/1/2011	1/11/2012	
AT-B-3-M	A	12/1/2012	12/6/2012	
AT-B-3-S	A	11/1/2011	1/11/2012	
AT-B-3-S	A	12/1/2012	12/6/2012	
AT-B-5-D	A	11/1/2011	3/19/2012	
AT-B-5-D	A	12/1/2012	12/10/2012	
AT-B-7-M	A	11/1/2011	3/19/2012	
AT-B-7-M	A	12/1/2012	12/7/2012	
C6227	A	11/1/2011	3/19/2012	
C6227	A	12/1/2012	12/4/2012	
C6228	A	11/1/2011	3/19/2012	
C6228	A	12/1/2012	12/4/2012	
C6229	A	12/1/2012	12/4/2012	
C6230	A	11/1/2011	2/29/2012	Under water 2/28/2012
C6230	A	12/1/2012	12/7/2012	
C6231	A	12/1/2012	12/7/2012	
C6232	A	12/1/2012	12/7/2012	
C6233	A	12/1/2012		Delayed to 1/2013
C6234	A	12/1/2012		Delayed to 1/2013
C6235	A	12/1/2012		Delayed to 1/2013
C7718	A	11/1/2011	3/19/2012	
C7718	A	12/1/2012	12/6/2012	
C7719	A	11/1/2011	3/19/2012	
C7719	A	12/1/2012	12/6/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C7720	A	12/1/2012	12/6/2012	
C7724	A	12/1/2012	12/6/2012	
C7725	A	12/1/2012	12/6/2012	
C7726	A	12/1/2012	12/6/2012	
C7780	A	12/1/2012	12/7/2012	
C7781	A	11/1/2011	1/11/2012	Frozen line 12/9/2011
C7781	A	12/1/2012	12/7/2012	
C7782	A	12/1/2012	12/7/2012	
100-FR SEGMENT				
62-M	A	10/1/2012	9/19/2012	
64-D	A	10/1/2012	9/19/2012	
64-M	A	10/1/2012	9/19/2012	
64-S	A	10/1/2012	9/19/2012	
66-D	A	10/1/2012	9/24/2012	
66-M	A	10/1/2012	9/24/2012	
66-S	A	10/1/2012	9/24/2012	
67-M	A	10/1/2012	9/24/2012	
67-S	A	10/1/2012	9/24/2012	
68-D	A	10/1/2012	9/24/2012	
68-M	A	10/1/2012	9/24/2012	
68-S	A	10/1/2012	9/24/2012	
74-D	A	10/1/2012	9/26/2012	
75-D	A	10/1/2012	9/26/2012	
76-D	A	10/1/2012	9/26/2012	
77-D	A	10/1/2012	9/26/2012	
AT-F-1-D	A	10/1/2012	9/24/2012	
AT-F-1-M	A	10/1/2012	9/24/2012	
AT-F-1-S	A	10/1/2012	9/24/2012	
C6302	A	10/1/2011	3/1/2012	
C6302	A	10/1/2012	9/19/2012	
C6303	A	10/1/2011	3/1/2012	
C6303	A	10/1/2012	9/19/2012	
C6305	A	10/1/2011	3/1/2012	
C6305	A	10/1/2012	9/19/2012	
C6306	A	10/1/2012	9/19/2012	
C6307	A	10/1/2012	9/19/2012	
C6308	A	10/1/2012	9/19/2012	
C6309	A	10/1/2012	9/19/2012	
C6311	A	10/1/2012	9/19/2012	
C6312	A	10/1/2012	9/19/2012	
C6314	A	10/1/2012	9/24/2012	
C6315	A	10/1/2012	9/24/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C6316	A	10/1/2012	9/24/2012	
100-HR(D) SEGMENT				
36-D	A	11/1/2012		No yield 11/27/12; cancelled
36-M	A	11/1/2012	11/27/2012	
36-S	A	11/1/2012	11/27/2012	
38-D	A	11/1/2012	11/27/2012	
38-M	A	11/1/2012	11/27/2012	
AT-D-1-D	A	11/1/2012	11/26/2012	
AT-D-1-M	A	11/1/2012	11/26/2012	
AT-D-1-S	A	11/1/2012	11/26/2012	
AT-D-2-M	A	11/1/2012	11/26/2012	
AT-D-2-S	A	11/1/2012	11/26/2012	
AT-D-3-D	A	11/1/2012	11/27/2012	
AT-D-3-M	A	11/1/2012	11/27/2012	
AT-D-3-S	A	11/1/2012	11/27/2012	
AT-D-4-D	A	11/1/2012	11/26/2012	
AT-D-4-M	A	11/1/2012	11/26/2012	
AT-D-4-S	A	11/1/2012	11/26/2012	
AT-D-5-D	A	11/1/2012	11/28/2012	
AT-D-5-M	A	11/1/2012	11/28/2012	
C6266	Q	1/1/2012	1/25/2012	
C6266	Q	4/1/2012	4/23/2012	
C6266	Q	7/1/2012	7/16/2012	
C6266	Q	11/1/2012	11/15/2012	
C6267	Q	1/1/2012	1/25/2012	
C6267	Q	4/1/2012	4/23/2012	
C6267	Q	7/1/2012	7/16/2012	
C6267	Q	11/1/2012	11/15/2012	
C6268	Q	1/1/2012	1/25/2012	
C6268	Q	4/1/2012	4/26/2012	
C6268	Q	7/1/2012	7/16/2012	
C6268	Q	11/1/2012	11/15/2012	
C6269	Q	1/1/2012	1/25/2012	
C6269	Q	4/1/2012	4/24/2012	
C6269	Q	7/1/2012	8/6/2012	
C6269	Q	11/1/2012	11/15/2012	
C6270	Q	1/1/2012	1/25/2012	
C6270	Q	4/1/2012	4/24/2012	
C6270	Q	7/1/2012	8/6/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C6270	Q	11/1/2012	11/15/2012	
C6271	Q	1/1/2012	1/25/2012	
C6271	Q	4/1/2012	4/24/2012	
C6271	Q	7/1/2012	8/6/2012	
C6271	Q	11/1/2012	11/15/2012	
C6272	A	11/1/2012	11/26/2012	
C6275	A	11/1/2012	11/27/2012	
C6278	A	11/1/2012	11/27/2012	
C6281	A	11/1/2012	11/28/2012	
C6282	A	11/1/2012	11/28/2012	
C7645	A	11/1/2012	11/15/2012	
C7646	A	11/1/2012	11/15/2012	
C7647	A	11/1/2012	11/15/2012	
C7648	A	11/1/2012	11/15/2012	
DD-06-2	A	11/1/2012	11/28/2012	
DD-06-3	A	11/1/2012	11/28/2012	
DD-12-2	A	11/1/2012	11/28/2012	
DD-12-4	A	11/1/2012	11/28/2012	
DD-15-2	A	11/1/2012	11/28/2012	
DD-15-3	A	11/1/2012	11/28/2012	
DD-15-4	A	11/1/2012	11/28/2012	
DD-16-3	A	11/1/2012	11/27/2012	
DD-16-4	A	11/1/2012	11/27/2012	
DD-17-2	A	11/1/2012	11/27/2012	
DD-17-3	A	11/1/2012	11/27/2012	
DD-39-1	Q	1/1/2012	1/26/2012	
DD-39-1	Q	4/1/2012	4/23/2012	
DD-39-1	Q	7/1/2012	7/17/2012	
DD-39-1	Q	11/1/2012	11/20/2012	
DD-39-2	Q	1/1/2012	1/26/2012	
DD-39-2	Q	4/1/2012	4/23/2012	
DD-39-2	Q	7/1/2012	7/17/2012	
DD-39-2	Q	11/1/2012	11/20/2012	
DD-41-1	Q	1/1/2012	1/25/2012	
DD-41-1	Q	4/1/2012	4/26/2012	
DD-41-1	Q	7/1/2012	7/17/2012	
DD-41-1	Q	11/1/2012	11/20/2012	
DD-41-2	Q	1/1/2012	1/25/2012	
DD-41-2	Q	4/1/2012	4/26/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
DD-41-2	Q	7/1/2012	7/17/2012	
DD-41-2	Q	11/1/2012	11/20/2012	
DD-41-3	Q	1/1/2012	1/25/2012	
DD-41-3	Q	4/1/2012	4/26/2012	
DD-41-3	Q	7/1/2012	7/17/2012	
DD-41-3	Q	11/1/2012	11/20/2012	
DD-42-2	Q	1/1/2012	1/25/2012	
DD-42-2	Q	4/1/2012	4/24/2012	
DD-42-2	Q	7/1/2012	7/16/2012	
DD-42-2	Q	11/1/2012	11/20/2012	
DD-42-3	Q	1/1/2012	1/25/2012	
DD-42-3	Q	4/1/2012	4/24/2012	
DD-42-3	Q	7/1/2012	7/16/2012	
DD-42-3	Q	11/1/2012	11/20/2012	
DD-42-4	Q	1/1/2012	1/25/2012	
DD-42-4	Q	4/1/2012	4/24/2012	
DD-42-4	Q	7/1/2012	7/16/2012	
DD-42-4	Q	11/1/2012	11/20/2012	
DD-43-2	Q	1/1/2012	1/25/2012	
DD-43-2	Q	4/1/2012	4/24/2012	
DD-43-2	Q	7/1/2012	7/16/2012	
DD-43-2	Q	11/1/2012	11/26/2012	
DD-43-3	Q	1/1/2012	1/25/2012	
DD-43-3	Q	4/1/2012	4/24/2012	
DD-43-3	Q	7/1/2012	7/16/2012	
DD-43-3	Q	11/1/2012	11/26/2012	
DD-44-3	Q	1/1/2012	1/25/2012	
DD-44-3	Q	4/1/2012	4/24/2012	
DD-44-3	Q	7/1/2012	8/2/2012	
DD-44-3	Q	11/1/2012	11/15/2012	
DD-44-4	Q	1/1/2012	1/25/2012	
DD-44-4	Q	4/1/2012	4/24/2012	
DD-44-4	Q	7/1/2012	8/2/2012	
DD-44-4	Q	11/1/2012	11/15/2012	
DD-49-1	A	11/1/2012	11/15/2012	
DD-49-2	A	11/1/2012	11/15/2012	
DD-49-3	A	11/1/2012	11/15/2012	
DD-49-4	A	11/1/2012	11/15/2012	
DD-50-1	A	11/1/2012	11/15/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
DD-50-2	A	11/1/2012	11/15/2012	
DD-50-3	A	11/1/2012	11/15/2012	
DD-50-4	A	11/1/2012	11/15/2012	
REDOX-1-3.3	Q	1/1/2012	1/26/2012	
REDOX-1-3.3	Q	4/1/2012	5/7/2012	
REDOX-1-3.3	Q	7/1/2012	8/6/2012	
REDOX-1-3.3	Q	11/1/2012	11/26/2012	
REDOX-1-6.0	Q	1/1/2012	1/26/2012	
REDOX-1-6.0	Q	4/1/2012	5/7/2012	
REDOX-1-6.0	Q	7/1/2012	8/6/2012	
REDOX-1-6.0	Q	11/1/2012	11/26/2012	
REDOX-2-6.0	Q	1/1/2012	1/26/2012	
REDOX-2-6.0	Q	4/1/2012	4/30/2012	
REDOX-2-6.0	Q	7/1/2012	7/17/2012	
REDOX-2-6.0	Q	11/1/2012	11/26/2012	
REDOX-3-3.3	Q	4/1/2012	5/7/2012	
REDOX-3-3.3	Q	7/1/2012	7/17/2012	
REDOX-3-3.3	Q	11/1/2012	11/20/2012	
REDOX-3-4.6	Q	4/1/2012	5/7/2012	
REDOX-3-4.6	Q	7/1/2012	7/17/2012	
REDOX-3-4.6	Q	11/1/2012	11/20/2012	
REDOX-4-3.0	Q	1/1/2012	1/26/2012	
REDOX-4-3.0	Q	4/1/2012	4/26/2012	
REDOX-4-3.0	Q	7/1/2012	7/17/2012	
REDOX-4-3.0	Q	11/1/2012	11/20/2012	
REDOX-4-6.0	Q	1/1/2012	1/26/2012	
REDOX-4-6.0	Q	4/1/2012	4/26/2012	
REDOX-4-6.0	Q	7/1/2012	7/17/2012	
REDOX-4-6.0	Q	11/1/2012	11/20/2012	
100-HR(H) SEGMENT				
44-M	A	11/1/2012	11/1/2012	
45-D	A	11/1/2012	11/6/2012	
45-M	A	11/1/2012	11/6/2012	
45-S	A	11/1/2012	11/7/2012	
47-D	A	11/1/2012	11/13/2012	
47-M	A	11/1/2012	11/13/2012	
48-M	A	11/1/2012	11/8/2012	
48-S	A	11/1/2012	11/8/2012	
49-D	A	11/1/2012	11/14/2012	
50-M	A	10/1/2011	1/3/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
50-M	A	11/1/2012	11/14/2012	
50-S	A	10/1/2011	1/3/2012	
50-S	A	11/1/2012	11/14/2012	
51-D	A	10/1/2011	1/3/2012	
51-D	A	11/1/2012	11/14/2012	
51-M	A	10/1/2011	1/3/2012	
51-M	A	11/1/2012	11/14/2012	
51-S	A	10/1/2011	1/3/2012	
51-S	A	11/1/2012	11/14/2012	
52-D	A	10/1/2011	1/3/2012	
52-D	A	11/1/2012	11/14/2012	
52-M	A	10/1/2011	1/3/2012	
52-M	A	11/1/2012	11/14/2012	
52-S	A	10/1/2011	1/3/2012	
52-S	A	11/1/2012	11/14/2012	
54-D	A	10/1/2011	1/4/2012	
54-D	A	11/1/2012	11/14/2012	
54-M	A	10/1/2011	1/4/2012	
54-M	A	11/1/2012	11/14/2012	
54-S	A	10/1/2011	1/4/2012	
54-S	A	11/1/2012	11/14/2012	
AT-H-1-D	A	11/1/2012	11/7/2012	
AT-H-1-M	A	11/1/2012	11/7/2012	
AT-H-1-S	A	11/1/2012	11/7/2012	
AT-H-2-D	A	11/1/2012	11/7/2012	
AT-H-2-M	A	11/1/2012	11/7/2012	
AT-H-2-S	A	11/1/2012	11/7/2012	
AT-H-3-D	A	11/1/2012	11/7/2012	
AT-H-3-S	A	11/1/2012	11/7/2012	
C5632	A	10/1/2011	1/5/2012	
C5632	A	11/1/2012	10/31/2012	
C5633	A	10/1/2011	1/5/2012	
C5633	A	11/1/2012	10/31/2012	
C5634	A	10/1/2011	1/5/2012	
C5634	A	11/1/2012	10/31/2012	
C5635	A	10/1/2011	1/4/2012	
C5635	A	11/1/2012	10/31/2012	
C5636	A	10/1/2011	1/4/2012	
C5636	A	11/1/2012	10/31/2012	
C5637	A	10/1/2011	1/4/2012	
C5637	A	11/1/2012	10/31/2012	
C5638	A	10/1/2011	1/5/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C5638	A	11/1/2012	10/31/2012	
C5641	A	10/1/2011	1/4/2012	
C5641	A	11/1/2012	10/31/2012	
C5644	A	10/1/2011	1/4/2012	
C5644	A	11/1/2012	11/1/2012	
C5673	A	10/1/2011	1/5/2012	
C5673	A	11/1/2012	11/1/2012	
C5674	A	10/1/2011	1/5/2012	
C5674	A	11/1/2012	11/1/2012	
C5676	A	10/1/2011	1/5/2012	
C5676	A	11/1/2012	11/1/2012	
C5677	A	10/1/2011	1/5/2012	
C5677	A	11/1/2012	11/1/2012	
C5678	A	10/1/2011	1/5/2012	
C5678	A	11/1/2012	11/1/2012	
C5679	A	10/1/2011	1/10/2012	
C5679	A	11/1/2012	11/1/2012	
C5680	A	10/1/2011	1/10/2012	Specific conductance did not stabilize
C5680	A	11/1/2012	11/1/2012	
C5681	A	10/1/2011	1/10/2012	
C5681	A	11/1/2012	11/1/2012	
C5682	A	11/1/2012	11/6/2012	
C6284	A	10/1/2011	1/5/2012	
C6284	A	11/1/2012	10/31/2012	
C6285	A	10/1/2011	1/5/2012	
C6285	A	11/1/2012	10/31/2012	
C6286	A	10/1/2011	1/5/2012	
C6286	A	11/1/2012	10/31/2012	
C6287	A	10/1/2011	3/1/2012	
C6287	A	11/1/2012	10/31/2012	
C6288	A	10/1/2011	1/5/2012	Specific conductance did not stabilize
C6288	A	11/1/2012	10/31/2012	
C6290	A	10/1/2011	1/3/2012	
C6290	A	11/1/2012	11/6/2012	
C6291	A	10/1/2011	1/3/2012	
C6291	A	11/1/2012	11/6/2012	
C6293	A	11/1/2012	11/6/2012	
C6296	A	11/1/2012	11/13/2012	
C6297	A	11/1/2012	11/13/2012	
C6299	A	11/1/2012	11/13/2012	
C6300	A	11/1/2012	11/13/2012	
C6301	A	11/1/2012	11/13/2012	
C7649	A	11/1/2012	11/13/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C7650	A	11/1/2012	11/13/2012	
100-KR SEGMENT				
14-D	A	11/1/2011	2/7/2012	
14-D	A	10/1/2012	10/9/2012	
17-D	A	11/1/2011	1/12/2012	
17-D	A	10/1/2012	9/24/2012	
18-S	A	11/1/2011	1/13/2012	
18-S	A	10/1/2012	11/29/2012	
19-D	A	11/1/2011	2/8/2012	
19-D	A	10/1/2012	10/3/2012	
19-M	A	11/1/2011	2/8/2012	
19-M	A	10/1/2012	10/3/2012	
21-M	A	11/1/2011	2/8/2012	
21-M	A	10/1/2012	10/8/2012	
21-S	A	11/1/2011	2/8/2012	
21-S	A	10/1/2012	10/8/2012	
22-D	A	11/1/2011	2/7/2012	
22-D	A	10/1/2012	10/9/2012	
22-M	A	11/1/2011	2/7/2012	
22-M	A	10/1/2012	10/9/2012	
23-M	A	11/1/2011	2/13/2012	
23-M	A	10/1/2012	10/9/2012	
25-D	A	11/1/2011	2/6/2012	
25-D	A	10/1/2012	10/11/2012	
26-D	A	11/1/2011	2/28/2012	No yield 1/13/2012, 2/13/2012
26-D	A	10/1/2012	10/11/2012	
26-D	Q	5/1/2012	5/21/2012	
26-D	Q	8/1/2012	8/2/2012	
26-M	A	11/1/2011	1/13/2012	
26-M	Q	5/1/2012	5/21/2012	
26-M	Q	8/1/2012	8/2/2012	
26-M	A	10/1/2012	10/11/2012	
26-S	A	11/1/2011	1/13/2012	
26-S	Q	5/1/2012	5/21/2012	
26-S	Q	8/1/2012	8/2/2012	
26-S	A	10/1/2012	10/11/2012	
AT-K-1-D	A	10/1/2011	1/6/2012	
AT-K-1-D	A	10/1/2012	9/24/2012	
AT-K-2-D	A	10/1/2011	1/6/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
AT-K-2-D	A	10/1/2012	10/10/2012	
AT-K-3-D	A	10/1/2011	1/6/2012	
AT-K-3-D	A	10/1/2012	10/4/2012	
AT-K-3-M	A	10/1/2011	1/6/2012	
AT-K-3-M	A	10/1/2012	10/4/2012	
AT-K-3-S	A	10/1/2011	1/6/2012	
AT-K-3-S	A	10/1/2012	10/4/2012	
AT-K-4-D	A	2/1/2012	2/1/2012	
AT-K-4-D	A	10/1/2012	10/9/2012	
AT-K-4-M	A	11/1/2011	2/1/2012	
AT-K-4-M	A	10/1/2012	10/9/2012	
AT-K-4-S	A	11/1/2011	2/1/2012	
AT-K-4-S	A	10/1/2012	10/9/2012	
AT-K-5-D	A	11/1/2011	2/6/2012	
AT-K-5-D	A	10/1/2012	10/9/2012	
AT-K-5-M	A	11/1/2011	2/6/2012	
AT-K-5-M	A	10/1/2012	10/9/2012	
AT-K-5-S	A	11/1/2011	2/6/2012	
AT-K-5-S	A	10/1/2012	10/9/2012	
AT-K-6-D	A	11/1/2011	1/13/2012	
AT-K-6-D	A	10/1/2012	10/11/2012	
AT-K-6-M	A	11/1/2011	1/13/2012	
AT-K-6-M	A	10/1/2012	10/11/2012	
AT-K-6-S	A	11/1/2011	1/13/2012	
AT-K-6-S	A	10/1/2012	10/11/2012	
C6236	A	11/1/2011	2/13/2012	
C6236	A	10/1/2012	9/24/2012	
C6237	A	11/1/2011	2/13/2012	
C6237	A	10/1/2012	9/24/2012	
C6238	A	11/1/2011	2/13/2012	
C6238	A	10/1/2012	9/24/2012	
C6239	A	11/1/2011	2/9/2012	
C6239	A	10/1/2012	9/24/2012	
C6240	A	11/1/2011	2/9/2012	
C6240	A	10/1/2012	9/24/2012	
C6241	Q	2/1/2012	2/13/2012	
C6241	Q	5/1/2012	5/21/2012	
C6241	Q	8/1/2012	8/13/2012	
C6241	A	10/1/2012	9/24/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C6242	A	11/1/2011	1/13/2012	
C6242	A	10/1/2012	9/24/2012	
C6243	A	11/1/2011	1/13/2012	
C6243	A	10/1/2012	9/24/2012	
C6244	A	11/1/2011	1/12/2012	
C6244	A	10/1/2012	9/24/2012	
C6245	A	11/1/2011	2/9/2012	
C6245	A	10/1/2012	10/3/2012	
C6246	A	11/1/2011	2/9/2012	
C6246	A	10/1/2012	10/3/2012	
C6247	A	11/1/2011	2/9/2012	
C6247	A	10/1/2012	10/3/2012	
C6248	A	11/1/2011	1/13/2012	
C6248	A	10/1/2012	10/4/2012	
C6249	A	11/1/2011	1/13/2012	
C6249	A	10/1/2012	10/4/2012	
C6250	A	11/1/2011	1/13/2012	
C6250	Q	5/1/2012	5/21/2012	
C6250	Q	8/1/2012	8/2/2012	
C6250	A	10/1/2012	10/4/2012	
C6251	A	11/1/2011	2/9/2012	
C6251	A	10/1/2012	10/4/2012	
C6252	A	11/1/2011	2/9/2012	
C6252	A	10/1/2012	10/4/2012	
C6253	A	11/1/2011	2/9/2012	
C6253	A	10/1/2012	10/4/2012	
C6254	A	11/1/2011	2/9/2012	
C6254	A	10/1/2012	10/8/2012	
C6255	A	11/1/2011	2/9/2012	
C6255	A	10/1/2012	10/8/2012	
C6256	A	11/1/2011	2/9/2012	
C6256	A	10/1/2012	10/8/2012	
C6257	A	11/1/2011	2/7/2012	
C6257	A	10/1/2012	10/8/2012	
C6258	A	11/1/2011	2/7/2012	
C6258	A	10/1/2012	10/8/2012	
C6259	A	11/1/2011	2/7/2012	
C6259	A	10/1/2012	10/8/2012	
C6260	A	11/1/2011	2/6/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C6260	A	10/1/2012	10/9/2012	
C6261	A	11/1/2011	2/7/2012	
C6261	A	10/1/2012	10/9/2012	
C6263	A	11/1/2011	2/13/2012	
C6263	A	10/1/2012	10/11/2012	
C6264	A	11/1/2011	2/13/2012	
C6264	A	10/1/2012	10/11/2012	
C6265	A	11/1/2011	2/13/2012	
C6265	A	10/1/2012	10/11/2012	
C7641	Q	10/1/2011	1/9/2012	
C7641	Q	7/1/2012	8/13/2012	
C7641	A	10/1/2012	10/10/2012	
C7642	Q	10/1/2011	1/10/2012	
C7642	Q	7/1/2012	8/13/2012	
C7642	A	10/1/2012	10/10/2012	
C7643	Q	10/1/2011	1/10/2012	
C7643	Q	7/1/2012	8/13/2012	
C7643	A	10/1/2012	10/10/2012	
DK-04-2	A	11/1/2011	3/19/2012	
DK-04-2	A	10/1/2012	10/30/2012	
100-NR SEGMENT				
C6132	Q	12/1/2011	1/17/2012	
C6132	Q	3/1/2012	3/27/2012	
C6132	Q	6/1/2012	6/27/2012	
C6132	Q	9/1/2012	9/10/2012	
C6132	Q	12/1/2012	12/12/2012	
C6135	Q	12/1/2011	1/17/2012	
C6135	Q	3/1/2012	3/27/2012	
C6135	Q	6/1/2012	6/27/2012	Sewer odor
C6135	Q	9/1/2012	9/10/2012	
C6135	Q	12/1/2012		Delayed to 1/2013, then broke; cancelled
C6317	A	12/1/2011	2/14/2012	
C6317	A	12/1/2012		Delayed to 1/2013
C6318	A	12/1/2011	2/14/2012	
C6318	A	12/1/2012		Delayed to 1/2013
C6319	A	12/1/2011	2/14/2012	
C6319	A	12/1/2012		Delayed to 1/2013
C6320	A	12/1/2011	1/26/2012	
C6320	A	12/1/2012		Delayed to 1/2013
C6321	A	12/1/2011	1/26/2012	
C6321	A	12/1/2012		Delayed to 1/2013
C6352	A	12/1/2011	2/14/2012	
C6352	A	12/1/2012		Delayed to 1/2013

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
C6322	A	12/1/2011	1/26/2012	
C6322	A	12/1/2012		Delayed to 1/2013
C6323	A	11/1/2011	1/17/2012	
C6323	A	12/1/2012		Delayed to 1/2013
C6324	A	11/1/2011	1/17/2012	
C6324	A	12/1/2012		Delayed to 1/2013
C6325	A	11/1/2011	1/17/2012	
C6325	A	12/1/2012		Delayed to 1/2013
C6326	A	12/1/2011	1/16/2012	
C6326	A	12/1/2012	12/11/2012	
C6327	A	12/1/2011	1/16/2012	
C6327	A	12/1/2012	12/11/2012	
C6328	A	12/1/2011		No yield 1/16/2012; cancelled
C6328	A	12/1/2012	12/11/2012	
C6329	A	12/1/2011	2/14/2012	
C6329	A	12/1/2012		Delayed to 1/2013
C6330	A	12/1/2011	2/14/2012	
C6330	A	12/1/2012		Delayed to 1/2013
C6331	A	12/1/2011	2/14/2012	
C6331	A	12/1/2012		Delayed to 1/2013
C6332	A	12/1/2011	1/16/2012	
C6332	A	12/1/2012	12/12/2012	
C6333	A	12/1/2011	1/16/2012	
C6333	A	12/1/2012	12/12/2012	
C6334	A	12/1/2011	1/16/2012	
C6334	A	12/1/2012	12/12/2012	
C7881	Q	12/1/2011	1/30/2012	
C7881	Q	3/1/2012	3/21/2012	
C7881	Q	6/1/2012	6/20/2012	Strong sewer odor
C7881	Q	9/1/2012	9/1/2012	
C7881	Q	12/1/2012		Delayed to 1/2013
C7934	1	12/1/2011	1/16/2012	
C7934	A	12/1/2012	12/11/2012	
C7935	1	12/1/2011	1/16/2012	
C7935	A	12/1/2012	12/11/2012	
C7936	1	12/1/2011	1/16/2012	
C7936	A	12/1/2012	12/11/2012	
C7937	1	12/1/2011	1/16/2012	
C7937	A	12/1/2012	12/11/2012	
C7938	1	12/1/2011	1/16/2012	Specific conductance declined during sampling
C7938	A	12/1/2012	12/11/2012	
C7939	1	12/1/2011	1/16/2012	
C7939	A	12/1/2012	12/11/2012	
N116mArray-0A	Q	12/1/2011	2/1/2012	
N116mArray-0A	Q	3/1/2012	3/27/2012	
N116mArray-0A	Q	6/1/2012	6/22/2012	Strong sewer odor

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
N116mArray-0A	Q	9/1/2012	9/17/2012	
N116mArray-0A	Q	12/1/2012		Delayed to 1/2013
N116mArray-10A	Q	12/1/2011	1/30/2012	
N116mArray-10A	Q	3/1/2012	3/21/2012	
N116mArray-10A	Q	9/1/2012	9/17/2012	
N116mArray-10A	Q	12/1/2012		Delayed to 1/2013
N116mArray-11A	Q	12/1/2011	1/27/2012	
N116mArray-11A	Q	3/1/2012	3/21/2012	
N116mArray-11A	Q	6/1/2012	6/11/2012	
N116mArray-11A	Q	9/1/2012	9/11/2012	
N116mArray-11A	Q	12/1/2012		Delayed to 1/2013
N116mArray-12A	Q	12/1/2011	3/22/2012	Line frozen or plugged 1/18/2012
N116mArray-12A	Q	6/1/2012	6/11/2012	
N116mArray-12A	Q	9/1/2012	9/18/2012	Line plugged 9/11/12
N116mArray-12A	Q	12/1/2012		Delayed to 1/2013, then no yield; cancelled
N116mArray-13A	Q	9/1/2012	9/18/2012	
N116mArray-13A	Q	12/1/2012		Delayed to 1/2013, then no yield; cancelled
N116mArray-14A	Q	12/1/2012		Tube broken; cancelled
N116mArray-15A	Q	12/1/2011	1/18/2012	
N116mArray-15A	Q	3/1/2012	3/21/2012	
N116mArray-15A	Q	6/1/2012	6/11/2012	
N116mArray-15A	Q	9/1/2012	9/10/2012	
N116mArray-15A	Q	12/1/2012		Delayed to 1/2013
N116mArray-1A	Q	12/1/2011	2/1/2012	
N116mArray-1A	Q	3/1/2012	3/26/2012	
N116mArray-1A	Q	6/1/2012	6/22/2012	Strong sewer odor; tubes need to be extended
N116mArray-1A	Q	9/1/2012	9/17/2012	
N116mArray-1A	Q	12/1/2012		Delayed to 1/2013
N116mArray-2A	Q	12/1/2011	1/31/2012	
N116mArray-2A	Q	3/1/2012	3/26/2012	
N116mArray-2A	Q	6/1/2012	6/22/2012	
N116mArray-2A	Q	9/1/2012	9/17/2012	
N116mArray-2A	Q	12/1/2012		Delayed to 1/2013
N116mArray-3A	M	3/1/2012	3/26/2012	
N116mArray-3A	M	4/1/2012	4/25/2012	
N116mArray-3A	M	5/1/2012	5/22/2012	
N116mArray-3A	M	6/1/2012	6/22/2012	
N116mArray-3A	M	7/1/2012	7/23/2012	
N116mArray-3A	M	8/1/2012	8/15/2012	
N116mArray-3A	M	9/1/2012	9/17/2012	
N116mArray-3A	M	10/1/2012	10/16/2012	
N116mArray-3A	M	11/1/2012	11/29/2012	
N116mArray-3A	M	12/1/2012		Delayed to 1/2013
N116mArray-4A	M	12/1/2011	2/1/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
N116mArray-4A	M	2/1/2012	2/28/2012	
N116mArray-4A	M	3/1/2012	3/26/2012	
N116mArray-4A	M	4/1/2012	4/25/2012	
N116mArray-4A	M	5/1/2012	5/22/2012	
N116mArray-4A	M	6/1/2012	6/22/2012	
N116mArray-4A	M	7/1/2012	7/23/2012	
N116mArray-4A	M	8/1/2012	8/15/2012	
N116mArray-4A	M	9/1/2012	9/17/2012	
N116mArray-4A	M	10/1/2012	10/16/2012	
N116mArray-4A	M	11/1/2012	11/29/2012	
N116mArray-4A	M	12/1/2012		Delayed to 1/2013
N116mArray-6A	M	12/1/2011	1/31/2012	
N116mArray-6A	M	2/1/2012	2/28/2012	
N116mArray-6A	M	3/1/2012	3/21/2012	
N116mArray-6A	M	4/1/2012	4/25/2012	
N116mArray-6A	M	5/1/2012	5/22/2012	
N116mArray-6A	M	6/1/2012	6/20/2012	
N116mArray-6A	M	7/1/2012	7/23/2012	
N116mArray-6A	M	8/1/2012	8/15/2012	
N116mArray-6A	M	9/1/2012	9/11/2012	
N116mArray-6A	M	10/1/2012	10/16/2012	
N116mArray-6A	M	11/1/2012	11/29/2012	
N116mArray-6A	M	12/1/2012		Delayed to 1/2013
N116mArray-8.5A	Q	12/1/2011	1/30/2012	Slow flow; partially plugged
N116mArray-8.5A	Q	3/1/2012	3/21/2012	
N116mArray-8.5A	Q	6/1/2012	6/20/2012	
N116mArray-8.5A	Q	9/1/2012	9/18/2012	Line plugged 9/11/12
N116mArray-8.5A	Q	12/1/2012		Delayed to 1/2013, then no yield; cancelled
N116mArray-8A	Q	12/1/2011	1/31/2012	
N116mArray-8A	Q	3/1/2012	3/21/2012	
N116mArray-8A	Q	6/1/2012	6/20/2012	
N116mArray-8A	Q	9/1/2012	9/11/2012	
N116mArray-8A	Q	12/1/2012		Delayed to 1/2013
N116mArray-9A	Q	12/1/2011	1/27/2012	
N116mArray-9A	Q	3/1/2012	3/21/2012	
N116mArray-9A	Q	6/1/2012	6/11/2012	
N116mArray-9A	Q	9/1/2012	9/11/2012	
N116mArray-9A	Q	12/1/2012		Delayed to 1/2013
NVP1-1	Q	3/1/2012	3/22/2012	
NVP1-1	Q	6/1/2012	6/20/2012	
NVP1-1	Q	9/1/2012	9/12/2012	
NVP1-1	Q	12/1/2012		Delayed to 1/2013

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
NVP1-2	Q	3/1/2012	3/22/2012	
NVP1-2	Q	6/1/2012	6/20/2012	
NVP1-2	Q	9/1/2012	9/12/2012	
NVP1-2	Q	12/1/2012		Delayed to 1/2013
NVP1-3	Q	12/1/2011	1/31/2012	
NVP1-3	Q	3/1/2012	3/22/2012	
NVP1-3	Q	6/1/2012	6/20/2012	
NVP1-3	Q	9/1/2012	9/12/2012	
NVP1-3	Q	12/1/2012		Delayed to 1/2013
NVP1-4	Q	12/1/2011	1/31/2012	
NVP1-4	Q	3/1/2012	3/22/2012	
NVP1-4	Q	6/1/2012	6/20/2012	
NVP1-4	Q	9/1/2012	9/12/2012	
NVP1-4	Q	12/1/2012		Delayed to 1/2013
NVP1-5	Q	12/1/2011	1/31/2012	
NVP1-5	Q	3/1/2012	3/22/2012	
NVP1-5	Q	6/1/2012	6/20/2012	
NVP1-5	Q	9/1/2012	9/12/2012	
NVP1-5	Q	12/1/2012		Delayed to 1/2013
NVP2-115.1	Q	12/1/2011	1/31/2012	
NVP2-115.1	Q	3/1/2012	3/22/2012	
NVP2-115.1	Q	6/1/2012	6/20/2012	
NVP2-115.1	Q	9/1/2012	9/12/2012	
NVP2-115.1	Q	12/1/2012		Delayed to 1/2013
NVP2-115.4	Q	12/1/2011	1/31/2012	
NVP2-115.4	Q	3/1/2012	3/22/2012	
NVP2-115.4	Q	6/1/2012	6/20/2012	
NVP2-115.4	Q	9/1/2012	9/12/2012	
NVP2-115.4	Q	12/1/2012		Delayed to 1/2013
NVP2-115.7	Q	12/1/2011	1/31/2012	
NVP2-115.7	Q	3/1/2012	3/22/2012	
NVP2-115.7	Q	6/1/2012	6/20/2012	
NVP2-115.7	Q	9/1/2012	9/12/2012	
NVP2-115.7	Q	12/1/2012		Delayed to 1/2013
NVP2-116.0	M	12/1/2011	1/31/2012	
NVP2-116.0	M	3/1/2012	3/27/2012	
NVP2-116.0	M	4/1/2012	4/25/2012	
NVP2-116.0	M	5/1/2012	5/22/2012	
NVP2-116.0	M	6/1/2012	6/20/2012	
NVP2-116.0	M	7/1/2012	7/23/2012	
NVP2-116.0	M	8/1/2012	8/15/2012	
NVP2-116.0	M	9/1/2012	9/12/2012	
NVP2-116.0	M	10/1/2012	10/16/2012	
NVP2-116.0	M	11/1/2012	11/29/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
NVP2-116.0	M	12/1/2012		Delayed to 1/2013
NVP2-116.3	Q	12/1/2011	1/31/2012	
NVP2-116.3	Q	3/1/2012	3/22/2012	
NVP2-116.3	Q	6/1/2012	6/20/2012	Strong sewer odor
NVP2-116.3	Q	9/1/2012	9/12/2012	
NVP2-116.3	Q	12/1/2012		Delayed to 1/2013
200-PO SEGMENT				
85-D	A	11/1/2011	2/27/2012	
85-D	A	10/1/2012	10/24/2012	
86-D	A	11/1/2011	2/27/2012	
86-D	A	10/1/2012	10/17/2012	
C6353	A	11/1/2011	2/23/2012	
C6353	A	10/1/2012	11/5/2012	
C6356	A	11/1/2011	2/23/2012	
C6356	A	10/1/2012	10/24/2012	
C6359	A	11/1/2011	2/21/2012	
C6359	A	10/1/2012	10/23/2012	
C6362	A	11/1/2011	2/21/2012	
C6362	A	10/1/2012	10/23/2012	
C6368	A	11/1/2011	2/16/2012	
C6368	A	10/1/2012	10/15/2012	
C6371	A	10/1/2012		No yield 10/15/12; attempted to unplug but no yield again 11/5/12; cancelled
C6374	A	11/1/2011	2/21/2012	
C6374	A	10/1/2012	10/23/2012	
C6375	A	11/1/2011	2/21/2012	
C6375	A	10/1/2012	10/23/2012	
C6378	A	11/1/2011	2/16/2012	
C6378	A	10/1/2012	10/15/2012	
C6380	A	11/1/2011	2/16/2012	
C6380	A	10/1/2012	10/15/2012	Low flow; eliminated some samples
C6383	A	11/1/2011	2/27/2012	
C6383	A	10/1/2012	10/17/2012	
C6384	A	11/1/2011	2/23/2012	
C6384	A	10/1/2012	10/17/2012	
300-FF SEGMENT				
AT-3-1-D(1)	A	12/1/2012	12/13/2012	
AT-3-1-M	SA	3/1/2012	3/2/2012	
AT-3-1-M	SA	12/1/2012	12/13/2012	
AT-3-1-S	A	12/1/2012	12/13/2012	
AT-3-2-M	SA	3/1/2012	3/14/2012	
AT-3-2-M	SA	12/1/2012	12/13/2012	
AT-3-2-S	A	10/1/2011	2/16/2012	
AT-3-2-S	A	12/1/2012	12/13/2012	

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment
AT-3-3-D	SA	3/1/2012	3/2/2012	
AT-3-3-D	SA	12/1/2012	12/18/2012	
AT-3-3-M	SA	3/1/2012	3/2/2012	
AT-3-3-M	SA	12/1/2012	12/18/2012	
AT-3-3-S	SA	3/1/2012	3/2/2012	
AT-3-3-S	SA	12/1/2012	12/18/2012	
AT-3-4-D	SA	3/1/2012	3/2/2012	
AT-3-4-D	SA	12/1/2012	12/18/2012	
AT-3-4-M	SA	12/1/2012	12/18/2012	
AT-3-4-S	SA	3/1/2012	3/2/2012	
AT-3-4-S	SA	12/1/2012	12/18/2012	
AT-3-5-S	SA	3/1/2012	3/14/2012	
AT-3-5-S	SA	12/1/2012		Delayed to 1/2013
AT-3-6-D	SA	3/1/2012	3/2/2012	
AT-3-6-D	SA	12/1/2012		Delayed to 1/2013
AT-3-6-M	A	12/1/2012		Delayed to 1/2013
AT-3-6-S	SA	3/1/2012	3/2/2012	
AT-3-6-S	SA	12/1/2012		Delayed to 1/2013
AT-3-7-D	SA	3/1/2012	3/15/2012	
AT-3-7-D	SA	12/1/2012		Delayed to 1/2013
AT-3-7-M	SA	3/1/2012	3/15/2012	
AT-3-7-M	SA	12/1/2012		Delayed to 1/2013
AT-3-7-S	A	12/1/2012		Delayed to 1/2013
AT-3-8-M	A	12/1/2012		Delayed to 1/2013
AT-3-8-S	SA	3/1/2012	3/15/2012	
AT-3-8-S	SA	12/1/2012		Delayed to 1/2013
C6341	SA	3/1/2012	3/14/2012	
C6341	SA	12/1/2012	12/13/2012	
C6342	SA	3/1/2012	3/14/2012	
C6342	SA	12/1/2012	12/13/2012	
C6343	SA	3/1/2012	3/14/2012	
C6343	SA	12/1/2012	12/13/2012	
C6344	SA	3/1/2012	3/14/2012	
C6344	SA	12/1/2012	12/18/2012	
C6347	SA	3/1/2012	3/14/2012	
C6347	SA	12/1/2012		Delayed to 1/2013
C6348	SA	3/1/2012	3/14/2012	
C6348	SA	12/1/2012		Delayed to 1/2013
C6350	SA	3/1/2012	3/15/2012	
C6350	SA	12/1/2012		Delayed to 1/2013
C6351	SA	3/1/2012	3/15/2012	
C6351	SA	12/1/2012		Delayed to 1/2013

Table 4-2. Aquifer Tube Sampling Dates, 2012

Tube Name	Freq.	Month Scheduled*	Sample Dates	Comment

* Table includes all tubes scheduled in 2012 or sampled in 2012 (delayed from 2011).

A = annually

M = monthly

Q = quarterly

SA = semiannually

Table 4-3. Nonroutine Aquifer Tube Sampling at 100-N Apatite Barrier, 2012

Tube Name	Sample Dates
APT-1	5/6/2012, 9/27/2012
APT-5	5/6/2012, 9/27/2012
C7881	5/9/2012, 9/27/2012
N116mArray-1A	5/6/2012, 9/27/2012
N116mArray-2A	5/6/2012, 9/27/2012
N116mArray-3A	5/7/2012, 9/26/2012
N116mArray-4A	5/7/2012, 9/26/2012
N116mArray-6A	5/9/2012, 9/26/2012
N116mArray-8A	5/9/2012, 10/1/2012
NVP2-116.0	9/26/2012
NVP2-116.3	5/7/2012

5 Groundwater Monitoring Data Quality Assessment

5.1 Introduction

This chapter presents the data quality assessment (DQA) for laboratory data generated from groundwater samples collected during CY2012 as part of the Hanford Site groundwater monitoring program. The purpose of this DQA is to determine whether these data meet the data quality requirements specified in *Hanford Site Environmental Monitoring Plan* (DOE/RL-91-50) and *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan* (CHPRC-00189).

For the groundwater monitoring program during CY2012, 1,224 wells, aquifer tubes, and seeps were sampled over the extent of the Hanford Site. These sampling events generated 16,271 samples: 3,661 field samples and 12,610 laboratory samples. From these 16,271 samples, Field Sampling Operations generated 18,320 field measurements, and 7 analytical laboratories reported 150,132 laboratory results for a total of 168,452 measurements.

5.2 Purpose

The purpose of this DQA is to determine whether the data generated from the CY2012 groundwater monitoring sampling effort meet the data quality requirements specified in the DOE/RL-91-50 and CHPRC-00189. Meeting the data quality requirements of these documents provides assurance that the data collected are of sufficient quantity and quality for the groundwater monitoring program.

5.3 Scope

This DQA focuses on the chemical and radiochemical data collected for the groundwater monitoring program. The data are evaluated to determine whether they meet the analytical criteria outlined in DOE/RL-91-50 and CHPRC-00189. The DQA methodology includes data verification and data usability evaluations.

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific dataset against the method, procedural requirements, or contractual requirements. It includes confirmation that the specified sampling and analytical requirements have been completed as specified in DOE/RL-91-50 and CHPRC-00189. This evaluation is documented in Section 5.5. In addition, verification is performed for field quality control (QC) in Section 5.8 and for laboratory QC samples in Section 5.9.

The data usability assessment is a determination of the adequacy of the data to support the groundwater monitoring program requirements and is based upon the verification results. This evaluation is summarized in Section 5.10.

5.4 Groundwater Monitoring Program Analytical Data Quality Requirements

Table 5-1 presents the groundwater monitoring program data requirements from DOE/RL-91-50 and CHPRC-00189. QC results for groundwater monitoring samples were evaluated against these requirements as part of this DQA (Sections 5.8 and 5.9). The QC samples governed by the QC requirements may be divided into two components: field QC samples and laboratory QC samples. The next two subsections describe these two types of QC samples.

Table 5-1. Quality Control Acceptance Criteria for Groundwater Samples

Constituent	QC Element	Acceptance Criterion[a]	Corrective Action
General Chemical Parameters			
Alkalinity, chemical oxygen demand, conductivity, oil and grease, pH, total dissolved solids, total organic carbon, total organic halides, total petroleum hydrocarbons by GC[b]	MB[c] LCS DUP MS SUR EB, FTB Field Duplicate Field Split	<MDL 80% to 120% recovery ≤20% RPD[h] 75% to 125% recovery Statistically derived <2 times MDL ≤20% RPD[h] ≤20% RPD[i]	Flagged with “C” Data reviewed[d] Data reviewed[d] Flagged with “N” Data reviewed[d] Flagged with “Q” Flagged with “Q” Data reviewed[d,e]
Ammonia and Anions			
Ammonia, anions, cyanide	MB LCS DUP MS EB, FTB Field Duplicate Field Split	<MDL 80% to 120% recovery ≤20% RPD[h] 75% to 125% recovery <2 times MDL ≤20% RPD[h] ≤20% RPD[i]	Flagged with “C” Data reviewed[d] Data reviewed[d] Flagged with “N” Flagged with “Q” Flagged with “Q” Data reviewed[d,e]
Metals			
ICP metals, ICP/MS metals, mercury, uranium	MB LCS MS MSD EB, FTB Field Duplicate Field Split	<MDL[f] 80% to 120% recovery 75% to 125% recovery ≤20% RPD <2 times MDL ≤20% RPD[h] ≤20% RPD[i]	Flagged with “C” Data reviewed[d] Flagged with “N” Data reviewed[d] Flagged with “Q” Flagged with “Q” Data reviewed[d,e]
Volatile Organic Compounds			
Volatiles by GC-MS	MB LCS MS MSD SUR EB, FTB, FXR Field Duplicate Field Split	<MDL[g] Statistically derived Statistically derived Statistically derived Statistically derived <2 times MDL[g] ≤20% RPD[h] ≤20% RPD[i]	Flagged with “B” Data reviewed[d] Flagged with “T” Data reviewed[d] Data reviewed[d] Flagged with “Q” Flagged with “Q” Data reviewed[d,e]

Table 5-1. Quality Control Acceptance Criteria for Groundwater Samples

Constituent	QC Element	Acceptance Criterion[a]	Corrective Action
Semivolatile Organic Compounds			
Herbicides by GC, PCBs by GC, pesticides by GC, phenols by GC, semivolatiles by GC-MS	MB LCS MS MSD SUR EB, FTB Field Duplicate Field Split	<2 times MDL Statistically derived Statistically derived Statistically derived Statistically derived <2 times MDL ≤20% RPD[h] ≤20% RPD[i]	Flagged with "B" Data reviewed[d] Flagged with "N" or "T" Data reviewed[d] Data reviewed[d] Flagged with "Q" Flagged with "Q" Data reviewed[d,e]
Radiological Parameters			
Gamma scan, gross alpha, gross beta, iodine-129, plutonium (isotopic), strontium-89/90, technetium-99, tritium, tritium (low level), uranium (isotopic)	MB LCS DUP MS EB, FTB Field Duplicate Field Split	<2 times MDA 70% to 130% recovery ≤20% RPD[h] 60% to 140% recovery <2 times MDL ≤20% RPD[h] ≤20% RPD[i]	Flagged with "B" Data reviewed[d] Data reviewed[d] Flagged with "N" Flagged with "Q" Flagged with "Q" Data reviewed[d,e]

Sources: DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*; CHPRC-00189, *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan*.

a. For the laboratory QC types LCS, DUP, MS, MSD, and SUR, laboratory-determined, statistical process-control limits were used when available, otherwise the limits shown is this table were used. For the laboratory duplicate types DUP, LCS duplicate, MSD, and SUR duplicate, the RPD limit of 20% was used if laboratory-determined limits were not available.

b. The source documents classify total petroleum hydrocarbons as a volatile organic compound. Total petroleum hydrocarbons have historically been classified as a general chemical parameter.

c. Does not apply to pH determinations.

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck, rerun, or flagging the associated groundwater monitoring data as suspect (Y flag) or rejected (R flag).

e. The source documents indicate that field splits with RPDs exceeding 20% are to be Q flagged. Historically, field splits are not Q flagged.

f. The source documents indicate that the MB is to be compared to the RDL. Because the RDL is not readily accessible in the HEIS database, the MDL was used instead. In most cases, the MDL is less than the RDL.

g. For the common laboratory contaminants 2-butanone, acetone, methylene chloride, toluene, and phthalate esters, the acceptance criterion is <5 times the MDL.

h. The RPD for duplicates is calculated only if at least one of the results is greater than or equal to five times the laboratory MDL or MDA.

i. The RPD for field splits is calculated only if at least one of the results is greater than or equal to five times the larger MDL or MDA of the two analyzing laboratories.

Data Flags:

B, C = Possible laboratory contamination (analyte was detected in the associated MB).

N = Result may be biased (associated matrix spike result was outside the acceptance limits).

Q = Problem with associated field quality control sample (field blank and/or field duplicate results were out of limits).

T = Result may be biased (associated matrix spike result was outside the acceptance limits; used with GC-MS methods only).

Abbreviations:

DUP	=	laboratory sample duplicate	MB	=	method blank
EB	=	equipment blank	MDA	=	minimum detectable activity
FTB	=	full trip blank	MDL	=	method detection limit
FXR	=	field transfer blank	MS	=	matrix spike
GC	=	gas chromatography	MSD	=	matrix spike duplicate
GC-MS	=	gas chromatography - mass spectrometry	PCB	=	polychlorinated biphenyl
ICP	=	inductively coupled plasma	RDL	=	required detection limit
ICP-MS	=	inductively coupled plasma - mass spectrometry	RPD	=	relative percent difference
LCS	=	laboratory control sample	SUR	=	surrogate

5.4.1 Field Quality Control Sample Types

Field QC samples are used to assess the precision, repeatability, and potential contamination related to sampling and laboratory activities. Field QC samples include three types of field blanks (equipment blanks, full trip blanks, and field transfer blanks), field duplicates, and split samples. Table 5-2 summarizes the various field QC sample types, their required collection frequencies, and the actual collection frequencies. Just as for groundwater samples, preservative reagents specific for the analyte(s) to be determined are added to the field QC sample bottles prior to the collection of the QC samples. All field QC samples are delivered to the laboratory without any differentiation between the field QC samples and actual groundwater samples. Table 5-2 describes each type of field QC sample and their evaluation:

- Equipment blanks (EBs) are samples of reagent water that are pumped or washed through nondedicated sampling equipment. EBs are used to monitor the effectiveness of equipment decontamination procedures and to monitor for contamination associated with field sampling equipment.
- Full trip blanks (FTBs) are samples that contain reagent water and any required preservatives. An FTB is used to check for contamination in sample bottles and laboratory sample preparation. The FTB is analyzed for all constituents of interest and is collected in the same types of sample bottles used to collect groundwater samples. The FTB is filled during bottle preparation using the same sample preparation used for regular well samples. FTBs are not opened in the field.
- Field transfer blanks (FXRs) are analyzed for volatile organic compounds (VOCs) and are used to check for VOC contamination associated with sampling activities. At the time of sample collection, the FXR is filled at the sampling site by pouring reagent water from a cleaned container into VOC sample vials pre-loaded with any required preservative. After collection, the FXR is treated in the same manner as the other samples collected during the sampling event. FXRs are collected only on days when other groundwater samples are collected for volatile organic analysis.
- Field duplicate samples are replicate samples collected to determine the precision of sampling and the laboratory analytical measurement process by comparing results with an identical sample collected at the same time and location. Matching field duplicates are stored in separate containers and are analyzed as separate samples by the same laboratory.
- Split samples are replicate samples sequentially collected from the same location in the same sampling event and analyzed by different laboratories. Split samples are used to evaluate interlaboratory precision and comparability.

Table 5-2. Field Quality Control Sample Collection Frequencies

Field QC Sample Type	Number of Well Trips	Number of QC Sample Sets Collected[a]	Frequency	
			Required[b]	Actual[c]
Full trip blanks	2,892	159	5%	5.5%
Field transfer blanks	163[d]	220	100%	135%
Equipment blanks	319[e]	59	10%[f]	18.5%
Field duplicates	2,892	188[g]	5%	6.5%
TOC quadruplicates	200[h]	206[i]	100%	103%

Table 5-2. Field Quality Control Sample Collection Frequencies

Field QC Sample Type	Number of Well Trips	Number of QC Sample Sets Collected[a]	Frequency	
			Required[b]	Actual[c]
TOX quadruplicates	197[h]	200[i]	100%	101.5%
Field split samples	2,892	105[j]	as needed	3.6%

a. Values listed include only field blanks, field duplicates, and field split sample sets collected for routine groundwater monitoring sampling events. A QC sample set consists of all the QC samples of a particular QC sample type (e.g. full trip blanks or field duplicates) for a given well trip and may contain multiple sample numbers.
b. Required frequency is from DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*, and CHPRC-00189, *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan*; required frequency for TOC and TOX quadruplicate samples is from 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis."
c. Actual frequency = 100 × Number of QC Sample Sets/Number of Well Trips.
d. Number of days volatile organic compound samples were collected.
e. Number of sampling events for which non-dedicated sampling equipment was used.
f. The 10% frequency is for routinely used, non-dedicated sampling equipment. For new types of non-dedicated sampling equipment, the equipment blank frequency is 100% until the decontamination procedure for the new equipment is shown to produce acceptable equipment blank results.
g. Number of pairs of field duplicate sample sets collected.
h. Number of well trips for which TOC or TOX samples were collected.
i. Number of sets of quadruplicate samples collected.
j. Number of pairs of field split sample sets collected.
QC = quality control
TOC = total organic carbon
TOX = total organic halides

FB results are evaluated by comparison with two times the method detection limit (MDL) of the performing laboratory; field blank results that exceed that limit and the results for any samples associated with the FB are given a review qualifier of Q (Table 5-4). For full trip and FXRs, an associated sample is one collected on the same day and analyzed by the same method as the corresponding full trip or FXR. For EBs, an associated sample is one that has the same collection date, collection method, sampling equipment, and analysis method as the EB.

Field duplicate sample results are evaluated only if at least one result is five times the laboratory MDL. Split sample results are evaluated only if at least one result is five times the larger of the laboratory MDL or minimum detectable activity (MDA) of the two analyzing laboratories. Field duplicate and field split samples that qualify are evaluated using the relative percent difference (RPD) between the duplicate or split sample pair. The RPD is a measure of precision and is calculated as shown in Equation 5-1:

$$\text{RPD} = \left| \frac{C_1 - C_2}{(C_1 + C_2)/2} \right| \times 100 \quad \textbf{(Equation 5-1)}$$

where:

C_1 = parent sample analyte concentration or activity

C_2 = duplicate sample analyte concentration or activity

A perfect match between the parent sample and its duplicate yields an RPD of 0 percent. Results for field duplicate samples that exceed the RPD limit of 20 percent are given a review qualifier of Q (Table 5-4); only the two samples of the duplicate pair are considered to be associated samples. Historically, split samples that exceed the RPD limit have not been Q flagged.

Total organic carbon (TOC) and total organic halides (TOX) are classified as *Resource Conservation and Recovery Act of 1976* (RCRA) indicator analytes; samples for these analytes are usually taken in quadruplicate (40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis"). Field quadruplicate sample results are evaluated only if at least one result is at least five times the laboratory MDL. Field quadruplicate results that qualify are evaluated using the percent relative standard deviation (%RSD) within the quadruplicate sample set. The %RSD is a measure of precision and is calculated as shown in Equation 5-2:

$$\%\mathrm{RSD} = \frac{\sqrt{\frac{\sum_{i=1}^{n}(C_i-\overline{C})^2}{(n-1)}}}{\overline{C}} \times 100 \qquad \textbf{(Equation 5-2)}$$

where:

C_i = i^th^ sample concentration

$\overline{C}$ = average sample concentration

n = number of results (usually four)

A perfect match of results within a quadruplicate sample set yields a %RSD of 0 percent. For any results in a qualifying quadruplicate dataset that were less than the laboratory MDL, MDLs were used to compute the %RSD. Quadruplicate split sample results qualified for evaluation only if at least one quadruplicate average is five times the larger of the laboratory MDLs of the two analyzing laboratories. To determine the precision of a set of split quadruplicate samples, the RPD of the two averages for the quadruplicate split samples is determined and compared to 20 percent. Results for field quadruplicate samples that exceed a %RSD of 20 percent or quadruplicate split samples that exceed an RPD of 20 percent are not given a review qualifier.

5.4.2 Laboratory Quality Control Sample Types

Laboratory quality assurance and QC requirements govern nearly all aspects of analytical laboratory operation, including instrument procurement, maintenance, calibration, and operation. During the analysis of groundwater samples, laboratory QC samples are used to assess potential sample contamination, precision, and accuracy related to laboratory activities. Laboratory QC samples may include method blanks (MBs), laboratory control samples (LCSs), laboratory control sample duplicates (LCSDs), matrix spike (MS) samples, matrix spike duplicates (MSDs), and surrogates. The following bullets describe each type of laboratory QC sample and the way they are evaluated.

Laboratory MBs provide a measure of the cleanliness during sample preparation and analysis. The appearance of measurable analytes in the MB may indicate contamination of customer samples during the analytical process.

Laboratory sample duplicates, LCSDs, MSDs, and surrogate duplicates provide a measure of the reproducibility of the analytical process. RPD is the metric used to determine reproducibility (Equation 5-1). Laboratory sample duplicates qualify for evaluation only if at least one result is five times the laboratory MDL.

LCSs, MS samples, and surrogates contain known amounts of analytes and provide a measure of the accuracy of the analytical process. Percent recovery is the metric used to determine analytical accuracy (Equation 5-3). Percent recoveries consistently less than or greater than 100 percent may indicate a bias in the analytical process.

These laboratory QC samples are included in sample preparation and analytical batches along with customer samples. An analytical batch typically consists of a maximum of 20 customer samples. The numbers and types of QC samples included in sample batches are dictated by the analytical method being used. Analytical methods usually employ only a subset of the available types of QC samples. At a minimum, most sample preparation and analytical methods include a MB, one of the duplicate types (e.g., sample duplicate), and one of the standard types (e.g., LCS).

Laboratory analytical accuracy for LCSs, MS samples, and surrogates is evaluated using percent recovery as shown in Equation 5-3:

$$\text{Percent Recovery} = \frac{C_m}{C_a} \times 100 \qquad \textbf{(Equation 5-3)}$$

where:

C_m = measured analyte concentration or activity

C_a = actual, known analyte concentration or activity

Perfect recovery of the measured analyte concentration or activity yields a percent recovery of 100 percent.

5.4.3 Qualification Flags

During the generation and evaluation of environmental analytical data, any of several qualification flags may be assigned to an individual result. The Hanford Environmental Information System (HEIS) database carries qualification flags applied from three sources: the laboratory (laboratory qualifier), a data reviewer (review qualifier), or a third party data validator (validation qualifier). Table 5-3 presents the laboratory qualifier flags and Table 5-4 outlines the review qualifier flags. For the CY2012 groundwater monitoring dataset, no third party validation was performed, and no validation qualifiers were applied to the dataset.

Table 5-3. Laboratory Qualifier Data Quality Flags

Flag	Definition
B	Inorganics and Wetchem* – The analyte was detected at a value greater than or equal to the MDL but less than the CRDL. Organics – The analyte was detected in both the associated QC blank and in the sample. Radionuclides – The associated QC sample blank has a result >= 2 times the MDA and, after corrections, result is >= MDA for this sample.
C	Inorganics and Wetchem – The analyte was detected in both the sample and the associated QC blank, and the sample concentration was less than or equal to five times the blank concentration.
D	All – Analyte was reported at a secondary DF. Typically, the DF is greater than 1. The primary preparation required additional dilution either to bring the analyte within the calibration range or to minimize interference.
E	Inorganics – Reported value is estimated because of interference. See any comments that may be in the laboratory report case narrative. Organics – Concentration exceeds the calibration range of the gas chromatograph - mass spectrometer (GC-MS).
N	All (except GC-MS methods) – The matrix spike recovery is outside control limits. The associated sample

Flag	Definition
	data may be biased.
J	Organics – The analyte was detected at a value greater than or equal to the MDL but less than the CRDL.
T	Organics (GC-MS methods only) – The matrix spike recovery is outside control limits. The associated sample data may be biased.
U	All – The constituent was analyzed for and was not detected.
X	All – Indicates a result-specific comment is provided in the data report and/or case narrative.

* Wetchem is a miscellaneous group of analytical methods such as the colorimetric determination of hexavalent chromium, titrimetric determination of alkalinity, and distillation and titrimetric determination of sulfide.

CRDL = contract required detection limit

DF = dilution factor

GC = gas chromatography

MDA = minimum detectable activity

MDL = method detection limit

MS = mass spectrometry

QC = quality control

Of the review qualifier flags, the request for data review (RDR) process most commonly generates F, G, R, and Y flags (Table 5-4). The F flag indicates that the analytical result is under review within the RDR process; F flags are typically resolved to an R flag, Y flag, or G flag during the RDR process. The R flag indicates the analytical result has been reviewed and has been rejected as a valid result based upon a known reason such as an instrument calibration failure. The Y flag indicates the analytical result has been reviewed and is considered questionable based on additional evidence, such as a result that does not fit with the historical trend for the sample source and is inconsistent with related parameters. The G flag indicates that the result has been reviewed within the RDR process and determined to be valid. In some cases, the G flag is applied to a result after the old, reviewed result has been replaced by a new value from the laboratory; the new laboratory value may be a correction of the originally reported value or may be from a re-analysis of the sample.

The Q flag review qualifier is applied to the analytical results of those samples associated with field QC samples having analytical results that exceed the QC criteria given in DOE/RL-91-50 and CHPRC-00189 and outlined in Table 5-1. Associated samples are defined in Section 5.4.1.

Table 5-4. Review Qualifier Data Quality Flags

Flag	Definition
A	Indicates an issue with the chain of custody that could affect data integrity.
F	Result is undergoing further review. This review qualifier is assigned when a Request for Data Review (RDR) is first processed.

Table 5-4. Review Qualifier Data Quality Flags

Flag	Definition
G	Result has been reviewed and determined to be correct, or the result has been corrected with laboratory confirmation or other supporting information.
H	Laboratory holding time was exceeded before the sample was analyzed.
P	Potential problem. Collection/analysis circumstances make the result questionable.
Q	Associated QC sample is out of limits. See Section 5.1 for the definition of associated samples.
R	Do not use. Further review indicates the result is not valid. This review qualifier is used only when there is documented evidence that the result is not valid. Generally, results that are "R" qualified will be excluded from statistical evaluations, maps, and other interpretations.
Y	Result is suspect. Review had insufficient evidence to show result valid or invalid.
Z	Miscellaneous circumstance exists. Additional information for this record may be found in the result comment field in the HEIS result table and/or in the sample comment field in the HEIS sample table.

HEIS = Hanford Environmental Information System

5.5 Data Completeness

Data completeness is a measure of how much of the dataset is judged to meet the quality criteria and, thus, useable for the groundwater monitoring program. The completeness goal is determined as a percentage of data judged "good" versus all data collected for the program and is set at a minimum of 85 percent[1] (DOE/RL-91-50). Completeness statistics may be calculated for the percentage of successful sampling events during CY2012 versus the number of scheduled sampling events and for the percentage of field QC samples collected versus the number of QC samples required. In this section, completeness is first addressed as the number of samples taken versus the number planned, then the number of field QC samples acquired versus the number required, and finally the percentage of the dataset that meets quality criteria.

5.5.1 Percentage of Successful Sampling Events

For the groundwater monitoring program during CY2012, 2,723 sampling events were planned, and 2,639 sampling events were successfully executed for a sampling event completion rate of 96.9 percent. This completion rate indicates that the groundwater monitoring program completed sufficient sampling events to meet program requirements. In addition to the 2,723 sampling events planned for CY2012, 315 sampling events originally scheduled for CY2011 were completed in CY2012. Sources for the sampling events included wells, aquifer tubes, seeps, and springs.

[1] DOE/RL-91-50 defines this completeness goal on a quarterly basis. For this data quality assessment, the completeness goal is applied over the entire calendar year.

5.5.2 Percentage of Field Quality Control Samples Collected

The types and collection frequencies of field QC samples for the groundwater monitoring program are given in DOE/RL-91-50 and CHPRC-00189; the collection of quadruplicate samples for TOC and TOX is mandated by 40 CFR 265.92. Section 5.1 gives a more complete discussion of field QC samples. Table 5-2 summarizes those QC types, their required collection frequencies, and the actual collection frequencies. The table indicates that the requirements for the minimum collection frequencies for groundwater monitoring field QC samples were met during CY2012.

The 135 percent sampling frequency for the field transfer blanks may seem somewhat excessive. However, should one or more sampling events for VOCs fail on a given day, planning to obtain FXRs during multiple sampling events on a given day provides some assurance that the requirement is met for at least one FXR to be acquired each day that VOCs are sampled.

For the TOC and TOX quadruplicate samples, the sampling frequency is slightly greater than 100 percent due to the collection of four split sample sets for TOC and a single split sample set TOX.

5.5.3 Percentage of Useable Data

Table 5-5 summarizes the percentage of useable groundwater monitoring data generated from samples collected during CY2012; overall data completeness is 96.6 percent. This is well above the data completeness goal of 85 percent as specified in DOE/RL-91-50 and indicates that the large majority of data collected for the groundwater monitoring program is useable. The CY2012 data completeness rate of 96.6 percent is similar to the 96.8 percent rate of CY2011; both rates are substantially better than the 89.5 percent rate of CY2010.

Data completeness was judged on the following:

- F, R, and Y review qualifier flags associated with the data[2]
- Q-flag review qualifiers for data associated with FBs exhibiting possible contamination or with poor field-sample-duplicate reproducibility
- Samples with missed holding times
- Samples with laboratory qualifiers indicating MB contamination

Table 5-5. Data Completeness Summarized by Method

HEIS Method Name	Total Results[a]	Results in Review[b]	Suspect Results[c]	Rejected Results[d]	Field QC Flags	Missed Holding Time	Method Blank Qualifiers	Total Results Flagged
Overall Percent Complete = 96.6%								
Overall Totals:	**168,452**	**168**	**357**	**99**	**3,598**	**703**	**795**	**5,720**
General Chemical Parameters: Percent Complete = 99.1%								
Totals	**22,935**	**30**	**10**	**13**	**148**	**11**	**3**	**215**
120.1_CONDUCT	2	—	—	—	—	—	—	0

[2] The F flag review qualifier ("result in review") was included in the assessment of CY2012 groundwater monitoring data for this report because a moratorium was instituted on the application of Y flags to data starting November 2012. As of this writing, F-flagged data that could be resolved to either a G flag (good data) or R flag (rejected data) was resolved as appropriate. The remaining F-flagged data will most likely be resolved to Y flags when the moratorium is lifted.

Table 5-5. Data Completeness Summarized by Method

HEIS Method Name	Total Results[a]	Results in Review[b]	Suspect Results[c]	Rejected Results[d]	Field QC Flags	Missed Holding Time	Method Blank Qualifiers	Total Results Flagged
1664A_OILGREASE	1	—	—	—	—	—	—	0
2320_ALKALINITY	2,034	4	4	4	51	—	—	63
2320_BICARBONATE	1	—	—	—	—	—	—	0
2540C_TDS	119	—	—	1	2	6	3	12
310.1_ALKALINITY	17	—	—	—	—	4	—	4
360.1_OXYGEN	14	—	—	—	—	—	—	0
360.1_OXYGEN_FLD	2,079	1	2	1	—	—	—	4
410.4_COD	57	—	—	—	—	—	—	0
8015M_TPH_GC	1	—	—	—	—	—	—	0
9020_TOX	900	—	—	—	16	—	—	16
9060_TOC	1,160	13	2	1	79	—	—	95
9070_OILGREASE	3	—	—	—	—	1	—	1
9223_COLIFORM	64	—	—	—	—	—	—	0
CONDUCT_FLD	3,666	4	—	1	—	—	—	5
PH_ELECT_FLD	3,659	1	1	2	—	—	—	4
REDOX_PROBE_FLD	1,584	5	—	1	—	—	—	6
TEMP_FLD	3,660	1	1	1	—	—	—	3
TURBIDITY_FLD	3,658	1	—	1	—	—	—	2
WTPH_DIESEL	176	—	—	—	—	—	—	0
WTPH_GASOLINE	80	—	—	—	—	—	—	0
Ammonia and Anions: Percent Complete = 98.5%								
Totals	***13,059***	***28***	***7***	***8***	***75***	***56***	***17***	***191***
300.0_ANIONS_IC	12,354	3	7	7	48	46	1	112
300.7_CATIONS_IC	68	—	—	—	2	—	—	2
4500E_CN	287	—	—	—	5	—	—	5
9012_CYANIDE	11	—	—	—	—	4	1	5
9030_SULFIDE	94	13	—	1	16	—	5	35
9034_SULFIDE	72	12	—	—	2	—	10	24
9056_ANIONS_IC	173	—	—	—	2	6	—	8
Metals: Percent Complete = 95.4%								
Totals	***70,941***	***68***	***316***	***17***	***2,180***	***8***	***640***	***3,229***
200.8_METALS_ICPMS	12,018	14	3	16	359	—	266	658
6010_METALS_ICP	56,474	52	308	—	1801	—	332	2,493
6020_METALS_ICPMS	510	—	1	—	—	—	42	43

Table 5-5. Data Completeness Summarized by Method

HEIS Method Name	Total Results[a]	Results in Review[b]	Suspect Results[c]	Rejected Results[d]	Field QC Flags	Missed Holding Time	Method Blank Qualifiers	Total Results Flagged
7196_CR6	1,918	2	4	1	20	8	—	35
7470_HG_CVAA	15	—	—	—	—	—	—	0
UTOT_KPA	6	—	—	—	—	—	—	0
Volatile Organic Compounds: Percent Complete = 95.4%								
Totals	***33,864***	***3***	***10***	***58***	***933***	***470***	***100***	***1,574***
8015_VOA_GC	25	—	—	—	—	2	—	2
8260_VOA_GCMS	33,838	3	10	58	933	468	100	1,572
RSK175_VOA_HDSPC_GC	1	—	—	—	—	—	—	0
Semi-Volatile Organic Compounds: Percent Complete = 98.8%								
Totals	***16,088***	***0***	***1***	***0***	***4***	***157***	***35***	***197***
8040_PHENOLIC_GC	1,377	—	—	—	—	—	—	0
8041_PHENOLIC_GC	357	—	—	—	—	—	—	0
8081_PEST_GC	1,332	—	—	—	—	26	—	26
8082_PCB_GC	364	—	—	—	—	—	—	0
8151_HERBICIDE_GC	230	—	—	—	—	—	—	0
8270_SVOA_GCMS	10,458	—	—	—	—	3	1	4
8290_DIOXINS_GCMS	530	—	—	—	—	—	31	31
8310_SVOA_HPLC	1,440	—	1	—	4	128	3	136
Radiological Parameters: Percent Complete = 97.3%								
Totals	***11,565***	***39***	***13***	***3***	***258***	***1***	***0***	***314***
900.0_ALPHABETA_GPC	2	—	—	—	—	—	—	0
906.0_H3_LSC	34	—	—	—	—	—	—	0
906.0ML_H3_LSC	33	—	—	—	—	—	—	0
9310_ALPHABETA_GPC	46	—	—	—	—	—	—	0
ALPHA_GPC	912	3	1	—	9	—	—	13
AMCMISO_IE_PREC_AEA	4	—	—	—	—	—	—	0
BETA_GPC	1,126	13	1	—	52	—	—	66
C14_CHEM_LSC	155	—	—	—	—	—	—	0
C14_LSC	122	1	—	—	7	—	—	8
GAMMA_GS	3,472	4	8	—	13	—	—	25
GAMMALL_GS	1,270	—	—	—	—	—	—	0
I129_SEP_LEPS_GS	3	—	—	—	—	—	—	0
I129LL_SEP_LEPS_GS	524	5	2	1	17	—	—	25
NP237_IE_PRECIP_AEA	1	—	—	—	—	—	—	0

Table 5-5. Data Completeness Summarized by Method

HEIS Method Name	Total Results[a]	Results in Review[b]	Suspect Results[c]	Rejected Results[d]	Field QC Flags	Missed Holding Time	Method Blank Qualifiers	Total Results Flagged
NP237_LLE_PLATE_AEA	2	—	—	—	—	—	—	0
PU241_IE_LSC	2	—	—	—	—	—	—	0
PUISO_IE_PRECIP_AEA	72	—	—	—	4	—	—	4
PUISO_PLATE_AEA	14	—	—	—	—	—	—	0
SE79_SEP_IE_LSC	20	—	—	—	2	—	—	2
SRISO_SEP_PRECIP_GPC	28	—	—	—	—	—	—	0
SRTOT_SEP_PRECIP_GPC	821	4	—	—	30	—	—	34
TC99_3MDSK_LSC	959	2	—	1	25	—	—	28
TC99_ETVDSK_LSC	21	—	—	—	—	—	—	0
TC99_SEP_LSC	109	1	—	—	—	—	—	1
TRITIUM_EIE_LSC	1,558	6	1	1	83	1	—	92
UISO_IE_PRECIP_AEA	246	—	—	—	16	—	—	16
UISO_PLATE_AEA	9	—	—	—	—	—	—	0

a. Groundwater monitoring results were pulled from the HEIS on May 21, 2013.

b. Results in review have a review qualifier of F.

c. Suspect results have a review qualifier of Y.

d. Rejected results have a review qualifier of R.

The poorest completion rate was 95.5 percent for VOCs determined using U.S. Environmental Protection Agency (EPA) Method 8260. Nearly two-thirds of these failures were due to the assignment of Q flag review qualifiers for data associated with contaminated FBs and/or poor field duplicate reproducibility. The analytes carrying the majority of these Q flags were acetone, carbon tetrachloride, chloroform, methylene chloride, and trichloroethene. Acetone is a common laboratory solvent and some of the Q flagged results may be due to laboratory contamination of the samples. Carbon tetrachloride, chloroform, and methylene chloride are strongly suspected to be contaminants in the source deionized water used to generate the FXRs and may explain some of the Q flags for data associated with contaminated FBs (SGW-52194, *Volatile Organic Compound Contamination in Groundwater Samples and Field Blanks*). About one-third of VOC data failures was due to missed holding times. All the missed holding times were traced to four analytical batches analyzed at WSCF. The missed holding times were attributed to re-runs of the samples outside of the holding time after the initial sample analyses suffered from batch QC failures. One hundred VOC data QC failures were due to MB contamination at TestAmerica St. Louis (TASL) laboratory primarily for acetone and methylene chloride.

The next poorest data completion rate was 95.7 percent for metals, primarily those determined by inductively coupled plasma (ICP) – atomic emission analysis (EPA Method 6010) and inductively coupled plasma-mass spectrometry (MS) (EPA Methods 200.8 and 6020). Nearly two-thirds of the incomplete data were due to the assignment of Q-flag review qualifiers for data associated with contaminated FBs and/or poor field duplicate reproducibility. A number of the Q flags were traced to four FBs that had six or more analytes with concentrations above the QC limits. Three of these FBs had apparently been swapped with well samples; requests for data review have been issued for those three blanks. Seven duplicate samples had five or more analytes that failed the RPD QC criterion; these failures contributed to the Q flags assigned to those duplicate samples. The metals also experienced a number of MB contamination incidents with 640 flagged results representing about 20 percent of the incomplete data; the analytes associated with the MB contamination incidents were spread over almost the entire list of ICP metal analytes. Finally, about 12 percent of the incomplete metals data was due to F, R, and Y review qualifiers.

The remaining completion rates were 97.4 percent for the radiochemical parameters, 98.8 percent for the semivolatile organic compounds (SVOCs), and 99.1 percent for the general chemical parameters.

5.6 Laboratory Information and Analytical Methods

Samples collected for the groundwater monitoring program were sent to the seven laboratories described in Section 6.1 for analysis. Each sample is tracked by a unique HEIS database number. Analytical requests for chemical and radiochemical services to be completed by the laboratories were documented on the chain-of-custody forms. Analytical results provided by the laboratories were documented by sample data group in data packages.

5.6.1 Laboratory Information

The samples collected were analyzed at the following laboratories:

- 222-S Laboratory (222-S, Hanford Site, managed by Advanced Technologies and Laboratories International, Inc.) provided sample analysis for chemical constituents; 222-S generated about 0.1 percent of the analytical laboratory results.
- Eberline Services (Richmond, California) provided sample analysis for radiochemical constituents; Eberline Services generated about 0.1 percent of the analytical laboratory results.
- Lionville Laboratory (LVL; Exton, Pennsylvania) provided sample analysis for chemical constituents; LVL generated about 0.1 percent of the analytical laboratory results.
- TestAmerica Knoxville (TAKN; Knoxville, Tennessee) performed polychlorinated biphenyl congener analyses on selected groundwater samples; TAKN generated about 0.3 percent of the analytical laboratory results.
- TestAmerica Richland (TARL; Richland, Washington) provided sample analysis for chemical and radiochemical constituents; TARL generated 1.6 percent of the analytical laboratory results.
- TASL (St. Louis, Missouri) provided sample analysis for chemical constituents; TASL generated 14.8 percent of the analytical laboratory results.
- Waste Sampling and Characterization Facility (WSCF), Hanford Site, managed by Mission Support Alliance) performed chemical and radiochemical analyses on groundwater samples. WSCF generated 82.8 percent of the analytical laboratory results.

Sections 8 and 9 discuss the analytical data provided by these laboratories.

5.6.2 Analytical Methods

The analyzing laboratories used standard methods from EPA, ASTM International (formerly American Society for Testing and Materials), and the American Public Health Association for the analysis of chemical constituents. For radiological constituents, the analyzing laboratories employed methods that are recognized as acceptable within the radiochemical industry.

Samples were analyzed using the methods listed in Table 5-6. Both multi-component and single-component method-based analyses were used. Multi-component method based analyses are those analyses typically based upon EPA methods as applicable that yield concentration data for multiple analytes in a single analysis. The analytes may include both target analytes and non-target analytes. Single-component method-based analyses are those analyses typically based upon EPA methods as applicable that yield concentration data for a single target analyte in a single analysis. Sample results were reported in the HEIS database.

Table 5-6. Analytical Methods

Parameter	Analytical Method	Source
General Chemical Parameters		
Alkalinity	EPA Method 310.1	EPA[a]
Alkalinity	Standard Method 2320	Standard Methods[b]
Chemical Oxygen Demand	EPA Method 410.4	EPA[c]
Coliform	Standard Method 9223	Standard Methods[b]
Dissolved Oxygen	EPA Method 360.1	EPA[a]
Oil and Grease	EPA Method 1664A	EPA[d]
Oil and Grease	EPA Method 9070	EPA[e]
Specific Conductivity	EPA Method 120.1	EPA[a]
Total Dissolved Solids	Standard Method 2540c	Standard Methods[b]
Total Organic Carbon (TOC)	EPA Method 9060	EPA[e]
Total Organic Halides (TOX)	EPA Method 9020	EPA[e]
Total Petroleum Hydrocarbons	EPA Method 8015 (modified)	EPA[e]
Total Petroleum Hydrocarbons - Diesel	NWTPH-D	Washington State Department of Ecology[f]
Total Petroleum Hydrocarbons - Gasoline	NWTPH-G	Washington State Department of Ecology[f]
Ammonia and Anions		
Anions by Ion Chromatography	EPA Method 300.0	EPA[g]
Anions by Ion Chromatography	EPA Method 9056	EPA[e]
Cations by Ion Chromatography	EPA Method 300.7	EPA[h]
Cyanide	EPA Method 9012	EPA[e]
Cyanide	Standard Method 4500-CN	Standard Methods[b]
Sulfide	EPA Methods 9030, 9034	EPA[e]
Metals		
Hexavalent Chromium	EPA Method 7196	EPA[e]
Mercury	EPA method 7470	EPA[e]
Metals by ICP-AES	EPA Method 6010	EPA[e]
Metals by ICP-MS	EPA Method 200.8	EPA[i]
Metals by ICP-MS	EPA Method 6020	EPA[e]

Table 5-6. Analytical Methods

Parameter	Analytical Method	Source
Uranium	ASTM D5174	ASTM
Volatile Organic Compounds		
Non-Halogenated Volatiles by GC	EPA Method 8015	EPA[e]
Non-Halogenated Volatiles by Headspace Equilibrium - GC	EPA Method RSKSOP-175	EPA
Volatile Organic Compounds by GC-MS	EPA Method 8260	EPA[e]
Semivolatile Organic Compounds		
Chlorinated Herbicides	EPA Method 8151	EPA[e]
Dioxin Congeners	EPA Method 8290	EPA[e]
Organochlorine Pesticides	EPA Method 8081	EPA[e]
Phenols	EPA Method 8040, 8041	EPA[e]
Polychlorinated Biphenyls	EPA Method 8082	EPA[e]
Polynuclear Aromatic Hydrocarbons	EPA Method 8310	EPA[e]
Semivolatile Organic Compounds	EPA Method 8270	EPA[e]
Radiological Parameters		
Americium-Curium Isotopes	Ion-exchange Separation/Precipitation/AEA	Lab Specific
Carbon-14	Chemical Oxidation/LSC	Lab Specific
Gamma-Emitting Isotopes	Gamma Energy Analysis	Lab Specific
Gross Alpha-Beta by GPC	EPA Method 900.0	EPA[j]
Gross Alpha-Beta by GPC	EPA Method 9310	EPA[e]
Iodine-129	Separation/Precipitation/LEPS	Lab Specific
Neptunium-237	Ion-exchange Separation/Precipitation/AEA	Lab Specific
Neptunium-237	Liquid-liquid Extraction/Electroplate/AEA	Lab Specific
Plutonium Isotopes	Ion-exchange Separation/Precipitation/AEA	Lab Specific
Plutonium Isotopes	Separation/Electroplate/AEA	Lab Specific
Selenium-79	Ion-exchange Separation/LSC	Lab Specific
Strontium-90	Separation/Precipitation/GPC	Lab Specific
Strontium-90 (total-beta radiostrontium)	Separation/Precipitation/GPC	Lab Specific
Technetium-99	Disk Separation/LSC	Lab Specific
Technetium-99	Ion-exchange Separation/LSC	Lab Specific
Tritium	EPA Method 906.0	EPA
Tritium	Ion-exchange Purification/LSC	Lab Specific
Uranium Isotopes	Ion-exchange Separation/Precipitation/AEA	Lab Specific

Table 5-6. Analytical Methods

Parameter	Analytical Method	Source
Uranium Isotopes	Separation/Electroplate/AEA	Lab Specific

a. EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*.
b. APHA/AWWA/WEF, 2012, *Standard Methods For the Examination of Water and Wastewater*.
c. O'Dell, 1993, *Method 410.4 The Determination of Chemical Oxygen Demand by Semi-Automated Colorimetry*.
d. EPA-821-R-98-002, *Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry*.
e. SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*
f. ECY 97-602, *Analytical Methods for Petroleum Hydrocarbons*.
g. EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*.
h. Peden, 1986, *Methods for Collection and Analysis of Precipitation*.
i. EPA-600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement I*.
j. EPA-600/4-80-032, *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*.
AEA = alpha energy analysis
ASTM = ASTM International (formerly American Society for Testing and Materials)
EPA = U.S. Environmental Protection Agency
GPC = gas-flow proportional counter
LEPS = low-energy photon spectroscopy
LSC = liquid scintillation counting

5.7 Sample Preservation and Holding Times

Sample preservation and holding times are designed to ensure the analytical results generated from a sample are representative of the sample's source. Sample preservation is any method used to ensure the analyte of interest is not altered between the time the sample is acquired and the time it is analyzed. Sample preservation includes selecting the correct sample container material (such as plastic or glass), and may include cooling the sample (typically to about 4°C), adjusting the sample pH with acids or bases, or adding other chemicals (such as sodium bisulfite) to prevent oxidation of the analyte of interest. Typically, any preservation chemicals are added to the sample container during container preparation prior to taking the container to the sample site.

Holding times are defined as the time from sample collection to sample analysis or extraction, and the time from sample extraction to sample analysis. Holding times are calculated from the date of sample collection as recorded on the sample's chain of custody to determine the validity of the results. Analytes that may change quickly with time, such as coliform or hexavalent chromium, have short holding times while other analytes, such as acid-preserved metals and radionuclides, have much longer holding times.

Table 5-7 lists the sample preservation and holding time requirements for the groundwater monitoring program. Upon receipt of a groundwater sample set, the analyzing laboratory inspects the contents of the sample set container, usually an ice chest, to ensure that the samples received reflect what is listed on the accompanying chains of custody. During the receipt inspection, the samples are usually checked for any anomalies, such as missing samples, broken sample bottles, or absent tamper tape. The as-received sample temperature is also usually checked. Samples that are received immediately from the field will not have had time to cool to the preservation temperature of 4°C; in this circumstance, the as-received condition of the samples is noted and normal processing of the samples for analysis proceeds. Either at the time of receipt, or immediately before sample preparation and analysis, the pH of samples that require pH adjustment is checked to ensure the sample was properly preserved. If the pH is not correct for the sample type (e.g., pH is greater than 2 for ICP metals or is less than 12 for cyanide samples), then the laboratory notes the anomaly and may perform adjustment of the sample pH. Any anomalies noted during sample receiving or with sample preservation are reported to the Soil and Groundwater Monitoring

Project via Sample Issue Resolution requests. If the Project does not deem the anomaly will affect the sample results, the laboratory is instructed to proceed with the analysis. The Project may decide that the anomaly (e.g., a cyanide sample with a pH less than 12) could jeopardize the integrity of the sample results; in this instance, the laboratory will be instructed to cancel the sample analysis.

5.7.1 Sample Preservation

Of the 150,132 groundwater monitoring laboratory results reported during CY2012, only 125 results, or 0.08 percent of all laboratory results, were associated with sample preservation issues. Of the 125 results with sample preservation issues, only 19 were cancelled. This indicates that incorrect sample preservation is not an issue for the groundwater monitoring program. Table 5-8 lists the preservation issues and affected analytes for the CY2012 groundwater monitoring effort.

5.7.2 Holding Times

Table 5-5 summarizes the number of sample results for each analytical method with missed holding times. Of the 150,132 groundwater monitoring laboratory results reported during CY2012, only 703 analytical results, or 0.5 percent of the groundwater monitoring dataset, were affected by missed holding times. Table 5-9 lists the reasons for those missed holding times. Many of the samples with missed holding times were often analyzed within two times the holding time; groundwater monitoring project scientists and project coordinators deemed these results acceptable for the groundwater monitoring program. Of the 703 analytical results with missed holding times, 470 were for VOCs (14-day holding time), 131 were for SVOCs (7-day holding time to sample extraction), 52 were for nitrate and nitrite (48-hour holding time), and 25 were for pesticides (7-day holding time to sample extraction). The remaining missed holding times were scattered among results for alkalinity, cyanide, hexavalent chromium, oil/grease, total dissolved solids, and tritium. By laboratory, WSCF reported 521 results with missed holding times, TASL reported 176, and the 222-S laboratory reported 6.

Table 5-7. Groundwater Sample Container, Preservative, and Holding Time Requirements

Parameter	Container	Preservative	Holding Time	Source
General Chemical Parameters				
Alkalinity	G/P	Cool to ≤6 °C	14 days	40 CFR 136, Table II
Chemical oxygen demand	G/P	Cool to ≤6 °C; H2SO4 to pH <2	28 days	40 CFR 136, Table II
Coliform	G/P	Cool to ≤10 °C; 0.0008% Na2S2O3	8 hours	40 CFR 136, Table II
Dissolved oxygen	G	None	as soon as possible	40 CFR 136, Table II
Hydrogen ion (pH)	G/P	None	as soon as possible	40 CFR 136, Table II
Oil and grease/Hexane extractable material	G	Cool to ≤6 °C; HCl or H2SO4 to pH <2	28 days	SW-846, Table 3-2
Specific conductance	G/P	None	28 days	40 CFR 136, Table II
Total dissolved solids	G/P	Cool to 4 °C	7 days	APHA/AWWA/WEF, 2012, SM 2540c
Total organic carbon	aG	Cool to ≤6 °C; HCl or H2SO4 to pH <2	28 days	40 CFR 136, Table II
Total organic halides	G	Cool to ≤6 °C; HCl or H2SO4 to pH <2	28 days	SW-846, method 9020B
Total Petroleum Hydrocarbons	aGs	Cool to ≤6 °C; HCl or H2SO4 to pH <2	14 days	SW-846, Table 4-1
Total Petroleum Hydrocarbons - Diesel	aGs	Cool to 4 °C; HCl to pH<2	14 days before extraction, 40 days after extraction*	ECY 97-602
Total Petroleum Hydrocarbons - Gasoline	aG	Cool to 4 °C; HCl to pH<2	14 days	ECY 97-602
Ammonia and Anions				
Cyanide	G/P	Cool to ≤6 °C; 50% NaOH to pH>12	14 days	SW-846, Table 3-2
Bromide, Chloride, Fluoride, Sulfate	G/P	Cool to ≤6 °C	28 days	SW-846, Table 3-2
Nitrate, Nitrite, Phosphate	G/P	Cool to ≤6 °C	48 hours	SW-846, Table 3-2
Sulfide	G/P	Cool to ≤6 °C; zinc acetate and NaOH to pH >9	7 days	SW-846, Table 3-2

Table 5-7. Groundwater Sample Container, Preservative, and Holding Time Requirements

Parameter	Container	Preservative	Holding Time	Source
Metals				
Hexavalent chromium	G/P	Cool to ≤6 °C	24 hours	SW-846, Table 3-2
Mercury	G/P	HNO3 to pH<2	28 days	SW-846, Table 3-2
All other metals	G/P	HNO3 to pH<2	6 months	SW-846, Table 3-2
Volatile Organic Compounds				
Volatile Organic Compounds	aGs	Cool to ≤6 °C; HCl or H_2SO_4 to pH <2	14 days	SW-846, Table 4-1
Semivolatile Organic Compounds				
Semivolatile organic compounds, Organochlorine pesticides and herbicides	aG/PTFE-lined cap	Cool to ≤6 °C	7 days before extraction, 40 days after extraction	SW-846, Table 4-1
Phenols	G/PTFE-lined cap	Cool to ≤6 °C; 0.008% Na2S2O3	7 days before extraction, 40 days after extraction	40 CFR 136, Table II
Polychlorinated biphenyls	aG/PTFE-lined cap	Cool to ≤6 °C	None	SW-846, Table 4-1
Polychlorinated dibenzo-p-dioxins, Polychlorinated dibenzofurans	aG/PTFE-lined cap	Cool to ≤6 °C	30 days before extraction, 45 days after extraction	SW-846, methods 8280 & 8290
Radiological Parameters				
Gross alpha, Gross beta	G/P	HNO3 to pH<2	6 months	SW-846, Table 2-40(B)
Carbon-14, Gamma spectroscopy radionuclides, Tritium	G	None	6 months	Laboratory procedure
Americium isotopics, Plutonium isotopics, Radium isotopics, Strontium-90, Uranium isotopics	G/P	HNO3 to pH<2	6 months	Laboratory procedure
Technetium-99	G/P	HCl or HNO3 to pH<2	6 months	Laboratory procedure

Table 5-7. Groundwater Sample Container, Preservative, and Holding Time Requirements

Parameter	Container	Preservative	Holding Time	Source

Sources: 40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants."

APHA/AWWA/WEF, 2012, *Standard Methods For the Examination of Water and Wastewater*.

ECY 97-602, *Analytical Methods for Petroleum Hydrocarbons*.

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-A.*

* ECY 97-602 does not give a holding time requirement after the sample has been extracted. The 40-day requirement given here is by analogy with the holding time requirement for semivolatile organic compounds.

aG = amber glass
aGs = amber glass with septum cap
G = glass
P = plastic
PTFE = polytetrafluorinatedethylene
SM = standard method

Table 5-8. Groundwater Sample Preservation Issues and Dispositions

Preservation Issue/ Analytes	Disposition/Number of Analytical Results Affected			
	Adjust pH and Report Results	Report Results	Cancel Analysis	Totals
Totals	**12**	**94**	**19**	**125**
Incorrect Acid	**—**	**—**	**18**	**18**
6010 ICP metals	—	—	18	18
Incorrect pH	**7**	**58**	**1**	**66**
TPH - Diesel	2	2	—	4
TPH - Gasoline	1	1	—	2
Cyanide	2	21	—	23
Sulfide	3	—	1	4
8260 VOCs	—	58	—	58
Strontium-90	2	—	—	2
Technetium-99	2	—	—	2
Incorrect Temperature*	**—**	**12**	**—**	**12**
Coliform	—	8	—	8
Hexavalent chromium	—	4	—	4

* The *incorrect temperature* preservation issue was for the delivery of samples by Field Sampling Operations to the TestAmerica Richland Laboratory. The samples were delivered within a few hours of sample collection, and the samples did not have time to cool to a storage temperature of 4°C prior to delivery of the samples to the analyzing laboratory. Soil and Groundwater Remediation Project personnel deemed as acceptable the results from these samples.

ICP = inductively coupled plasma
TPH = total petroleum hydrocarbon
VOC = volatile organic compound

Table 5-9. Missed Sample Holding Time Issues

Missed Holding Time Issue	Number of Results	Percentage of All Missed Holding Times
Totals	**703**	**100.0%**
QC Failure/Reanalysis	406	57.8%
Incorrect Holding Time on COC	147	20.9%
Other Laboratory Issue	104	14.8%
Late Sample Delivery	29	4.1%
Instrument Failure	9	1.3%
Dilution/Reanalysis	7	1%
RDR Reanalysis	1	0.1%

COC = chain of custody
QC = quality control
RDR = request for data review

An explanation of the holding time issues follows:

- *QC failure/Reanalysis*: When the laboratory reports a batch QC failure, such as an out-of-limits LCS, groundwater monitoring personnel may request a reanalysis of the sample outside of the holding time. If the reanalysis time for the sample is within two times the holding time, the reanalysis results are usually considered acceptable. Of the 406 results in this category, 390 of the affected results were for VOCs from 15 different samples. Of the remaining results, seven results were for nitrate and nitrite, seven results were for the pesticides endrin aldehyde and aldrin, and two results for the analytes diphenylamine/N-nitrosodiphenylamine and 1,4-dioxane.
- *Incorrect holding time on COC*: This issue affected eight samples acquired on March 14, 2012, and submitted for pesticide and polynuclear aromatic hydrocarbon analysis at the TASL laboratory. A 14-day extraction holding time was incorrectly listed on the sample chains of custody; the correct holding time to extraction was seven days. The incorrect extraction holding time has since been corrected.
- *Other laboratory issue*: This issue covers miscellaneous reasons for missed holding times such as laboratory waste generation issues, laboratory personnel turnover, or laboratory failure to observe the holding time limits for samples. Of the 104 results out of holding time, 78 results from 3 samples were for VOCs, 16 results from 6 samples were for nitrate and nitrite, and 6 results from 6 samples for total dissolved solids. The remaining four out-of-holding-time results were for the analytes cyanide, diphenylamine/N-nitrosodiphenylamine, hexavalent chromium, and oil/grease.
- *Late sample delivery*: This missed holding time reason was specific to 16 groundwater samples acquired on January 18, 2012. Because of the closure of the Hanford Site for hazardous weather conditions, the samples were delivered to WSCF and TASL for analysis after the holding times had lapsed for alkalinity, hexavalent chromium, nitrate, and nitrite.
- *Instrument failure*: Samples were reanalyzed after the holding time expired when the first analysis was unsuccessful due to an instrument failure. This issue affected seven samples with nine total results for cyanide, methanol, nitrate, and nitrite.
- *Dilution/Reanalysis*: When an analyte exceeded the calibration range during the first analysis, the sample was diluted and reanalyzed after the holding time lapsed. This issue affected six samples with six results for nitrate and one result for nitrite.
- *RDR Reanalysis*: As part of the Request for Data Review process, Soil and Groundwater Remediation Project personnel requested a reanalysis of a sample after the holding time expired. This issue affected the tritium result for a single sample.

5.8 Field Quality Control

This section discusses the CY2012 groundwater monitoring field QC data that exceeded the QC acceptance criteria listed in Table 5-1. The types of field QC samples that are evaluated in this section are discussed in Section 5.1.

5.8.1 Field Blanks

FBs are used to assess potential contamination associated with sampling and laboratory activities. Analytical results for the FBs are assessed against the acceptance limits listed in Table 5-1. Overall, the percentage of acceptable FB results evaluated during this reporting period was 98.1 percent (compared to 98 percent for 2011 and 97 percent for 2010), indicating little problem with contamination.

FB results greater than the acceptance criterion of two times the MDL or two times the minimum detectable activity are identified as suspected contamination. For the common laboratory contaminants

2-butanone, acetone, methylene chloride, toluene, and phthalate esters, the limit is five times the MDL. Results for samples associated with FBs that are above these criteria are given a review qualifier of Q in the HEIS database to indicate potential contamination issues. Associated samples for blanks are defined in Section 5.1. Table 5-10 presents the FB results that exceeded QC limits.

Table 5-10. Field Blank Results Exceeding Quality Control Limits

Constituent	Blank Type	Number of Results	Number Out of Limits	Percent Out of Limits	Range of QC Limits*	Range of Out-of-Limit Results
Total Field Blanks Out = 317						
General Chemical Parameters: Total Out = 10						
Alkalinity	FTB	74	2	2.7	2,000 µg/L	2,500 - 2,800 µg/L
Alkalinity	EB	27	2	7.4	2,000 µg/L	5300 - 10,000 µg/L
Bicarbonate	EB	9	1	11.1	2,000 µg/L	10,000 µg/L
Total dissolved solids	EB	8	1	12.5	20,000 µg/L	22,000 µg/L
Total organic carbon	EB	13	1	7.7	200 µg/L	224 µg/L
Total organic carbon	FTB	74	2	2.7	200 µg/L	209 - 1,180 µg/L
Total organic halides	FTB	57	1	1.8	10 µg/L	12.3 µg/L
Ammonia and Anions: Total Out = 8						
Chloride	FTB	122	3	2.5	240 µg/L	272 - 976 µg/L
Cyanide	FTB	20	1	5.0	8 µg/L	159 µg/L
Nitrogen in Nitrate	FTB	122	1	0.8	76 µg/L	81.7 µg/L
Sulfide	FTB	13	1	7.7	166 µg/L	330 µg/L
Sulfide	EB	9	2	22.2	166 µg/L	270 - 330 µg/L
Metals: Total Out = 123						
Aluminum	EB	19	3	15.8	10 - 20 µg/L	39.3 - 253 µg/L
Aluminum	FTB	18	3	16.7	20 µg/L	20.6 - 48.8 µg/L
Arsenic	FTB	51	2	3.9	0.8 µg/L	5.34 - 6.38 µg/L
Barium	EB	89	2	2.2	0.4 - 8 µg/L	1.27 - 75.2 µg/L
Barium	FTB	175	4	2.3	0.8 - 8 µg/L	29.1 - 105 µg/L
Boron	EB	4	1	25.0	2 µg/L	2.25 µg/L
Cadmium	FTB	175	1	0.6	0.2 - 8 µg/L	0.77 µg/L
Calcium	EB	70	1	1.4	98 µg/L	74,300 µg/L
Calcium	FTB	158	6	3.8	98 µg/L	101 - 111,000 µg/L
Chromium	EB	89	2	2.2	0.2 - 10 µg/L	0.3 - 0.716 µg/L
Chromium	FTB	175	3	1.7	0.4 - 10 µg/L	1.29 - 38.5 µg/L
Cobalt	EB	89	1	1.1	0.1 - 8 µg/L	0.218 µg/L
Cobalt	FTB	175	1	0.6	0.2 - 8 µg/L	0.606 µg/L
Copper	FTB	175	4	2.3	0.4 - 8 µg/L	0.412 - 18.5 µg/L
Copper	EB	89	3	3.4	0.2 - 8 µg/L	0.558 - 1.92 µg/L
Hexavalent Chromium	FTB	75	1	1.3	4 µg/L	105 µg/L

Table 5-10. Field Blank Results Exceeding Quality Control Limits

Constituent	Blank Type	Number of Results	Number Out of Limits	Percent Out of Limits	Range of QC Limits*	Range of Out-of-Limit Results
Iron	FTB	158	4	2.5	38 µg/L	72.8 - 711 µg/L
Iron	EB	70	1	1.4	38 µg/L	164 µg/L
Magnesium	EB	70	3	4.3	8 µg/L	8.3 - 24,100 µg/L
Magnesium	FTB	158	10	6.3	8 µg/L	12.5 - 23,500 µg/L
Manganese	EB	75	1	1.3	0.4 - 8 µg/L	0.612 µg/L
Manganese	FTB	160	1	0.6	0.4 - 8 µg/L	71.4 µg/L
Molybdenum	EB	19	1	5.3	0.1 - 0.2 µg/L	0.11 µg/L
Molybdenum	FTB	18	2	11.1	0.2 µg/L	2.35 - 8.89 µg/L
Potassium	FTB	158	2	1.3	152 µg/L	6,080 - 9,790 µg/L
Potassium	EB	70	1	1.4	152 µg/L	10,100 µg/L
Selenium	FTB	20	1	5.0	4 µg/L	7.35 µg/L
Silver	FTB	175	1	0.6	0.2 - 8 µg/L	14 µg/L
Sodium	EB	70	12	17.1	20 µg/L	22.9 - 30,100 µg/L
Sodium	FTB	158	32	20.3	20 µg/L	20.1 - 45,500 µg/L
Strontium	EB	71	2	2.8	0.4 - 18 µg/L	5.05 - 474 µg/L
Strontium	FTB	160	2	1.2	0.4 - 18 µg/L	84.2 - 406 µg/L
Uranium	FTB	66	4	6.1	0.1 - 0.2 µg/L	1.19 - 834 µg/L
Vanadium	EB	71	1	1.4	0.8 - 10 µg/L	15.8 µg/L
Vanadium	FTB	160	2	1.2	0.8 - 10 µg/L	0.838 - 3.15 µg/L
Zinc	FTB	160	1	0.6	4 - 10 µg/L	21.5 µg/L
Zinc	EB	71	1	1.4	4 - 10 µg/L	5.38 µg/L
Volatile Organic Compounds: Total Out = 149						
Acetone	EB	20	1	5.0	1.7 - 5 µg/L	19 µg/L
Acetone	FTB	40	4	10.0	1.7 - 5 µg/L	1.9 - 74 µg/L
Acetone	FXR	220	18	8.2	1.7 - 10 µg/L	2 - 98 µg/L
Carbon tetrachloride	FXR	220	2	0.9	0.24 - 5 µg/L	0.29 - 3.2 µg/L
Chloromethane	FTB	15	1	6.7	0.154 - 2 µg/L	0.22 µg/L
Iodomethane	FTB	15	1	6.7	0.18 - 2 µg/L	0.73 µg/L
Methylene chloride	EB	20	2	10.0	1.35 - 5 µg/L	1.7 - 1.9 µg/L
Methylene chloride	FXR	220	98	44.5	1.35 - 6 µg/L	1.5 - 48 µg/L
Methylene chloride	FTB	40	20	50.0	1.35 - 5 µg/L	1.4 - 110 µg/L
Toluene	FXR	220	1	0.5	0.35 - 5 µg/L	0.41 µg/L
Trichloroethene	FXR	220	1	0.5	0.5 - 5 µg/L	4.3 µg/L
Semivolatile Organic Compounds: Total Out = 1						
Gross beta	EB	6	1	16.7	5 - 6.4 pCi/L	5.5 pCi/L

Table 5-10. Field Blank Results Exceeding Quality Control Limits

Constituent	Blank Type	Number of Results	Number Out of Limits	Percent Out of Limits	Range of QC Limits*	Range of Out-of-Limit Results
Radiochemical Parameters: Total Out = 26						
Gross alpha	FTB	47	1	2.1	1.92 - 4.8 pCi/L	7.8 pCi/L
Gross beta	EB	22	2	9.1	5 - 6.8 pCi/L	5.5 - 8 pCi/L
Gross beta	FTB	61	2	3.3	3 - 8.2 pCi/L	13 - 20 pCi/L
Iodine-129	FTB	45	1	2.2	0.266 - 0.54 pCi/L	3.16 pCi/L
Plutonium-238	EB	2	1	50.0	0.34 - 0.38 pCi/L	0.45 pCi/L
Potassium-40	EB	12	1	8.3	49.4 - 820 pCi/L	410 pCi/L
Strontium-90	EB	23	3	13.0	1.02 - 3.4 pCi/L	2.7 - 3.7 pCi/L
Strontium-90	FTB	25	1	4.0	1.06 - 2.8 pCi/L	3 pCi/L
Technetium-99	FTB	65	3	4.6	11.2 - 20.6 pCi/L	18 - 5,900 pCi/L
Tritium	EB	42	1	2.4	520 - 740 pCi/L	24,000 pCi/L
Tritium	FTB	90	5	5.6	34.6 - 720 pCi/L	650 - 10,000 pCi/L
Uranium-233/234	EB	3	1	33.3	0.05 - 0.22 pCi/L	0.072 pCi/L
Uranium-238	FTB	3	2	66.7	0.048 - 0.052 pCi/L	0.058 - 0.096 pCi/L
Uranium-238	EB	3	2	66.7	0.05 - 0.178 pCi/L	0.072 - 0.084 pCi/L

* Because MDLs are specific to the laboratory and may change during the reporting period, the limits are presented as a range. However, each result was evaluated according to the MDL in effect at the time the sample was analyzed.
EB = equipment blank
FTB = full trip blank
FXR = field transfer blank
QC = quality control

For CY2012, 438 FB sets were obtained consisting of 1,115 samples that were analyzed to generate 16,267 sample results. By blank type, 59 EB sets were acquired consisting of 242 EB samples; these samples yielded 3,587 results of which 98.4 percent met the acceptance criteria. For FTBs, 159 blank sets were acquired consisting of 653 samples that yielded 6,888 analytical results of which 98.0 percent met the acceptance criteria. For FXR, 220 blank samples yielded 5,792 analytical results of which 97.9 percent met the acceptance criteria.

The CY2012 FB data consisted of 16,267 results of which 317 (1.9 percent) exceeded QC limits. Of the 376 general chemical parameter FB results, 10 results (2.7 percent) exceeded QC limits, including five alkalinity/bicarbonate, one total dissolved solids, three TOC, and one TOX measurements. Of the 980 ammonia/anion results, 8 (0.8 percent) exceeded QC limits, including three chloride, one cyanide, one nitrogen in nitrate, and three sulfide results.

Of the 4,947 metals results, 123 (2.5 percent) exceeded QC limits. Sodium was the worst offender with 44 results exceeding the acceptance criterion followed by magnesium (13 results), calcium (seven results), and copper (seven results). Four blank samples (B2K710, B2LJB9, B2M1N6, and B2N0H0) had at least five metal analytes that exceeded the acceptance criterion. These samples most likely represent a mix-up between the actual blank sample and a groundwater sample either in the field or in the laboratory. Requests for data review have been initiated to flag the out-of-limits blank results for these samples.

All three FB types (EB, FTB, and FXR) contributed to the 8,193 VOC FB results. Of these results, 149 (1.8 percent) exceeded QC limits and included 120 methylene chloride and 23 acetone results. During CY2012, a study of VOC contamination in groundwater FBs determined that the deionized water used to generate the FBs is the most likely source of the methylene chloride and to a lesser extent, the carbon tetrachloride and chloroform found in the FBs (SGW-52194). The same study also concluded that the appearance of acetone, bromomethane, carbon disulfide, chloromethane, tetrachloroethene, and toluene in laboratory MBs indicates that these volatile organic analytes may be introduced as contaminants during laboratory sample preparation and analysis and then appear as spurious analytes in groundwater samples. Several corrective actions to decrease the appearance of spurious organic compounds in groundwater monitoring FBs and samples have been initiated.

Of the 909 SVOC results, only one result (0.1 percent) for acenaphthene exceeded QC limits. Of the 862 radiochemical parameter results, 26 (3.0 percent) exceeded QC limits. Six of the out-of-limit results were for tritium and probably represent substitutions of the blank with samples either in the field or in the laboratory. Gross beta, strontium-90, and uranium-238 each had four field blank results that exceeded the acceptance criteria.

5.8.2 Field Duplicate Samples

Field duplicate samples are replicate groundwater samples sent to the same laboratory and are used to assess field sampling and laboratory measurement precision. According to Table 5-1, the results of field duplicates must have a precision less than or equal to 20 percent as measured by the RPD (Equation 5-1). Field duplicates with at least one result greater than five times the MDL or MDA were evaluated. Field duplicate results that have an RPD greater than 20 percent are given a review qualifier of Q in the HEIS database to indicate potential precision issues. Field duplicate values with a review qualifier of Y were included in the assessment of duplicate precision.

For CY2012, 188 duplicate sample sets were acquired consisting of 791 sample pairs. These 791 sample pairs yielded 10,190 pairs of results of which 2,755 result pairs (27.0 percent) met the evaluation criterion. Of these 2,755 result pairs, 2,596 (94.2 percent) were acceptable, indicating reasonable field sampling and intra-laboratory precision. Table 5-11 presents the duplicate results that exceeded QC limits. For comparison, the CY2011 percentage of acceptable duplicate results was 95.0 percent, and the CY2010 percentage of acceptable duplicate results was 93.0 percent.

Table 5-11. Field Duplicates Exceeding Quality Control Limits

Constituent	Laboratory	Total Number of Duplicates	Number of Duplicates Evaluated[a]	Number Out of Limits[b]	Percent Out of Limits	Range of Out-of-Limit RPD[c]
Total Field Duplicate Results Out = 159						
General Chemical Parameters: Total Out = 1						
Carbonate alkalinity	WSCF	23	1	1	100	139.4
Ammonia and Anions: Total Out = 9						
Fluoride	222-S	4	4	1	25.0	153.7
Fluoride	WSCF	142	49	3	6.1	23.1 - 34.7
Nitrogen in ammonium	WSCF	2	1	1	100	170.4
Nitrogen in Nitrate	WSCF	142	133	1	0.8	87.1
Nitrogen in Nitrite	WSCF	142	2	1	50.0	37.2

Table 5-11. Field Duplicates Exceeding Quality Control Limits

Constituent	Laboratory	Total Number of Duplicates	Number of Duplicates Evaluated[a]	Number Out of Limits[b]	Percent Out of Limits	Range of Out-of-Limit RPD[c]
Sulfide	TASL	14	2	2	100	40 - 95.2
Metals: Total Out = 116						
Aluminum	WSCF	59	12	8	66.7	20.3 - 160.1
Arsenic	WSCF	95	69	7	10.1	20.1 - 184.2
Barium	WSCF	266	244	9	3.7	21.7 - 199.7
Boron	WSCF	8	8	3	37.5	26.6 - 33.1
Calcium	WSCF	210	210	4	1.9	27.5 - 58.8
Chromium	WSCF	266	101	11	10.9	22 - 199.9
Cobalt	WSCF	266	10	8	80.0	29.9 - 188.4
Copper	WSCF	266	23	9	39.1	26 - 189.6
Hexavalent Chromium	WSCF	101	37	1	2.7	183.9
Iron	WSCF	233	55	15	27.3	20.7 - 172.7
Lead	WSCF	69	3	1	33.3	34.1
Magnesium	WSCF	233	233	4	1.7	23.4 - 52.1
Manganese	WSCF	219	34	7	20.6	26.8 - 199.6
Molybdenum	WSCF	59	59	7	11.9	20.2 - 184.9
Nickel	WSCF	211	15	2	13.3	125.2 - 183.6
Potassium	WSCF	210	210	2	1.0	20.7 - 29.5
Sodium	WSCF	210	210	3	1.4	88.2 - 158.8
Strontium	WSCF	211	209	5	2.4	31.8 - 200
Tin	WSCF	61	1	1	100	133.8
Uranium	WSCF	66	64	3	4.7	20.6 - 183.6
Vanadium	WSCF	211	33	4	12.1	20.5 - 186.7
Zinc	WSCF	211	6	2	33.3	77.2 - 155.8
Volatile Organic Compounds: Total Out = 5						
Acetone	TASL	16	3	3	100	77.8 - 130.3
Acetone	WSCF	41	1	1	100	181.8
cis-1,2-Dichloroethylene	WSCF	41	2	1	50.0	35.3
Radiochemical Parameters: Total Out = 28						
Carbon-14	TARL	6	4	2	50.0	50.5 - 59.2
Carbon-14	TASL	5	5	1	20.0	94.4
Gross alpha	WSCF	60	13	2	15.4	38.9 - 40.5
Gross beta	WSCF	72	46	8	17.4	20.4 - 149.1
Iodine-129	TARL	39	16	4	25.0	25.9 - 73.1
Potassium-40	WSCF	36	2	2	100	116 - 116.5
Selenium-79	TARL	1	1	1	100	29.7

Table 5-11. Field Duplicates Exceeding Quality Control Limits

Constituent	Laboratory	Total Number of Duplicates	Number of Duplicates Evaluated[a]	Number Out of Limits[b]	Percent Out of Limits	Range of Out-of-Limit RPD[c]
Tritium	WSCF	115	66	5	7.6	32.7 - 71.7
Uranium-235	WSCF	8	4	3	75.0	53.3 - 100

a. Duplicates with at least one result five times greater than the MDL or MDA were evaluated.
b. Duplicate control limit is a RPD less than or equal to 20%.
c. In cases where a non-detected result was compared with a measured value, the MDL or MDA was used for the nondetected concentration.
MDA = minimum detectable activity
MDL = method detection limit
RPD = relative percent difference

Metals had the largest number of duplicate result failures with 116 data pairs exceeding the RPD criterion of 20 percent. Historically, many of the out-of-limit duplicates for metals were attributed to unfiltered samples in which suspended solids in the samples tend to cause discrepancies between result pairs. However, for CY2012, the failures occurred in almost as many filtered samples as unfiltered samples. This, and the 28 radiochemical data pairs that exceeded the RPD criterion, may indicate possible sample swaps either in the field or in the laboratory. The four result pairs for acetone that exceeded the RPD criterion may indicate possible contamination of one of the duplicate sample pairs during laboratory sample preparation and analysis.

5.8.3 Quadruplicate Total Organic Carbon and Total Organic Halides Samples

TOC and TOX are classified as RCRA indicator analytes, and the samples for these analytes are usually taken in quadruplicate (40 CFR 265.92). For these analytes, the %RSD of the quadruplicate results was determined as described in Section 5.1 and compared to the precision limit of 20 percent.

For TOC, 206 quadruplicate sample sets were taken. Of these 206 sample sets, 35 sets (17 percent) met the evaluation criterion and of these, 27 sets (77.1 percent) had RSDs less than 20 percent. This represents at best only fair reproducibility for TOC samples. The %RSD values of the eight TOC quadruplicate result sets that exceeded 20 percent ranged from 22.7 percent to 77.6 percent. Table 5-12 presents the quadruplicate sample sets that exceeded QC limits. One possible explanation for these failures may be inconsistent removal of inorganic carbon (typically present as bicarbonate or carbonate) from the sample prior to the determination of organic carbon in the sample. If inorganic carbon is not consistently and completely removed from the sample before determining organic carbon, the apparent concentration of organic carbon is likely to vary across a set of quadruplicate samples.

For TOX, 200 quadruplicate sample sets were taken. Of these 200 sample sets, only four sets (2.0 percent) met the evaluation criterion and of these, none exceeded the 20 percent RSD criterion.

Table 5-12. Total Organic Carbon and Total Organic Halide Quadruplicate Results Exhibiting Out-of-Limits Precision

Well	Lab	Reporting Limit µg/L	Result 1, µg/L		Result 2, µg/L		Result 3, µg/L		Result 4, µg/L		%RSD
Total Organic Carbon: Total Out = 8											
299-W15-83	TASL	270	3,000		3,900		6,900		2,500		48.4
299-W15-83	WSCF	100	654		358		362		357		34.1
699-25-34A	WSCF	100	540	N	1,490	N	1,120	N	1,740	N	42.7
699-25-34B	TASL	270	570	B	1,800		780	B	270	U	77.6
699-25-34B	WSCF	100	1,510	N	1,660	N	2,610	N	1,990	N	25.1
699-26-34A	WSCF	100	393		668		411		412		28.0
699-26-35A	WSCF	100	294	B	440		526		441		22.7
699-43-41G	WSCF	100	352		617		361		406		28.6
Total Organic Halides: Total Out = 0											

B = method detection limit < analytical result < limit of quantitation
N = matrix spike recovery outside quality control limit
RSD = relative standard deviation
TASL = TestAmerica St. Louis (laboratory)
U = analyte not detected above the reporting limit
WSCF = Waste Sampling and Characterization Facility

5.8.4 Field Split Samples

Field split samples are duplicate samples that are sent to two different laboratories to allow interlaboratory comparisons of analytical results. These interlaboratory comparisons are used to evaluate the performance of the laboratories, to determine the extent of any analytical problems, and to confirm out-of-trend results. According to Table 5-1, the precision acceptance criterion for field splits is an RPD less than or equal to 20 percent. Only those field split results pairs with at least one result greater than five times the MDLs or MDAs of both laboratories were evaluated. If the laboratory reported an estimated quantitation limit instead of an MDL, the evaluation criterion was one times the estimated quantitation limit instead of five times the MDL. For TOC and TOX split samples, a matching set of quadruplicate samples was submitted to each of the two laboratories. To evaluate the interlaboratory reproducibility for TOC and TOX, an average result was first calculated for each laboratory’s quadruplicate sample set, and then the average values from the two laboratories were used to calculate the RPD.

For CY2012, 105 field split sample sets consisting of 310 samples yielded 3,192 pairs of field split data. Of the 3,192 pairs, 634 pairs (19.9 percent) met the evaluation criterion. For the evaluated field splits, 548 pairs (86.4 percent) met the 20 percent RPD criterion. For comparison, the percentage of pairs within the limit was 84 percent for CY2011 and 78 percent for CY2010. Table 5-13 summarizes the results for field splits that exceeded the 20 percent RPD limit.

Table 5-13. Field Splits Exceeding Quality Control Limits

Constituent	Total Number of Splits	Number of Splits Evaluated[a]	Number Out of Limits[b]	Percent Out of Limits	Range of Out-of-Limit Relative Percent Difference[c]
Total Field Duplicate Results Out = 86					
General Chemical Parameters: Total Out = 2					
Total Organic Carbon	4	3	2	66.7	39.7 - 164.8
Ammonia and Anions: Total Out = 9					
Chloride	42	41	1	2.4	64.1
Fluoride	42	16	7	43.8	22.7 - 61.5
Nitrogen in Nitrate	42	41	1	2.4	26.1
Metals: Total Out = 60					
Aluminum	31	5	5	100	140.1 - 186.4
Barium	87	84	6	7.1	29 - 53.1
Calcium	56	56	1	1.8	26.5
Chromium	87	23	2	8.7	102.7 - 134.4
Cobalt	87	2	2	100	54.5 - 101
Copper	87	9	5	55.6	51.3 - 186
Hexavalent Chromium	31	4	1	25.0	145.6
Iron	56	11	11	100	25.6 - 164.8
Lead	31	2	2	100	46.9 - 125.2
Magnesium	56	56	1	2	45.7
Manganese	60	2	2	100	47.8 - 73.3
Nickel	56	3	1	33.3	22.2
Silver	87	9	9	100	141.2 - 169.2
Sodium	56	56	3	5.4	21.5 - 122.6
Strontium	56	56	1	1.8	35.7
Tin	31	2	2	100	192.4
Vanadium	56	2	1	50.0	22.3
Zinc	56	9	5	55.6	22.9 - 157
Volatile Organic Compounds: Total Out = 5					
Acetone	19	2	2	100	132.2 - 173.3
Carbon Tetrachloride	19	5	1	20.0	114.9
Methylene Chloride	19	1	1	100	192.4
Trichloroethene	19	1	1	100	144.4
Radiochemical Parameters: Total Out = 10					
Carbon-14	20	4	2	50.0	66.9 - 101.8
Gross Beta	20	10	5	50.0	20.9 - 131.8
Strontium-90	28	7	1	14.3	21.5
Technetium-99	47	20	1	5.0	66.7
Tritium	30	16	1	6.2	42.6

Table 5-13. Field Splits Exceeding Quality Control Limits

Constituent	Total Number of Splits	Number of Splits Evaluated[a]	Number Out of Limits[b]	Percent Out of Limits	Range of Out-of-Limit Relative Percent Difference[c]

a. Splits sample results were evaluated when at least one result was greater than five times the MDL or MDA of both labs.
b. Split control limit is a RPD less than or equal to 20%.
c. In cases where a non-detected result was compared with a measured value, the MDL or MDA was used for the non-detected concentration.
MDA = minimum detectable activity
MDL = method detection limit
RPD = relative percent difference

The metals analyses constituted 69.8 percent of the total split failures. The majority of these failures occurred on filtered samples; hence, while suspended solids in the samples may have caused some of the discrepancies in the results for non-filtered samples, the most likely explanations for the discrepancies are samples swapped either in the field or in the laboratory, or possible dilution errors at the time of analysis.

After the metals analyses, the radiochemical results accounted for 11.6 percent of the split sample failures; carbon-14 and gross beta constituted most of the failures. The two carbon-14 failures showed TARL biased low with respect to Eberline Services. The low bias of the TARL carbon-14 results was a known bias that the laboratory has addressed with changes to its carbon-14 sample preparation procedure. For the five out-of-limits gross beta split pairs, WSCF reported four sample activities greater than TARL. Examination of the blind standards gross beta results for CY2012 indicated that WSCF does tend to report gross beta activities somewhat greater than those of TARL; the TARL gross beta blind standard recoveries tended to be closer to 100 percent.

The anions represented the next group with the most split failures at 10.5 percent of the total split failures. Of the nine anion split failures, seven were for fluoride with TASL reporting fluoride concentrations greater than those reported by WSCF. An examination of the fluoride results for the blind standards did not reveal any strong bias in fluoride results between the two laboratories.

For the remaining analyte classes, VOCs had five split pair failures, or 5.8 percent of the total failures. General chemical parameters reported two split pair failures, or 2.3 percent of the total split failures. No split pair results passed the evaluation criterion for the semivolatile organic compounds.

Groundwater project personnel will continue to monitor the analytes that exhibited split failures during CY2012 and will initiate corrective actions as required.

5.9 Laboratory Quality Control

This section discusses the CY2012 groundwater monitoring laboratory batch QC data that exceeded the QC acceptance criteria listed in Table 5-1. The types of laboratory QC samples that are evaluated in this section are discussed in Section 5.2. Table 5-14 summarizes the laboratory QC data by laboratory, and Table 5-15 summarizes the laboratory QC data by analyte class. Only laboratory QC data that were reported electronically are included in this assessment. Overall, the laboratory QC data indicate that laboratory analytical measurements for the groundwater monitoring program are produced within the QC limits of Table 5-1. Of the 97,077 laboratory batch QC measurements reported with groundwater monitoring results, 99 percent of the measurements met the groundwater monitoring QC requirements. When the laboratories detect failures in batch QC samples, the laboratories apply a QC laboratory qualifier to the data as noted in the remainder of this section.

Table 5-14. Laboratory Quality Control Results by Laboratory

QC Parameter	222-S	Eberline Services	Lionville	TestAmerica Knoxville	TestAmerica Richland	TestAmerica St. Louis	WSCF	Total
Total Laboratory QC Results	253	126	27	152	1,520	35,368	59,631	97,077
Laboratory QC Results Out	0	0	0	18	19	458	517	1,012
Laboratory QC Results Out Percent	0.0	0.0	0.0	11.8	1.3	1.3	0.9	1.0
Method Blanks Total	103	64	—	50	834	7,083	14,049	22,183
Method Blanks Out	0	0	—	18	6	78	235	337
Method Blanks Out Percent	0.0	0.0	—	36.0	0.7	1.1	1.7	1.5
Lab Control Samples Total	103	45	—	68	440	6,746	11,080	18,482
Lab Control Samples Out Low	0	0	—	0	1	71	13	85
Lab Control Samples Out High	0	0	—	0	0	36	23	59
Lab Control Samples Out Percent	0.0	0.0	—	0.0	0.2	1.6	0.3	0.8
Lab Control Sample Duplicates Total	—	—	—	34	—	799	39	872
Lab Control Sample Duplicates Out	—	—	—	0	—	5	1	6
Lab Control Sample Duplicates Out Percent	—	—	—	0.0	—	0.6	2.6	0.7
Matrix Spikes Total	29	6	—	—	114	10,927	18,495	29,571
Matrix Spikes Out Low	0	0	—	—	1	41	79	121
Matrix Spikes Out High	0	0	—	—	0	73	40	113
Matrix Spikes Out Percent	0.0	0.0	—	—	0.9	1.0	0.6	0.8
Matrix Spike Duplicates Total	—	—	—	—	42	5,340	8,960	14,342
Matrix Spike Duplicates Out	—	—	—	—	0	87	0	87
Matrix Spike Duplicates Out Percent	—	—	—	—	0.0	1.6	0.0	0.6
Sample Duplicates Total	18	11	—	—	90	160	1,538	1,817
Sample Duplicates Out	0	0	—	—	11	5	29	45
Sample Duplicates Out Percent	0.0	0.0	—	—	12.2	3.1	1.9	2.5
Surrogates Total	—	—	27	—	—	3,972	4,858	8,857
Surrogates Out Low	—	—	0	—	—	22	47	69
Surrogates Out High	—	—	0	—	—	37	35	72

Table 5-14. Laboratory Quality Control Results by Laboratory

QC Parameter	222-S	Eberline Services	Lionville	TestAmerica Knoxville	TestAmerica Richland	TestAmerica St. Louis	WSCF	Total
Surrogates Out Percent	—	—	0.0	—	—	1.5	1.7	1.6
Surrogate Duplicates Total	—	—	—	—	—	341	612	953
Surrogate Duplicates Out	—	—	—	—	—	3	15	18
Surrogate Duplicates Out Percent	—	—	—	—	—	0.9	2.5	1.9

QC = quality control

WSCF = Waste Sampling and Characterization Facility

Table 5-15. Laboratory Quality Control Results by Analyte Class

QC Parameter	General Chemical Parameters	Ammonia/ Anions	Metals	Volatile Organic Compounds	Semivolatile Organic Compounds	Radiochemical Parameters	Total
Total Laboratory QC Results	2,565	11,036	31,708	27,295	20,184	4,289	97,077
Laboratory QC Results Out	30	82	328	268	249	55	1,012
Laboratory QC Results Out Percent	1.2	0.7	1.0	1.0	1.2	1.3	1.0
Method Blanks Total	333	2,384	6,592	5,386	5,148	2,340	22,183
Method Blanks Out	1	20	275	6	21	14	337
Method Blanks Out Percent	0.3	0.8	4.2	0.1	0.4	0.6	1.5
Lab Control Samples Total	537	2,394	6,597	4,301	3,375	1,278	18,482
Lab Control Samples Out Low	1	0	5	14	63	2	85
Lab Control Samples Out High	0	1	4	46	8	0	59
Lab Control Samples Out Percent	0.2	0.0	0.1	1.4	2.1	0.2	0.8
Lab Control Sample Duplicates Total	1	4	—	537	330	—	872
Lab Control Sample Duplicates Out	0	0	—	4	2	—	6
Lab Control Sample Duplicates Out Percent	0	0	—	0.7	0.6	—	0.7
Matrix Spikes Total	744	3,505	12,345	7,539	5,185	253	29,571

Table 5-15. Laboratory Quality Control Results by Analyte Class

QC Parameter	General Chemical Parameters	Ammonia/ Anions	Metals	Volatile Organic Compounds	Semivolatile Organic Compounds	Radiochemical Parameters	Total
Matrix Spikes Out Low	1	42	21	44	10	3	121
Matrix Spikes Out High	4	14	23	50	21	1	113
Matrix Spikes Out Percent	0.7	1.6	0.4	1.2	0.6	1.6	0.8
Matrix Spike Duplicates Total	363	1,631	6,006	3,758	2,584	—	14,342
Matrix Spike Duplicates Out	1	0	0	61	25	—	87
Matrix Spike Duplicates Out Percent	0.3	0.0	0.0	1.6	1.0	—	0.6
Sample Duplicates Total	113	1,118	168	—	—	418	1,817
Sample Duplicates Out	5	5	0	—	—	35	45
Sample Duplicates Out Percent	4.4	0.4	0.0	—	—	8.4	2.5
Surrogates Total	387	—	—	5,284	3,186	—	8,857
Surrogates Out Low	7	—	—	1	61	—	69
Surrogates Out High	6	—	—	41	25	—	72
Surrogates Out Percent	3.4	—	—	0.8	2.7	—	1.6
Surrogate Duplicates Total	87	—	—	490	376	—	953
Surrogate Duplicates Out	4	—	—	1	13	—	18
Surrogate Duplicates Out Percent	4.6	—	—	0.2	3.5	—	1.9

QC = quality control

5.9.1 Laboratory Method Blanks

Laboratory MBs are used to assess potential contamination associated with laboratory sample preparation and analysis. Overall, the percentage of the 22,183 acceptable laboratory MB results evaluated during this reporting period was 98.5 percent, indicating little problem with laboratory contamination. This is slightly poorer than the 99.5 percent reported for CY2011 and CY2010.

Evaluation of MB results was based on the percentage of analytes detected above the MB QC limits listed in Table 5-1. For the common laboratory contaminants 2-butanone, acetone, methylene chloride, phthalate esters, and toluene, the QC limit is five times the MDL. Results associated with out-of-limit blank results are flagged in the laboratory qualifier field in the HEIS database as described in Table 5-3. For inorganic analytes (including the indicator analytes TOC and TOX), results associated with an out-of-limit MB are flagged with a C. For organic analytes, results associated with an out-of-limit MB are flagged with a B.

By laboratory, TAKN reported the largest failure rate for MBs at 36 percent of the MB results reported by that laboratory. These failures were associated exclusively with the analysis of dioxins and dibenzofurans. For most of these analytes, the extent of MB contamination was between about one and three times the QC acceptance criteria. The highest blank contamination value for these analytes was a factor of 9.4 times the acceptance criterion for the hexachlorodibenzofurans.

The WSCF laboratory had the next highest failure rate for MBs at 1.7 percent of the MBs reported by WSCF. Most of the MB failures were for the ICP metals; those metals with 10 or more MB failures were chromium, copper, magnesium, sodium, vanadium, and zinc. By percentage, 43.5 percent of the MBs analyzed for sodium failed, followed by vanadium (12.2 percent) and boron (11.1 percent). The WSCF laboratory also reported 13 radiochemical MB failures. The WSCF radionuclides with highest MB failure rates were uranium-233/234 (12.0 percent), uranium-238 (8.0 percent), and potassium-40 (6.8 percent).

TASL had a 1.1 percent failure rate for the MBs they reported. The majority of the out-of-limits MBs were for the ICP metals; metals with 10 or more MB failures were silver and zinc. By percentage, 31.3 percent of the MBs analyzed for zinc failed, followed by silver (21.6 percent), boron and tin (21.1 percent), thallium (15.8 percent), and copper (11.8 percent). For TASL, the next analyte class with several out-of-limit MBs was the anions including three cyanide blanks (50.0 percent) and four chloride blanks (13.3 percent).

The remaining laboratories reported MB failure rates less than 1 percent.

By analyte category, metals had the highest MB failure at 4.2 percent. This failure rate is primarily attributable to the ICP metals MB failures at TASL and WSCF as discussed in the previous paragraphs. The remaining analyte classes had MB failure rates less than 1 percent.

5.9.2 Laboratory Control Samples and Laboratory Control Sample Duplicates

LCS recoveries give a measure of the accuracy of an analytical result, and the LCSD RPD gives a measure of the repeatability of the analytical result. Laboratories may apply a laboratory qualifier of X and an accompanying explanatory note when LCS recoveries or LCSD RPDs are outside QC limits. LCS results were available across all the analyte categories while LCSD results were available primarily for VOCs and SVOCs.

Overall, 99.2 percent of the percent recoveries for the 18,482 reported LCSs and 99.3 percent of the RPDs for the 872 reported LCSDs met the QC criteria cited in Table 5-1. This is comparable to the acceptance rates of 99 percent for LCS percent recoveries and 98 percent for LCSD RPDs during CY2011. These success rates for percent recoveries and RPDs provide assurance that the analytical measurement processes are in good control and are producing results with sufficient accuracy and precision to meet the needs of the groundwater monitoring program.

By laboratory, TASL had a 1.6 percent failure rate for the LCS recoveries they reported and 0.6 percent failure rate for out-of-limit LCSD RPDs. Most of the out-of-limits LCSs were for VOCs and SVOCs. For the VOCs, the LCS failures were spread over 22 different compounds; 0.3 percent of the LCSs had recoveries less than the lower recovery limit (failed low) and 0.9 percent had LCS recoveries that exceeded the upper recovery limit (failed high). Three VOCs had LCSDs that failed the RPD criterion: 2-butanone (18.2 percent failure rate), isobutyl alcohol (12.5 percent), and trichloromonofluoromethane (12.5 percent). The SVOC LCS failures included a range of 33 EPA Method 8270 compounds, pesticides, and polynuclear aromatic hydrocarbons. For these SVOCs, 2.3 percent of the LCS results failed low and 0.3 percent failed high. The prevalence of low LCS recoveries may indicate a possible low bias for the SVOC results associated with those low recoveries. TAS reported only a single LCSD result for SVOCs (the pesticide impurity endrin aldehyde) that exceeded the precision criterion.

The highest LCS out-of-limits rates for the WSCF laboratory was for the VOCs: 0.3 percent failed low and 1.5 percent failed high. The tendency for these LCS failures to fail high may indicate a slight positive bias for the associated VOC results. The WSCF LCS and LCSD failure rates for the remaining analyte classes were less than 1 percent or involved only a single QC failure.

By analyte category, the SVOCs had the highest LCS failure at 2.1 percent followed by the VOCs with 1.4 percent. These failure rates are primarily attributable to the LCS failures at TASL and WSCF, as discussed in the previous paragraphs. Most of the LCS failures for the SVOCs were for recoveries less than the lower recovery limit, suggesting a possible low bias for the results associated with those low recoveries. Just the opposite behavior was observed for the VOC LCS failures: most of those were for recoveries that exceeded the upper recovery limit. These high recoveries suggest a possible high bias for those results associated with high LCS recoveries.

5.9.3 Matrix Spikes and Matrix Spike Duplicates

MSs give a measure of the accuracy of an analytical result and are used to determine if sample matrix effects may have affected analytical results. MSDs give a measure of the repeatability of the analytical result. Only those samples that were spiked at a level at least one-fourth of the original sample concentration were included in the evaluation. For MS/MSD recovery failures, the laboratories apply a laboratory qualifier of N for non-gas chromatography – mass spectrometry methods, and a laboratory qualifier of T for gas chromatography – mass spectrometry methods. MS results were available across all the analyte categories, and MSD results were available for all the analyte categories except the radiochemical parameters.

Overall, 99.2 percent of the percent recoveries for the 29,571 reported MSs and 99.4 percent of the RPDs for the 14,342 reported MSDs met the QC criteria cited in Table 5-1. This is slightly better than the acceptance rates of 98.5 percent for MS percent recoveries and 97.9 percent for MSD RPDs during CY2011. These success rates for percent recoveries and RPDs are comparable to those for the LCS and LCSD QC and provide additional assurance that the laboratories are producing data with sufficient accuracy and precision to meet the needs of the groundwater monitoring program.

The laboratories that reported MS/MSD QC data all had MS recovery failure rates of 1 percent or less. For the MSDs, TASL had a 1.6 percent failure rate, primarily for VOC and SVOC results. For the VOCs, the MSD failures were mostly among polar compounds: 1,4-dioxane (14.0 percent MSD failure rate), 1-butanol (26 percent), 2-butanone (12 percent), acetonitrile (10.8 percent), and acrylonitrile (10.0 percent). These polar analytes tend to be more difficult to separate from a water matrix than non-polar analytes. They also tend to adsorb to any active sites during the analysis process. Both factors can affect the reproducibility with which these analytes are determined. For the SVOCs, 15 analytes had MSDs that failed the RPD criterion; the 2 analytes with the greatest MSD failure rates were heptachlor (10.5 percent failure rate) and 4-nitrophenol (8.1 percent).

The analyte categories with the highest MS failure rates were anions at 1.6 percent and the VOCs at 1.2 percent. Radiochemical parameters also had a 1.6 percent MS failure rate, but this was only four MS failures in 253 MS measurements. No MSDs were performed for the radiochemical parameters.

For the anions, 3,505 MSs were analyzed with 56 MS results outside the recovery limits; TASL and WSCF reported these results. The MS failures occurred for all the ion-chromatography anions, cyanide, and sulfide; three-quarters of the MS failures were low recoveries. Nitrogen-in-nitrite had the largest number of failures with nine failing low and five high. Cyanide had the largest percentage of failures with 5.2 percent of its MS recoveries falling outside the recovery limits; all of these failed low. None of the MSD for anions exceeded the RPD limit.

For the VOCs, 7,539 MS were analyzed with 94 MS results outside the recovery limits. TASL and WSCF reported all the VOC MS results. The MS failures were distributed over 45 VOC analytes with about half of the failures failing low and half failing high. The MSD failures for the VOC were mainly for polar compounds and are covered in the laboratory discussion of MSD failures for the VOCs.

5.9.4 Laboratory Sample Duplicates

Laboratory sample duplicates give a measure of the repeatability of an analytical result. Only those sample results with values five times greater than the MDL or the MDA, or one times the estimated quantitation limit were evaluated. The RPDs for sample duplicates that met the evaluation criteria were compared to either the laboratory-specific statistically derived RPD maximum or to a maximum of 20 percent if no laboratory-specific RPD was available. When laboratory sample duplicate RPDs are outside QC limits, laboratories may apply a laboratory qualifier of X and an accompanying explanatory note.

Of the 1,817 evaluated laboratory sample duplicates, 45 (2.5 percent) had RPDs that did not meet the precision criteria. This failure rate, while not as low as those for the LCSD and MSD quoted in the previous sections, still demonstrates reasonable analytical reproducibility. The WSCF Laboratory reported the bulk of the sample duplicate data, and the 222-S Laboratory, Eberline Services, TARL, and TASL reported the remainder. By analyte class, laboratory sample duplicate data were reported for the general chemical parameters, anions, metals, and the radiochemical parameters. For the radiochemical parameters, the laboratory sample duplicate is the only available measure of analytical precision.

By laboratory, TARL had the poorest laboratory sample duplicate success: of its 90 sample duplicates that met the evaluation criterion, 11 RPD failures occurred for a 12.2 percent failure rate. These sample duplicate failures were for the radionuclides carbon-14, iodine-129, potassium-40, and tritium. Carbon-14 had an 80 percent failure rate and was traced to a sample preparation method that caused variable recoveries of carbon-14. TestAmerica Richland has since modified its sample preparation method to minimize these variable recoveries and should improve the measurement precision for this radionuclide. For iodine-129, TARL had a 27.8 percent failure rate; groundwater monitoring QC staff will continue to monitor future iodine-129 results to determine if corrective action is necessary to improve analytical precision. The single potassium-40 sample duplicate that met the evaluation criterion failed, and of the 17 tritium duplicates that met the evaluation criterion, only one failed.

TASL reported 160 laboratory sample duplicate results with five (3.1 percent) that did not meet RPD criteria: TOC (1), cyanide (1), fluoride (2), and sulfide (1). The WSCF laboratory reported 1,538 sample duplicate results with 29 (1.9 percent) RPD failures. Most of the failures were for the radiochemical parameters gross alpha (3), gross beta (5), plutonium-239/240 (1), potassium-40 (1), strontium-90 (2), technetium-99 (1), tritium (3), uranium-233/234 (1), uranium-235 (4), and uranium-238 (3). The 222-S Laboratory and Eberline Services also reported a few laboratory sample duplicates that met the evaluation criterion; none of these duplicates failed the RPD criteria.

By analyte class, the radiochemical parameters had the most laboratory sample duplicate failures: of the 418 duplicates that met the evaluation criterion, 35 (8.4 percent) failed the RPD criteria. These failures are discussed in the previous paragraphs. For the general chemical parameters, 113 duplicates met the evaluation criterion with five (4.4 percent) failures: alkalinity (1), total dissolved solids (3), and total organic carbon (1).

5.9.5 Surrogates and Surrogate Duplicates

Surrogates and surrogate duplicates are used to monitor percent recovery and precision during the analysis of samples for total petroleum hydrocarbons (TPHs), VOCs, and SVOCs. Surrogates are typically fluorinated or deuterated organic compounds similar in chemical properties to those of the analytes of interest in a sample but are not normally found in groundwater samples. Known amounts of the surrogates are added to the sample prior to sample preparation and analysis to monitor the recovery of the organic compounds during the analytical process. As Table 5-1 indicates, percent recoveries for surrogates are compared to statistically derived laboratory-specific process control limits. The precision limit for surrogate duplicate RPDs was 20 percent unless the laboratory provided a statistically derived precision limit.

Tables 5-14 and 5-15 indicate that 98.4 percent of the percent recoveries for the 8,857 reported surrogates and 98.1 percent of the RPDs for the 953 reported surrogate duplicates met the QC criteria for CY2012. These success rates, along with those for the other measures of laboratory accuracy and precision, continue to provide assurance that the laboratories are producing data with sufficient accuracy and precision to meet the needs of the groundwater monitoring program. The CY2012 surrogate success rates are similar to the CY2011 success rates of 97.5 percent for surrogate percent recoveries and 98.0 percent for surrogate RPDs.

For the current reporting period, LVL, TASL, and WSCF reported surrogate data for TPHs, VOCs, and SVOCs. LVL reported only 27 surrogate percent recoveries for VOCs and SVOCs, none of which were outside QC limits, and no surrogate duplicate results; their surrogate results are not further discussed in this section. The laboratories may apply a laboratory qualifier of X and an accompanying explanatory note in the data report or case narrative when laboratory surrogate/surrogate duplicate percent recoveries or RPDs are outside QC limits.

By laboratory, WSCF had the highest surrogate recovery failure rate at 1.7 percent and the highest RPD failure rate at 2.5 percent. The largest failure rate of the WSCF surrogates was for the SVOCs with 3.1 percent of surrogate recoveries falling below the lower control limit and 1.9 percent exceeding the upper control limit. For the WSCF TPH analyses, 1.9 percent of the surrogate recoveries failed low and 1.1 percent failed high. Surrogate recovery failures for WSCF’s VOC analysis was only 0.2 percent, all failing high. The RPD failure rate for the WSCF surrogate duplicates was 4.8 percent each for TPHs and the SVOCs; no RPD failures were reported for the VOC.

TASL had an overall 1.5 percent failure rate for their surrogate recoveries and a 0.9 percent failure rate for out-of-limit surrogate RPDs. The largest surrogate recovery failure was for TPHs with a 7.4 percent failure rate; all exceeded the upper recovery limit. For the VOCs, the TASL surrogate recovery failure rate was 1.7 percent, all failing high, with a surrogate RPD failure rate of 0.5 percent. For the SVOCs, the surrogate recovery failure rate was 1.1 percent low and 0.1 percent high, and the surrogate RPD failure rate was 1.4 percent.

By analyte class, the TPH analysis within the general chemical parameters had the largest percentages of surrogate recovery failures: of the 387 surrogates reported, seven failed low and six failed high for a total failure rate of 3.4 percent. Of the 87 TPH surrogate duplicates reported, four (4.6 percent) failed the RPD criteria. These failures do not indicate any general bias or poor precision for the TPH data generated for the groundwater monitoring program.

The analyte class with the next poorest surrogate recovery and RPD performance was the SVOCs. Of the 3,186 surrogate results reported, 61 had recoveries less than the lower recovery limit, and 25 exceeded the upper recovery limit for a total failure rate of 2.7 percent. Most of the low recovery failures were due to low recovery of phenol-d5 at WSCF. Phenol is an acidic compound that can be easily lost to any basic materials or sites during the sample preparation and analysis process. While these results may indicate a possible low bias for phenolic compounds in groundwater samples analyzed at WSCF, the recoveries for phenols in LCS and MS samples are within QC limits. Looking at the entire QC sample suite for phenols, poor recovery of these compounds in groundwater samples does not appear to be an issue.

For the VOC analytes, the failure rates for percent recoveries and RPDs were both less than 1 percent.

5.10 Laboratory Performance

5.10.1 Quarterly Blind Standard Evaluation

The groundwater monitoring program issues blind standards to the supporting laboratories to provide a measure of inter- and intra-laboratory precision and accuracy. These standards help groundwater staff troubleshoot analytical problems identified through data reviews and QC evaluations. The blind standards also may be used to confirm the adequacy of corrective actions to resolve analytical problems. The quality requirements and control limits for the groundwater monitoring blind standards are given in CHPRC-00189 and DOE/RL-91-50 and are listed in Table 5-16. A *success rate* is calculated for the results returned by each supporting laboratory:

$$\text{Success Rate} = \frac{\text{number of results meeting QC criteria}}{\text{total number of results reported}} \times 100 \qquad \textbf{(Equation 5-4)}$$

The acceptance criterion for the success rate is 80 percent (CHPRC-00189).

Table 5-16. Groundwater Blind Standard Recovery and Precision Requirements[a]

Analyte Class	Recovery Limits (% Recovery)	Precision Limit[b] (% Relative Standard Deviation)
General Chemical Parameters	75 - 125	≤ 25
Ammonia and Anions	75 - 125	≤ 25
Metals	80 - 120	≤ 20
Volatile Organic Compounds	75 - 125	≤ 25
Semivolatile Organic Compounds[c]	Not Required	Not Required
Radiological Parameters	70 - 130	≤ 20

Sources: DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*, and CHPRC-00189, *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan*.

a. Blind standards are required to be submitted to participating laboratories on a quarterly basis; the identity of the analytes and their concentrations vary from quarter to quarter.

b. If the results are less than five times the required detection limit, then the criterion is that the difference of the results of the replicates is less than the required detection limit.

c. The blind standards program does not require semivolatile organic compound standards.

During CY2012, the groundwater monitoring program sent blind standards to Eberline Services, LVL, TARL, TASL, and WSCF. In summary, the evaluation of the double-blind standards for 2012 indicates that, with some exceptions, the participating laboratories generally met the 80 percent success rate requirement for the groundwater monitoring program. Performance was somewhat uneven over the reporting period with LVL, TARL, and WSCF each turning in at least one quarter with a success rate less than 80 percent. Of the blind results for all laboratories for 2012, 88.7 percent of the blind sample determinations were acceptable. This percentage is somewhat better than the 83.6 percent for 2011 and the 86.6 percent for 2010. Table 5-17 presents the success rates by quarter during CY2012 for each laboratory.

Table 5-17. Blind Standards Laboratory Success Rates for Calendar Year 2012

Laboratory	Success Rate (%) by Quarter*			
	Q1	Q2	Q3	Q4
Eberline	86.7	100.0	95.2	83.3
Lionville	100.0	**67.5**	100.0	**75.0**
TestAmerica Richland	**75.0**	94.1	85.2	96.7
TestAmerica St. Louis	98.5	91.3	84.2	80.5
WSCF	90.7	87.7	**76.3**	83.1

*Success Rate = 100 × number of results within QC criteria/total number of results submitted. The minimum acceptable success rate is 80% (CHPRC-00189, *CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan*). Success rates less than the 80% criterion are denoted by shaded cells.

Blind standards were generally prepared in triplicate and submitted to the laboratories to check the accuracy and precision of analyses. For most constituents, the blind standards were prepared in a groundwater matrix from an appropriate background well to simulate actual groundwater samples. Standards for specific conductance were commercially prepared in deionized water. Multi-metal blind standards for analysis by ICP techniques were prepared in deionized water using commercially prepared metals standards. The blind standards were submitted to the laboratories as regular groundwater samples.

After analysis, the laboratories' results were compared with the spiked concentrations to generate percent recoveries and precisions for the results. The percent recoveries and precisions were compared to the control limits to determine whether the data were acceptable. Out-of-limit results were reviewed for errors. In situations where several results for the same method were unacceptable, an RDR may be generated to reanalyze the blind samples (if within holding times) or for recheck of the results. Any remaining out-of-limit results were discussed with the laboratory, potential problems were investigated, and corrective actions requested when appropriate. Table 5-18 summarizes the blind standards that exceeded the recovery or precision criteria during 2012; results that are outside the recovery or precision limits are in shaded cells.

The most notable blind standard failures for 2012 were the following:

- *Total organic carbon*: During the first quarter, TASL submitted one significantly low TOC value, but later in the year a number of high results were submitted by LVL (fourth quarter), TASL (third and fourth quarters), and WSCF (fourth quarter). The fourth quarter results were so uniformly high among the three laboratories that a faulty blind standard was suspected. However, because the TOC standard value for the fourth quarter was near the MDLs for the laboratories, two alternate explanations exist for the high TOC recoveries.

- The blind standards likely contain residual inorganic carbon in the form of dissolved carbon dioxide. Failure to completely purge inorganic carbon from the sample prior to the TOC determination could lead to the high TOC recoveries noted for the third and fourth quarter blind samples.
- The best estimate for the background TOC content of the groundwater used to generate the TOC blind samples is <100 µg/L. If the actual background TOC value is nearly 100 µg/L, then a TOC blind standard spiked with an additional 500 µg/L TOC could have an actual concentration of nearly 600 µg/L and would yield a 120 percent recovery. Many of the fourth quarter high recoveries were greater than 120 percent, which supports the hypothesis that inorganic carbon is not being completely removed from the samples prior to the TOC determination.

- *Total organic halides*: Two types of standards were used to generate TOX blind samples each quarter: one based on the relatively non-volatile compound 2,4,5-trichlorophenol and one based on the same standards as those used for the VOC blind standard containing carbon tetrachloride, chloroform, and trichloroethene. Because of the sample preparation method used at the laboratory, WSCF has historically reported low recoveries for the VOC-based TOX blind standards; that trend continued for the first through third quarters of 2012. For the fourth quarter, both TAS and WSCF reported high recoveries for the 100 µg/L TOX blind standards. One possible explanation for these high recoveries is insufficient removal of inorganic chloride from the charcoal adsorption tubes prior to combustion and analysis of the charcoal. This issue was addressed at WSCF in 2009 (HNF-39194, *Investigation of the Total Organic Halogen Analytical Method at the Waste Sampling and Characterization Facility*). Should the laboratories continue to report high TOX recoveries for the blind standards, groundwater monitoring program personnel will initiate an investigation into possible causes.

Table 5-18. CY2012 Blind Standard Out-of-Limit Results

Constituent	Laboratory	Spike Value	MDL/ MDA	Recovery Limits (%)	Recovery 1 (%)	Recovery 2 (%)	Recovery 3 (%)	Recovery 4 (%)	Precision Limit (%)	Precision (%RSD)	Precision Criterion Exceeded?
First Quarter Results											
TOC	TASL	1,284 µg/L	260 µg/L	75 - 125	85.7	20.2	93.4	85.7	25	48.0	N*
TOX (VOA)	WSCF	45.9 µg/L	10 µg/L	75 - 125	71.5	64.5	82.8	—	25	12.7	N*
Uranium	WSCF	299 µg/L	0.1 µg/L	80 - 120	122.2	120.8	125.2	—	20	1.8	N
Carbon-14	Eberline	210 pCi/L	100 pCi/L	70 - 130	69.5	78.0	57.1	—	20	15.4	N*
Carbon-14	TARL	210 pCi/L	7.97 pCi/L	70 - 130	30.3	38.7	43.4	—	20	17.7	N
Gross alpha	Eberline	103 pCi/L	2.8 pCi/L	70 - 130	49.9	68.9	73.7	—	20	19.6	N
Gross alpha	TARL	103 pCi/L	3.36 pCi/L	70 - 130	48.2	57.9	67.7	—	20	16.9	N
Gross alpha	WSCF	103 pCi/L	1.6 pCi/L	70 - 130	55.1	57.1	60.9	—	20	5.1	N
Iodine-129	TARL	0.31 pCi/L	0.211 pCi/L	70 - 130	139.7	158.1	102.9	—	20	22.0	N*
Iodine-129	Eberline	3.18 pCi/L	0.868 pCi/L	70 - 130	104.1	126.4	77.0	—	20	24.2	Y*
Plutonium-239	TARL	2 pCi/L	0.321 pCi/L	70 - 130	112.5	137.0	115.0	—	20	11.1	N*
Second Quarter Results											
TOX (VOA)	WSCF	490 µg/L	50 µg/L	75 - 125	71.6	73.1	70.2	73.9	25	2.2	N
Fluoride	Lionville	560 µg/L	100 µg/L	75 - 125	141.0	142.8	139.3	—	25	1.3	N*
Fluoride	Lionville	560 µg/L	100 µg/L	75 - 125	142.8	144.6	148.2	—	25	1.9	N*
Fluoride	Lionville	560 µg/L	100 µg/L	75 - 125	148.2	146.4	150.0	—	25	1.2	N*
Nitrogen in Nitrite	Lionville	122 µg/L	60 µg/L	75 - 125	624.0	624.0	599.3	—	25	2.3	N*
Nitrogen in Nitrite	Lionville	122 µg/L	30 µg/L	75 - 125	123.2	114.9	131.4	—	25	6.7	N*
Nitrogen in Nitrite	WSCF	122 µg/L	38 µg/L	75 - 125	128.1	121.5	126.4	—	25	2.7	N*
Nitrogen in Nitrite	WSCF	122 µg/L	38 µg/L	75 - 125	165.0	143.7	170.8	—	25	8.9	N*
Antimony	TASL	5.02 µg/L	4 µg/L	80 - 120	105.6	139.4	141.4	—	20	15.6	N*
Boron	TASL	25.1 µg/L	10 µg/L	80 - 120	139.0	152.6	131.9	—	20	7.5	N*
Cadmium	WSCF	5.02 µg/L	4 µg/L	80 - 120	97.6	79.7	101.6	—	20	12.6	N*
Hexavalent chromium	TARL	25 µg/L	3.7 µg/L	80 - 120	80.0	76.0	76.0	—	20	3.0	N*

Table 5-18. CY2012 Blind Standard Out-of-Limit Results

Constituent	Laboratory	Spike Value	MDL/ MDA	Recovery Limits (%)	Recovery 1 (%)	Recovery 2 (%)	Recovery 3 (%)	Recovery 4 (%)	Precision Limit (%)	Precision (%RSD)	Precision Criterion Exceeded?
Nickel	TASL	25.1 µg/L	13.3 µg/L	80 - 120	123.5	124.3	121.5	—	20	1.2	N*
Selenium	TASL	5.01 µg/L	1.6 µg/L	80 - 120	103.8	81.8	61.9	—	20	25.4	N*
Silver	WSCF	5.02 µg/L	4 µg/L	80 - 120	117.5	157.4	117.5	—	20	17.5	N*
Uranium	WSCF	296 µg/L	0.1 µg/L	80 - 120	115.5	112.1	123.3	—	20	4.9	N
Vanadium	TASL	5.02 µg/L	4.1 µg/L	80 - 120	127.5	119.5	121.5	—	20	3.4	N*
Zinc	TASL	25.1 µg/L	7 µg/L	80 - 120	132.7	138.6	135.9	—	20	2.2	N*
Carbon tetrachloride	WSCF	496 µg/L	10 µg/L	75 - 125	1,028.2	201.6	967.7	—	25	62.9	Y
Chloroform	WSCF	197 µg/L	10 µg/L	75 - 125	1,218.3	60.9	1,167.5	—	25	80.2	Y
Tetrachloroethene	WSCF	5 µg/L	1 µg/L	75 - 125	90.0	52.0	38.0	—	25	45.0	N*
Trichloroethene	WSCF	203 µg/L	10 µg/L	75 - 125	936.0	54.2	886.7	—	25	79.2	Y
Iodine-129	TARL	1.5 pCi/L	0.237 pCi/L	70 - 130	115.3	136.0	122.0	—	20	8.6	N*
Strontium-90	WSCF	2.04 pCi/L	0.99 pCi/L	70 - 130	137.3	142.2	83.3	—	20	27.1	N*
Third Quarter Results											
TOC	TASL	2,205 µg/L	270 µg/L	75 - 125	158.7	117.9	149.7	136.1	25	12.6	N*
TOX (VOA)	WSCF	46.3 µg/L	5 µg/L	75 - 125	83.6	66.3	62.9	—	25	15.7	N*
Nitrogen in Nitrite	TASL	92.6 µg/L	3 µg/L	75 - 125	17.3	3.2	11.9	—	25	65.6	N*
Nitrogen in Nitrite	WSCF	92.6 µg/L	38 µg/L	75 - 125	41.1	65.1	52.7	—	25	22.7	N*
Uranium	WSCF	297 µg/L	0.1 µg/L	80 - 120	137.2	138.9	127.5	—	20	4.6	N
Carbon tetrachloride	WSCF	21.7 µg/L	1 µg/L	75 - 125	78.3	36.9	73.7	—	25	36.1	Y*
Trichloroethene	WSCF	10.2 µg/L	1 µg/L	75 - 125	69.6	67.7	70.6	—	25	2.1	N*
Carbon-14	TARL	208 pCi/L	8 pCi/L	70 - 130	78.7	80.6	56.6	—	20	18.5	N
Gross alpha	Eberline	106 pCi/L	2.54 pCi/L	70 - 130	88.7	53.4	81.8	—	20	25.1	Y
Gross alpha	TARL	106 pCi/L	2.35 pCi/L	70 - 130	70.3	52.2	75.2	—	20	18.4	N
Gross beta	WSCF	120 pCi/L	3.8 pCi/L	70 - 130	108.7	133.8	125.5	—	20	10.4	N
Tritium	TARL	292 pCi/L	20 pCi/L	70 - 130	71.6	64.0	67.1	—	20	5.6	N

Table 5-18. CY2012 Blind Standard Out-of-Limit Results

Constituent	Laboratory	Spike Value	MDL/ MDA	Recovery Limits (%)	Recovery 1 (%)	Recovery 2 (%)	Recovery 3 (%)	Recovery 4 (%)	Precision Limit (%)	Precision (%RSD)	Precision Criterion Exceeded?
Fourth Quarter Results											
TOC	Lionville	500 µg/L	200 µg/L	75 - 125	134.0	136.0	142.0	162.0	25	8.9	N*
TOC	TASL	500 µg/L	270 µg/L	75 - 125	102.0	132.0	120.0	120.0	25	10.4	N*
TOC	WSCF	500 µg/L	100 µg/L	75 - 125	132.4	136.0	131.6	153.6	25	7.5	N*
TOX (phenol)	TASL	99.9 µg/L	1.8 µg/L	75 - 125	174.2	186.2	188.2	—	25	4.1	N
TOX (phenol)	WSCF	99.9 µg/L	25 µg/L	75 - 125	137.1	113.1	115.1	—	25	11.0	N
TOX (VOA)	TASL	100 µg/L	1.8 µg/L	75 - 125	151.9	159.8	189.8	149.9	25	11.4	N
Uranium	Eberline	62.2 µg/L	0.218 µg/L	80 - 120	76.3	79.2	73.9	—	20	3.5	N*
Uranium	WSCF	62.2 µg/L	0.1 µg/L	80 - 120	147.9	132.4	135.0	—	20	6.0	N
Chloroform	WSCF	98.9 µg/L	1 µg/L	75 - 125	121.3	131.5	121.3	—	25	4.7	N
Gross alpha	Eberline	20.3 pCi/L	2.59 pCi/L	70 - 130	122.5	114.6	154.9	—	20	16.4	N
Gross alpha	WSCF	20.3 pCi/L	3.8 pCi/L	70 - 130	93.5	88.5	49.2	—	20	31.5	Y
Iodine-129	TARL	0.31 pCi/L	0.231 pCi/L	70 - 130	119.4	158.7	85.2	—	20	29.0	N*

* The blind standard concentration was less than five times the required detection limit for this analyte. Hence, the secondary precision criterion that the difference between the maximum and minimum value reported be less than the required detection limit was used.

MDA = minimum detectable activity
MDL = method detection limit
%RSD = percent relative standard deviation
TOC = total organic carbon
TOX = total organic halides
VOA = volatile organic analysis

- *Nitrogen in nitrite*: As a result of a study that WSCF performed on quantitating nitrite in the presence of chloride by ion chromatography (HNF-53079-VA, *Nitrite Investigation at Waste Sampling and Characterization Facility*), several low-level nitrite blind standards were submitted to LVL, TASL, and WSCF during the second and third quarters. If the nitrite peak is not properly integrated, the nitrite concentration in the presence of large amounts of chloride may cause the nitrite value to be overestimated. This appears to be the case for the second quarter nitrite results for the LVL and to a lesser extent for WSCF. TASL returned reasonable results for nitrite in the presence of chloride when the nitrite concentration was well above the laboratory's MDL, but reported less than the MDL when the nitrite concentration was within about a factor of 10 above the laboratory's MDL. This indicates that the TASL MDL for nitrite is estimated too low for Hanford Site groundwater samples and may lead to false negatives for nitrite in these types of samples.

- For the third quarter nitrite results, both TASL and WSCF under-reported the nitrite results in the presence of high chloride. The nitrite content in these blind standards was less than the LVL MDL, and this laboratory correctly reported the blind standard's nitrite content as being less than their MDL. These results again illustrate the fact that an analyte's MDL tends to be higher when in the presence of an actual groundwater matrix.

- *Metals*: Four laboratories returned results for metals blind standards during CY2012: Eberline Services (total uranium), TARL (hexavalent chromium and total uranium), TASL (inductively coupled plasma – atomic emission spectroscopy [ICP-AES] and inductively coupled plasma – mass spectrometry [ICP-MS]), and WSCF (ICP-AES and ICP-MS). The following bullets present highlights of those results.

  – *WSCF/uranium by ICP-MS*: 10 of 12 results failed high with out-of-limit recoveries ranging from 120.8 percent to 147.9 percent. Eberline Services and TARL, both of which used kinetic phosphorescence methods for uranium, returned total uranium recoveries within the acceptance limits. Groundwater monitoring personnel will continue to observe the WSCF laboratory results for total uranium by ICP-MS and request corrective actions at the laboratory should high recoveries continue to be returned.

  – *TASL/antimony, nickel, vanadium, and zinc by ICP-AES and boron and selenium by ICP-MS*: 13 of the 18 results for these metals failed high with out-of-limit recoveries ranging from 121.5 percent to 152.6 percent. The selenium failure was the only low out-of-limit recovery at 61.9 percent. The WSCF laboratory reported acceptable recoveries for these analytes. High failures for boron and zinc at TASL were also noted for the CY2011 blind standards; a request to investigate these high failures will be sent to TASL.

- *Volatile Organic Compounds*: TASL and WSCF reported results for VOC blind standards during CY2012. All of TASL VOC results were within the acceptance criteria. However, WSCF reported a number of results with highly variable out-of-limit recoveries. For the second quarter VOC blind standards, WSCF reported five results with recoveries ranging from 201.6 percent to 1,218 percent. An RDR was issued for these results. As a result of the data review, the laboratory concluded that incorrect dilution factors (DFs) were probably applied to the results, but the actual DFs could not be determined and applied to correct the reported results. Otherwise, most of the out-of-limits recoveries failed low; this continues the historical trend of low recoveries for the VOC blind standards. Low recoveries for this analysis have been attributed in part to losses of the VOCs from those blind standards during standards make-up and sample handling.

- *Radiochemical parameters*: Three laboratories returned results for radiochemical blind standards during CY2012: Eberline Services, TARL, and WSCF. The following bullets discuss the highlights of those results.
  - *Carbon-14*: Eberline Services and TARL both reported low recoveries for carbon-14 during this reporting period. Eberline Services reported two low recoveries during the first quarter while TARL reported low recoveries during the first and third quarters. TARL low recoveries were traced to their sample preparation method. TARL has modified the sample preparation method to remedy the low recoveries; groundwater monitoring staff will continue to scrutinize the carbon-14 blind standard results in the future to ensure that the modified method is providing acceptable carbon-14 recoveries.
  - *Gross alpha*: Three laboratories, Eberline Services, TARL, and WSCF, reported gross alpha results for this reporting period. Twelve of the 36 results for gross alpha had recoveries that were outside the recovery limits for this analysis. Eleven of the 12 out-of limit recoveries were low and ranged from 48.2 percent to 68.9 percent with the three laboratories each reporting several low recoveries for gross alpha. Because the low recoveries tended to be similar in range among the three laboratories, the standard used to prepare the gross alpha blind standards was suspected. To rule out a possible bad standard, several quarters of gross alpha standards are planned for CY2013 that will be made using the same plutonium standard as that used for the plutonium-239 blind standard. Historically, the laboratories have reported good recoveries for this plutonium-239 standard. If low gross alpha recoveries still occur, then additional investigation will be initiated to determine if the low recoveries are due to the groundwater matrix, method calibration, and/or the sample preparation and analysis methods.
  - *Iodine-129*: Eberline Services and TARL reported 36 results for iodine-129 blind standards during CY2012. Of these 36 results, four had recoveries outside the acceptance limits; all failed high with recoveries ranging from 136.0 percent to 158.7 percent. One first-quarter iodine-129 result set from Eberline Services had no results that exceeded recovery limits, but did exceed the precision criterion. All of the out-of-limit results were for iodine-129 standards that were typically less than five times the reporting laboratories' MDAs. In the light of this fact, Eberline Services and TARL performed remarkably well analyzing these low-level iodine-129 blind standards.

5.11 Data Usability Conclusions

In general, this quality assessment for CY2012 groundwater monitoring data shows that the great majority of the data are useable for the purposes of groundwater monitoring. This assessment also noted some deficiencies in the data. These deficiencies are summarized in the following subsections.

5.11.1 Data Completeness

As noted in Section 5.5 and in Tables 5-2 and 5-5, 96.9 percent of planned groundwater samples were collected during CY2012, the requirements for the number of field QC samples were met or exceeded, and 96.6 percent of the analytical results met the groundwater monitoring QC criteria. Based on the review performed in this DQA, nearly all required samples, field QC, and analytical results were collected in accordance with the groundwater monitoring requirements of CHPRC-00189 and DOE/RL-91-50.

5.11.2 Sample Preservation and Holding Time

As noted in Section 5.7, improper sample preservation was a very minor issue with only 0.08 percent of all laboratory results affected by sample preservation issues; only 19 analyses were cancelled as a result of this issue. Missed holding times had a somewhat greater impact on the groundwater monitoring dataset with 0.5 percent of the analytical results associated with missed holding times. Most of the results with missed holding times were still generated within two times the holding time and hence were deemed useable by the groundwater monitoring program.

5.11.3 Field Quality Control

Field QC samples were collected and analyzed in accordance with the groundwater monitoring requirements of CHPRC-00189 and DOE/RL-91-50. Field QC issues generated minimal impact to data usability.

For the FBs, the number and types of FBs collected met groundwater monitoring collection requirements, and 98.1 percent of the FB results were found to meet groundwater monitoring criteria. Of the 317 FB results that exceeded the criteria, 123 were for metals and 149 for VOCs. Many of the out-of-limit metal results were likely due to sample swaps of the FB with a groundwater sample either in the field or at the laboratory. Most of the out-of-limit VOC results were traced to probable contamination of the deionized water source used to generate the blank (methylene chloride) or to laboratory contamination during sample preparation and analysis (acetone).

For the field sample duplicates, 27.0 percent of the reported duplicate laboratory results met the evaluation criterion, and of these duplicate results, 94.2 percent were acceptable, indicating reasonable precision for field sampling operations laboratory analysis.

For the field sample TOC and TOX quadruplicates, 17.0 percent of the reported quadruplicate laboratory results met the evaluation criterion, and of these quadruplicate results, only 77.1 percent met the reproducibility criterion. This represents at best only fair reproducibility and may be linked to deficiencies in the laboratory sample preparation and analysis of these analytes. Groundwater monitoring personnel will continue to evaluate groundwater TOC and TOX data to determine what course of corrective action to take on this issue.

Of the CY2012 split sample results, 19.9 percent met the evaluation criterion and 86.4 percent of those results met the precision criterion. This success rate for split sample results is in keeping with historical trends for split samples and indicates reasonable analytical agreement between laboratories. The metals analyses constituted most of the split failures and may have resulted from samples swapped either in the field or in the laboratory, or possible dilution errors at the time of analysis.

5.11.4 Laboratory Quality Control

In general, the frequency at which laboratory QC samples were analyzed met the requirements of CHPRC-00189 and DOE/RL-91-50. Laboratory QC sample results met requirements at least 98 percent of the time with the exception of laboratory sample duplicates, which had a 97.5 percent acceptance rate. This indicates reasonable control of sample preparation and analytical methods at the laboratories with respect to cleanliness, precision, and accuracy.

For the laboratory MBs, TAKN reported significant MB contamination during the analysis of dioxins and dibenzofurans; the contaminated blanks called into question about 5.6 percent of the data reported from this laboratory during CY2012. TASL and WSCF blank failure rates were 1.1 percent and 1.7 percent, respectively. The bulk of these failures were for the ICP metals.

Overall, more than 98 percent of the results for LCS, MS, and surrogates met QC requirements. This indicates that the analytical methods are yielding adequate accuracy for the groundwater monitoring program. With respect to analytical precision, greater than 98 percent of the LCSD, MSD, and surrogate duplicate results met QC precision requirements. Laboratory sample duplicates met precision requirements 97.5 percent of the time. These precision results indicate that the analytical methods are producing groundwater monitoring data that meet groundwater monitoring precision requirements.

5.11.5 Laboratory Performance

The blind standards program provides an additional check on laboratory performance. Three laboratories, LVL, TARL, and WSCF, each had at least one quarter during CY2012 in which the laboratory did not meet the 80 percent success rate criterion defined in CHPRC-00189. Emerging issues appear to be occasional high TOC and TOX results reported by TASL and WSCF; miscellaneous high metal results reported by TASL; high total uranium values as determined by ICP-MS at WSCF; and low recoveries for gross alpha as determined at Eberline Services, TARL, and WSCF. These issues will continue to be monitored during and corrective actions sought as warranted.

5.11.6 Conclusions

Based on the results of this DQA, the overall sample sets and associated analytical data are sufficient in quantity and have a low overall degree of suspect data points to be usable for the groundwater monitoring program. Sample results appear to represent target analyte concentrations in Hanford Site groundwater accurately. Field QC samples were collected and laboratory QC samples were analyzed at the frequencies required in CHPRC-00189 and DOE/RL-91-50. Overall, laboratory and matrix accuracy and precision are in control. Some systematic discrepancies displayed in the blind standards program are being tracked to determine appropriate resolutions.

6 Confined Aquifers

This chapter describes groundwater flow and groundwater quality in confined aquifers within the Ringold Formation and the upper portion of the Columbia River Basalt Group.

6.1 Ringold Confined Aquifers

Confined, water-bearing units are present in the Ringold Formation (Figure 6-1). The most widespread Ringold confined aquifer is where the Ringold Formation lower mud unit confines the underlying sediment of Ringold unit A. Approximately 40 wells are screened in Ringold unit A, although not all of these have been sampled in recent years. Most of the wells are located in or near the Central Plateau; others are located in the southern Hanford Site (including the 300 Area), and one is in the 100 Area.

Local, water-bearing units in or beneath the Ringold upper mud unit exist in the northern Hanford Site. These are not believed to be interconnected into a regional aquifer. Nineteen wells in the 100 Area are screened in water-bearing units within or beneath this unit.

6.1.1 Groundwater Flow in Ringold Confined Aquifers

This subsection describes groundwater flow in the confined aquifer of Ringold unit A in the region near the 200 Area and farther south. The elevation of this Ringold confined aquifer varies from 34 meters above mean sea level (NAVD88, *North American Vertical Datum of 1988*) southwest of 200 West Area (Plate 3 of PNNL-13858, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington*) to more than 128 meters (NAVD88) northeast of 200 East Area (Plate 3 of PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*). There are insufficient data from unit A in the northern part of the Hanford Site to interpret groundwater flow directions. Groundwater flow in the Ringold upper mud is not characterized because the water-bearing units are not known to be interconnected.

Figure 6-2 presents the March-April 2012 potentiometric surface for a portion of the confined aquifer in the Ringold Formation unit A. This map is subject to uncertainty because only a few wells monitor this aquifer. However, generalized flow patterns can be inferred from available data when the hydrogeologic framework (that is, the extent of the confined unit, presence of basalt subcrops, and influence of the May Junction Fault) is considered.

Groundwater flow in the Ringold confined aquifer is generally west to east near the 200 West Area and west to east along the southern boundary of the aquifer near the Rattlesnake Hills. This flow pattern indicates that recharge occurs west of the 200 West Area in upgradient areas within the Cold Creek Valley, as well as in the Dry Creek Valley, and possibly the Rattlesnake Hills. Near the 200 East Area, flow in the Ringold confined aquifer converges from the west, south, and east before discharging to the unconfined aquifer where the Ringold Formation lower mud is absent (Section 4.2.3 of PNNL-12261). This water is thought to flow southeast over the top of the confining unit (Section 2.4.3 of DOE/RL-2008-59, *Interim Status Groundwater Monitoring Plan for the 216-B-3 Pond*). Near the 200 East Area, water-level elevation data from piezometers 299-E25-32P and 299-E25-32Q (used to monitor different depths in the unconfined aquifer) indicate a slight upward gradient along the confined unit boundary. This upward gradient is consistent with discharge of groundwater from the confined aquifer to the overlying unconfined aquifer.

Artificially elevated water levels are present in the Ringold confined aquifer to the northeast of the 216-B-3 Pond (B Pond). The high water levels reflect mounding from past wastewater discharges and subsequently cause a southwest flow beneath B Pond where mounding is not as prevalent. Eastward flow away from the region of elevated water levels does not occur due to the north-south trending May Junction Fault, located east of the B Pond area (Section 2.4.3 of DOE/RL-2008-59). Hydraulic head and water chemistry differences across this fault indicate it is a barrier to groundwater flow in the confined aquifers (Sections 4.2.3 and 4.3.2 in PNNL-12261). While impermeable units have been juxtaposed against permeable units along part of the fault, the mud units may also have smeared along the fault zone and sealed it (Plates 8 and 9 in PNNL-12261). South of the B Pond area, the flow of water divides, with some flow moving northwest toward the 200 East Area and some flow moving east or southeast. The exact location of the flow divide is not known because of a lack of water-level data in this area and uncertainty regarding the southward extent of the May Junction Fault.

The potentiometric contours for the Ringold confined aquifer (Figure 6-2) are similar to the potentiometric surface contours for the upper basalt-confined aquifer system, indicating that flow patterns in the central portion of the Hanford Site are similar in both aquifers. Basalt bedrock from the topographic low area at Gable Gap near the 200 East Area was eroded significantly by late Pleistocene catastrophic flooding (Section 7.0 of PNNL-19702, *Hydrogeologic Model for the Gable Gap Area, Hanford Site*), which facilitates intercommunication between the unconfined and confined aquifers. The 200 East Area is a discharge area for both of the confined aquifers, which explains the similar flow patterns.

Water levels declined throughout much of the Ringold confined aquifer from March 2011 to March 2012. The decline in individual wells ranged from 0.03 to 0.21 meter. The largest declines were in the 200 West Area where the potentiometric surface declined an average of 0.16 meter. The potentiometric surface is responding to reduced loading of the confined aquifer (that is, a reduction in external stress) caused by water-level declines in the overlying unconfined aquifer. The water table in the unconfined aquifer is declining in response to the reduction of liquid effluent discharges to the ground since the discharge volumes peaked in the mid 1980s.

6.1.2 Groundwater Quality in Ringold Confined Aquifers

Wells monitoring Ringold confined aquifers are sampled in accordance with the objectives of the groundwater operable units in which they are located. DOE/RL-2013-22 discuss monitoring results and highlights are summarized in the following text.

With few exceptions, groundwater in the Ringold upper mud unit is not contaminated (Table 6-1). Nineteen wells screened in this unit were sampled at least once between 2010 and 2012. Hexavalent chromium concentrations are greater than the 48 µg/L “Model Toxics Control Act—Cleanup” (WAC 173-340) standard in some Ringold upper mud wells in 100-H Area (higher than currently observed in the unconfined aquifer) and in one well in the Horn. As discussed in the 100-HR section of DOE/RL-2013-22, it appears that portions of this unit east of 100-D Area were eroded, allowing contaminated cooling water into the mud. This water moves more slowly than unconfined groundwater so the contamination persists.

Tritium concentrations are elevated, but currently below the drinking water standard (DWS), in Ringold mud well 199-N-80 (100-NR section of DOE/RL-2013-22). This is the only well in 100-NR screened in the mud. Attempts to install another well in a similar, water-bearing zone in 2011 were unsuccessful; no water-bearing zone was encountered during drilling.

Seventeen wells screened in unit A were sampled at least once between 2010 and 2012. Two wells just east of 200 West Area are contaminated with carbon tetrachloride and nitrate. These contaminants apparently reached unit A in a region of the 200 West Area where the lower mud unit is absent. As the groundwater continues to flow toward the east where the lower mud is present, it becomes confined. The 200-ZP section of DOE/RL-2013-22 discusses contaminant distribution with depth in the 200-ZP-1 Operable Unit.

The Ringold confined aquifer (unit A) is the uppermost aquifer in a region east of 200 East (200-BP and 200-PO groundwater interest areas). Regional contaminants iodine-129 and tritium are detected in wells monitoring this aquifer (Table 6-1). Contamination has not been observed in wells located downgradient of the contaminated wells, indicating it is of limited extent.

6.2 Upper Basalt Confined Aquifer

The upper basalt-confined aquifer groundwater system occurs within basalt fractures and joints, interflow contacts, and sedimentary interbeds within the upper Saddle Mountains Basalt. The thickest and most widespread sedimentary unit in this system is the Rattlesnake Ridge interbed, which is present beneath much of the Hanford Site. Groundwater also occurs within the Levey interbed, which is present only in the southern portion of the Site. A small interflow zone occurs within the Elephant Mountain Member of the upper Saddle Mountains Basalt and may be significant to the lateral transmission of water. The upper basalt-confined aquifer system is confined by the dense, low-permeability interior portions of the overlying basalt flows and in some places by silt and clay units of the lower Ringold Formation that overlie the basalt. Approximately 50 wells screened in the upper basalt-confined aquifer have been sampled or had water levels measured in recent years (Figure 6-3).

An area of intercommunication between the unconfined and upper basalt-confined aquifers exists near the 200 East Area where the confining layers are eroded away or fractured. Several basalt-confined wells have shown evidence of intercommunication with the overlying unconfined aquifer (Section 3.0 of PNL-10817, *Hydrochemistry and Hydrogeologic Conditions within the Hanford Site Upper Basalt Confined Aquifer System*).

6.2.1 Groundwater Flow in Upper Basalt-Confined Aquifer

Figure 6-4 presents the interpreted March-April 2012 potentiometric surface for the upper basalt-confined aquifer system south of Gable Butte and Gable Mountain, based on measurements from 25 monitoring wells. The region to the north of Gable Butte and Gable Mountain was not contoured because of an insufficient number of wells in this area. Plate 1 of PNL-8869, *Preliminary Potentiometric Map and Flow Dynamic Characteristics for the Upper-Basalt Confined Aquifer System*, provides a generalized potentiometric surface map of this area. The upper basalt-confined aquifer system does not exist in the Cold Creek Valley and along the west portion of the Gable Mountain and Gable Butte structural area because of the absence of the Rattlesnake Ridge interbed.

Recharge to the upper basalt-confined aquifer system likely occurs from upland areas along the margins of the Pasco Basin and results from the infiltration of precipitation and surface water where the basalt and interbeds are exposed at or near ground surface. Recharge may also occur from the overlying aquifers (that is, the unconfined aquifer or confined aquifer in the Ringold Formation) in areas where the hydraulic gradient is downward and from deeper basalt aquifers where an upward gradient is present. The Yakima River may also be a source of recharge to this aquifer system. The Columbia River represents a discharge area for this aquifer system in the southeastern portion of the Hanford Site where the river has a lower head than the upper basalt-confined aquifer, but not for the northern portion of the site where the river head is higher (Section 3.2 of PNL-8869). Discharge also occurs to the overlying aquifers in areas where the hydraulic gradient is upward. Discharge to the overlying unconfined aquifer near the Gable Butte and Gable Mountain structural area is believed to occur through windows eroded in the basalt.

South of Gable Butte and Gable Mountain, groundwater in the upper basalt-confined aquifer system generally flows from west to east across the Hanford Site, toward the Columbia River. The north-south trending May Junction Fault, located east of B Pond, acts as a barrier to groundwater flow in the unconfined aquifer and the confined aquifer within the Ringold Formation (Section 2.4.3 of DOE/RL-2008-59). It may also impede the movement of water in the upper basalt-confined aquifer system by juxtaposing permeable units opposite impermeable units. As with the Ringold confined aquifer, a flow divide is interpreted to exist southeast of the 200 East Area and B Pond in the upper basalt-confined aquifer system, but the exact location of this divide is uncertain because of a lack of wells in the area.

Groundwater flow rates within the Rattlesnake Ridge interbed have been estimated between 0.7 and 2.9 meters per year (Section 4.2 of PNL-10817), which is a considerably lower flow rate than most estimates for the overlying unconfined aquifer system. The sediment comprising the interbed consists mostly of sandstone (with silts and clays) and is much less permeable than the sediment in the unconfined aquifer. In addition, the magnitude of the hydraulic gradient is generally lower than in the unconfined aquifer.

The vertical hydraulic gradient between the upper basalt-confined aquifer system and the overlying aquifer varies spatially, as shown by comparison of observed heads (Figure 6-5). A downward gradient exists in the central portion of the Hanford Site, near the B Pond recharge mound, as well as in regions north and east of the Columbia River. Near the B Pond, the vertical head gradient between the unconfined aquifer system and the upper basalt-confined aquifer system has diminished in recent years but remains downward. In other areas of the Site, the hydraulic gradient is upward from the upper basalt-confined aquifer system to the overlying aquifer system.

In the 200 East Area, the potentiometric surface (Figure 6-4) is similar to the potentiometric surface for the Ringold confined aquifer (Figure 6-2). The basalt in this area was significantly eroded by late Pleistocene catastrophic flooding, which facilitates aquifer intercommunication (Section 7.0 of PNNL-19702). In the 200 East Area and to the immediate north, the vertical hydraulic gradient between the upper basalt-confined aquifer system and the overlying aquifer is upward. It is likely that the upper basalt-confined aquifer system currently discharges to the overlying aquifer in this region.

Water levels in the upper basalt-confined aquifer system declined throughout most of the Hanford Site from March 2011 to April 2012, but water levels increased in some wells north of the 200 East Area. Water levels declined up to 0.15 meter near the 200 West Area. In the 200 East Area and to the immediate north and east (near B Pond), water-level declines in wells were up to 0.08 meter. In most locations, the potentiometric surface is responding to reduced loading of the confined aquifer (that is, a reduction in external stress) caused by water-level declines in the overlying unconfined aquifer and Ringold confined aquifer. Where the basalt is not confining, the water-level declines in the deeper aquifer are directly due to the declining water table. The water table in the unconfined aquifer is declining in response to reduced effluent disposal activities in the 200 Area. However, in two wells north-northwest of the 200 East Area, 699-52-55B and 699-54-57, the water level increased by 0.06 m (in both wells). These wells are within an area of aquifer intercommunication, and water levels in the overlying unconfined aquifer have been increasing in response to higher than normal Columbia River stage during the summers of 2011 and 2012.

6.2.2 Groundwater Quality in Upper Basalt-Confined Aquifer

The U.S. Department of Energy (DOE) monitors groundwater quality in the upper basalt-confined aquifer system because of the potential for downward migration of contaminants from the overlying unconfined aquifer in areas where confining units are absent or fractured. The upper basalt-confined aquifer system is not affected by contamination as much as the unconfined aquifer. Contamination found in the upper basalt-confined aquifer system is most likely to occur in areas where the confining units have been eroded away or were never deposited, and where past disposal of large amounts of wastewater resulted in downward hydraulic gradients. Researchers have identified areas of intercommunication between the contaminated unconfined aquifer and the upper basalt-confined aquifer by geochemical signatures and the presence of nitrate and tritium in groundwater in some basalt-confined wells near 200 East Area (Chapter 3.0 of PNL-10817). However, groundwater monitoring data do not indicate that contamination has migrated into the upper basalt-confined aquifer. Because of poor seals in wells constructed prior to implementation of WAC 173-160 ("Minimum Standards for Construction and Maintenance of Wells"), intercommunication between aquifers has permitted groundwater flow from the unconfined aquifer to the underlying confined aquifer in the past, increasing the potential to spread contamination (such as at well 299-E33-12, discussed below). Section 2.14.2 of DOE/RL-2008-01, *Hanford Site Groundwater Monitoring for Fiscal Year 2007*, further discusses communication between the upper basalt-confined aquifer system and the overlying aquifers.

Twenty-seven wells screened in the upper basalt-confined aquifer were sampled between 2010 and 2012. Concentrations of contaminants are far below DWSs in the basalt-confined aquifer (Table 6-2), except where well construction or drilling effects allowed migration of groundwater from the overlying unconfined aquifer. The highest concentrations of contaminants continued to be observed in well 299-E33-12 in the northwestern 200 East Area. This well was drilled in 1953 and was uncased from just above the bottom of the unconfined aquifer through the Rattlesnake Ridge interbed. Contamination is believed to have migrated from the unconfined aquifer, down the open borehole, to the Rattlesnake Ridge interbed (Section 2.14.2 of DOE/RL-2008-01). The well was sealed from the unconfined aquifer in 1979 with an additional seal placed in the well in 1990 to shorten the open interval. Concentrations of waste indicators cyanide, nitrate, technetium-99, and tritium continued to be elevated in samples from this well, and possibly in a small area of the confined aquifer. Well 299-E33-50, located near 299-E33-12, consistently shows levels of technetium-99 between 25 and 50 pCi/L. Other confined wells in this region showed no contamination. The hydraulic gradient is upward in this region (Figure 6-5).

Tritium and iodine-129 continued to be detected at levels below their DWSs in well 699-42-40C, located east of 200 East (200-PO section of DOE/RL-2013-22). Iodine-129 concentrations are near or below detection limits and tritium concentrations generally are declining. The hydraulic gradient in this region remains downward (Figure 6-5).

Groundwater in basalt-confined wells in other regions of the Hanford Site is uncontaminated, based on data from a small number of available wells that were sampled in recent years (Table 6-2).

Table 6-1. Groundwater Quality in Ringold Confined Aquifers

Groundwater Interest Area	Wells Sampled	Groundwater Contamination[a]
Wells Screened in Ringold Upper Mud Unit		
100-BC	199-B2-12, 199-B2-15	None
100-KR-4	199-K-32B, 199-K-192	None
100-NR	199-N-80	Hexavalent chromium: up to 198 µg/L[b] Tritium: up to 13,000 pCi/L
100-HR-D and 100-HR-H	199-D5-134, 199-D5-141, 199-D8-54B, 199-H2-1, 199-H3-2C, 199-H3-9, 199-H3-10, 199-H4-12C, 199-H4-15CS, 699-97-43C, 699-97-45B, 699-97-48C	Hexavalent chromium: up to 179 µg/L
100-FR	199-F5-43B, 199-F5-53	None
Well Screened in Ringold Unit B		
100-HR-H	199-H4-15CR	None
Wells Screened in Ringold Unit A		
100-HR-H	199-H4-15CQ	None
200-ZP[c]	699-43-69, 699-45-69C	Carbon tetrachloride: up to 580 µg/L Chromium (filtered; 699-43-69): up to 48 µg/L[b] Nitrate: up to 190 mg/L

Table 6-1. Groundwater Quality in Ringold Confined Aquifers

Groundwater Interest Area	Wells Sampled	Groundwater Contamination[a]
200-UP	None	N/A
200-BP	699-42-40A, 699-42-40B, 699-42-42B, 699-43-41G	Iodine-129: up to 3.3 pCi/L Tritium: up to 39,000 pCi/L
200-PO	699-40-36, 699-41-40, 699-42-37, 699-42-39B	Chromium (filtered; 699-42-37): up to 25 µg/L[b] Iodine-129: up to 1 pCi/L Tritium: up to 36,000 pCi/L
300-FF	399-1-16C, 399-1-17C, 399-1-18C, 399-1-9, 399-8-5C	None
1100-EM	699-S29-E16C	None

a. Evaluation based on data from 2010 through 2012, excluding characterization data.

b. Suspected corrosion product.

c. Other wells in 200-ZP are screened in unit A where the lower mud is not present: 299-W6-6, 299-W7-3, 299-W11-88, 299-W12-2, 299-W12-3, 299-W14-73, and 299-W14-74. The aquifer is not confined at these locations, and results are not reported here.

Table 6-2. Groundwater Quality in Upper Basalt-Confined Aquifer

Groundwater Interest Area	Wells Sampled	Groundwater Contamination[a]
Wells Screened in Upper Saddle Mountains Basalt Flow Top[b]		
200-BP	699-54-34	None
Offsite	699-42-E9B	None
Wells Screened in Rattlesnake Ridge Interbed		
100-H	199-H4-2	None
200-BP	299-E33-12, 299-E33-40, 299-E33-50, 299-E33-340, 699-49-55B, 699-49-57B, 699-50-45, 699-50-53B, 699-52-46A, 699-52-55B, 699-54-45B, 699-54-57, 699-56-53	Chromium (filtered; 699-50-53B): up to 17 µg/L[c] Cyanide: up to 27 µg/L[d] Iodine-129: up to 0.32 pCi/L Technetium-99: up to 1,200 pCi/L[d]
200-PO	699-24-1P, 699-32-22B, 699-42-40C, 699-13-1C	Iodine-129: up to 0.289 pCi/L Tritium: up to 4,300 pCi/L
Wells Screened in Levey Interbed		
300-FF	399-5-2	None
200-PO	699-S11-E12AP,	None
Other Units or Uncertain Completion		
Various	199-H4-15CP, 299-E16-1, 699-S24-19P	None

a. Evaluation based on data 2010 through 2012.

b. Some of these wells are screened in the flow top and the Rattlesnake Ridge interbed.

c. Suspected corrosion product.

d. Not representative of basalt-confined aquifer. Migrated down wellbore from unconfined aquifer; see text.

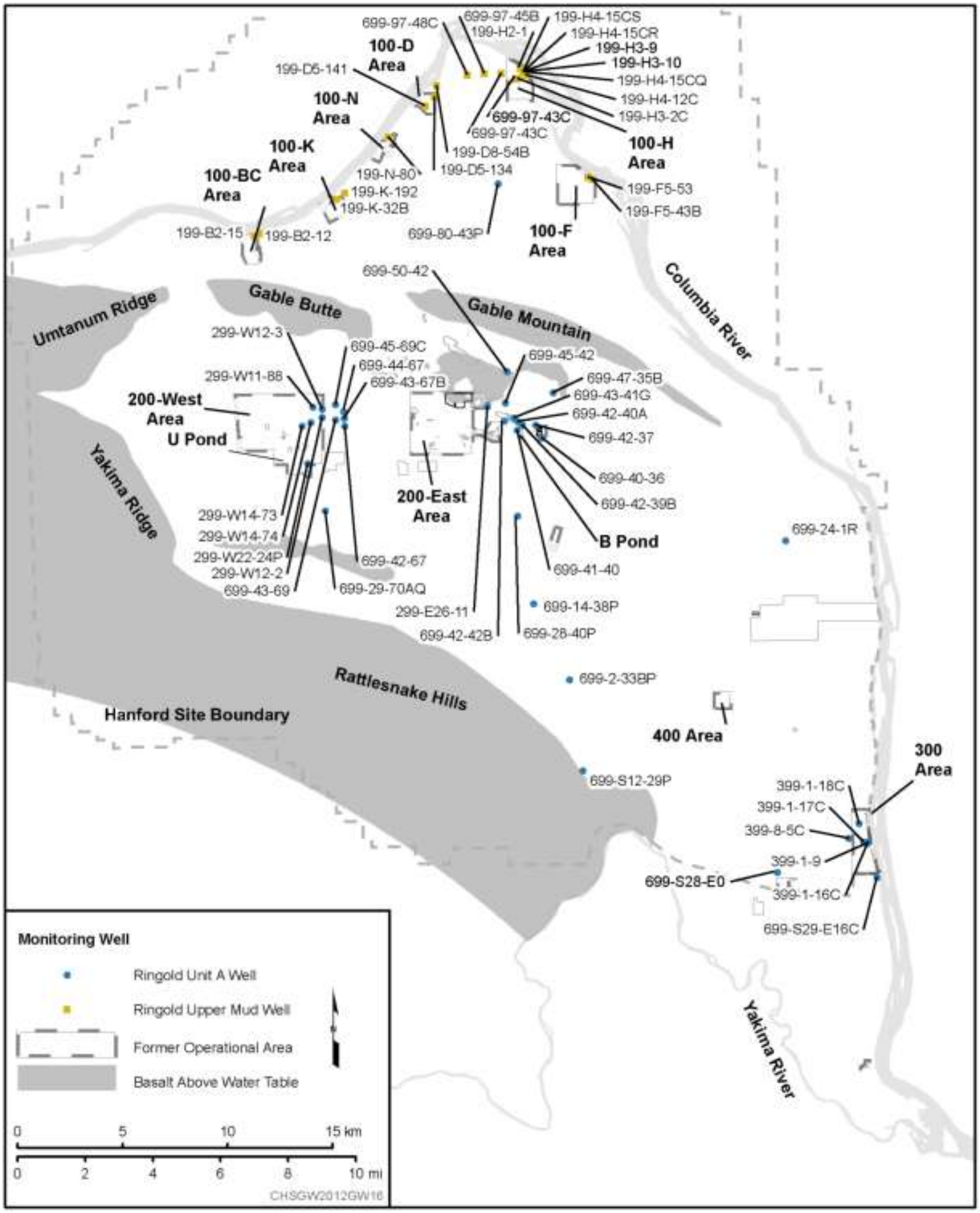

Figure 6-1. Ringold Confined Monitoring Wells

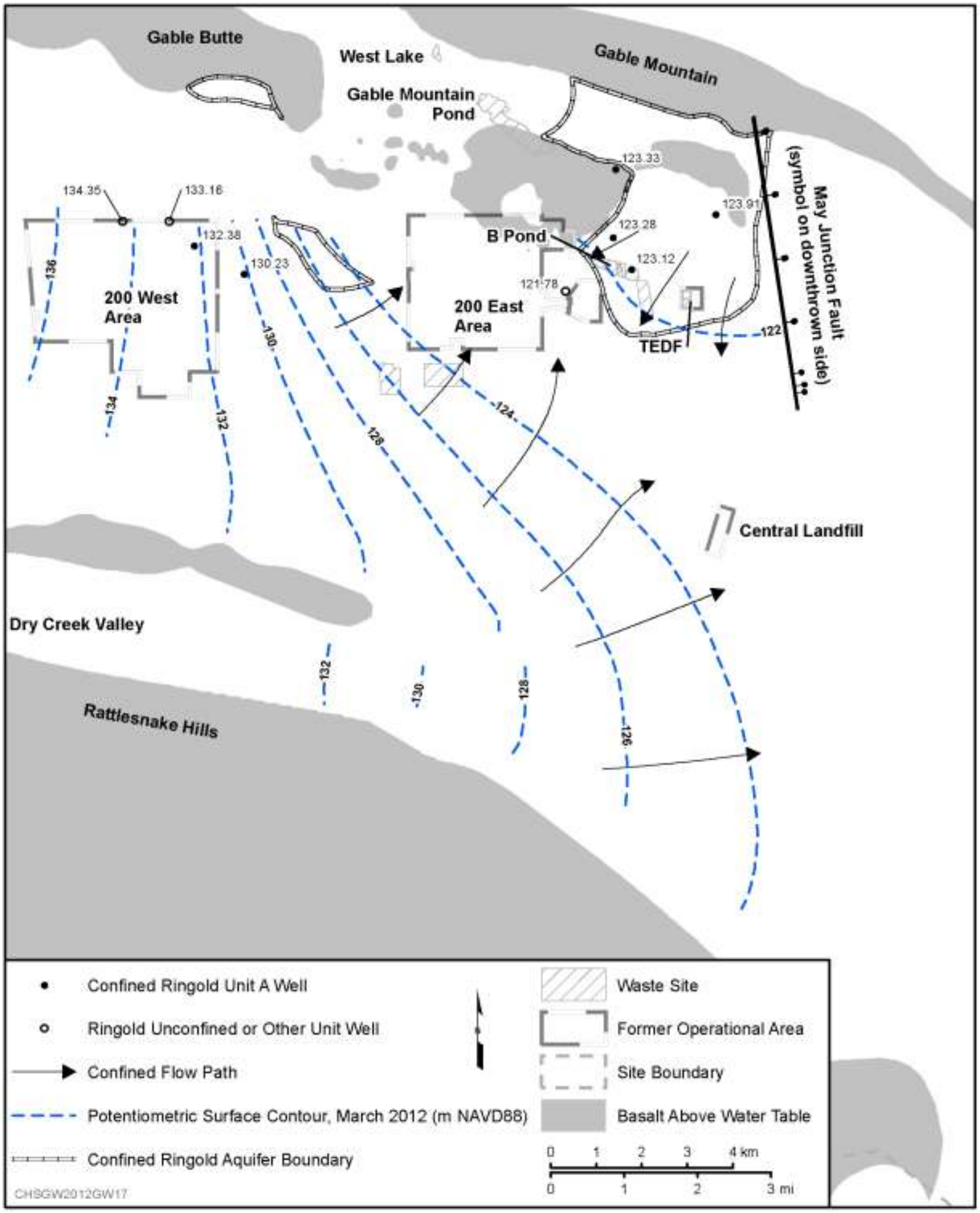

Figure 6-2. Potentiometric Surface for Ringold Unit A, March-April 2012

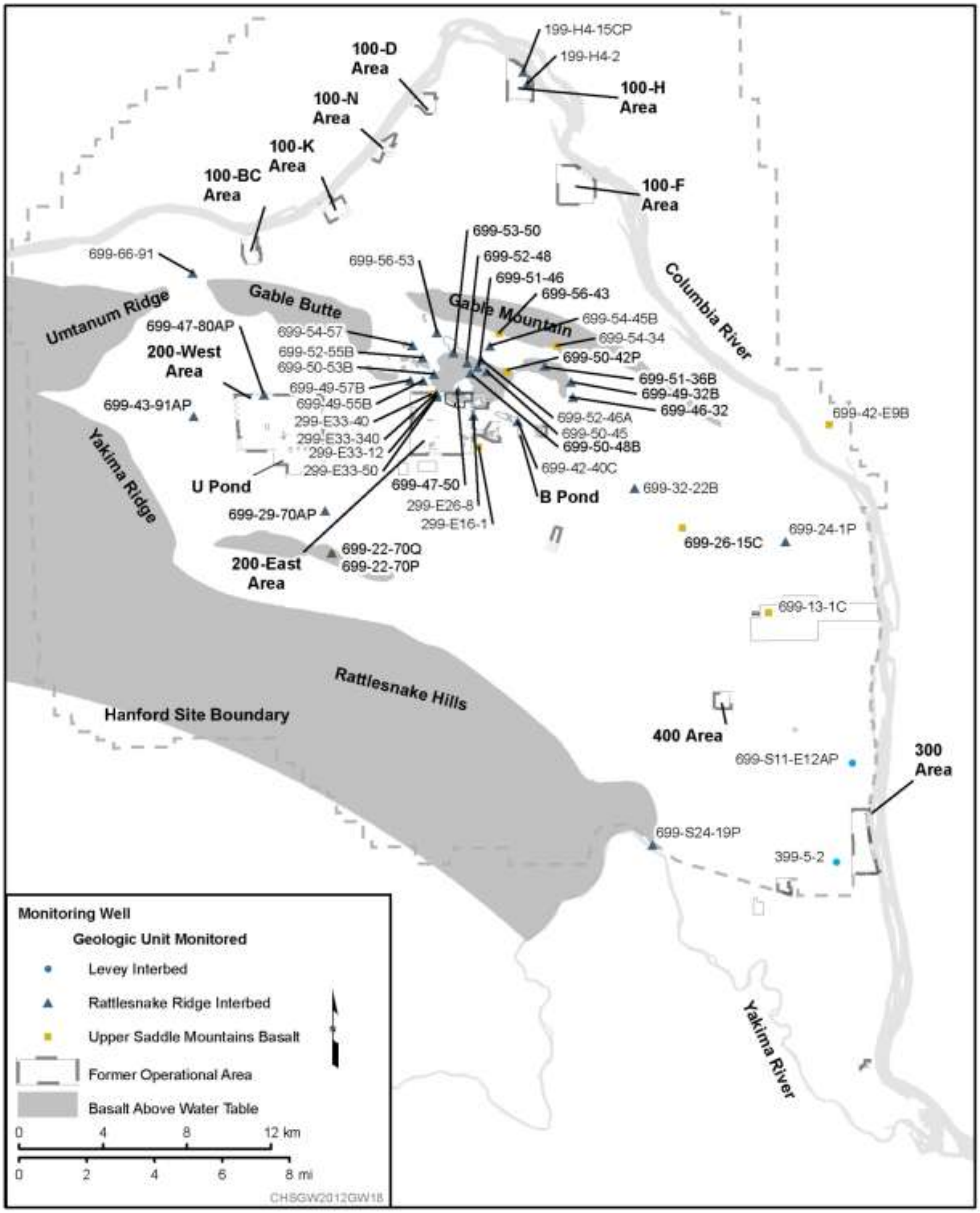

Figure 6-3. Basalt-Confined Monitoring Wells

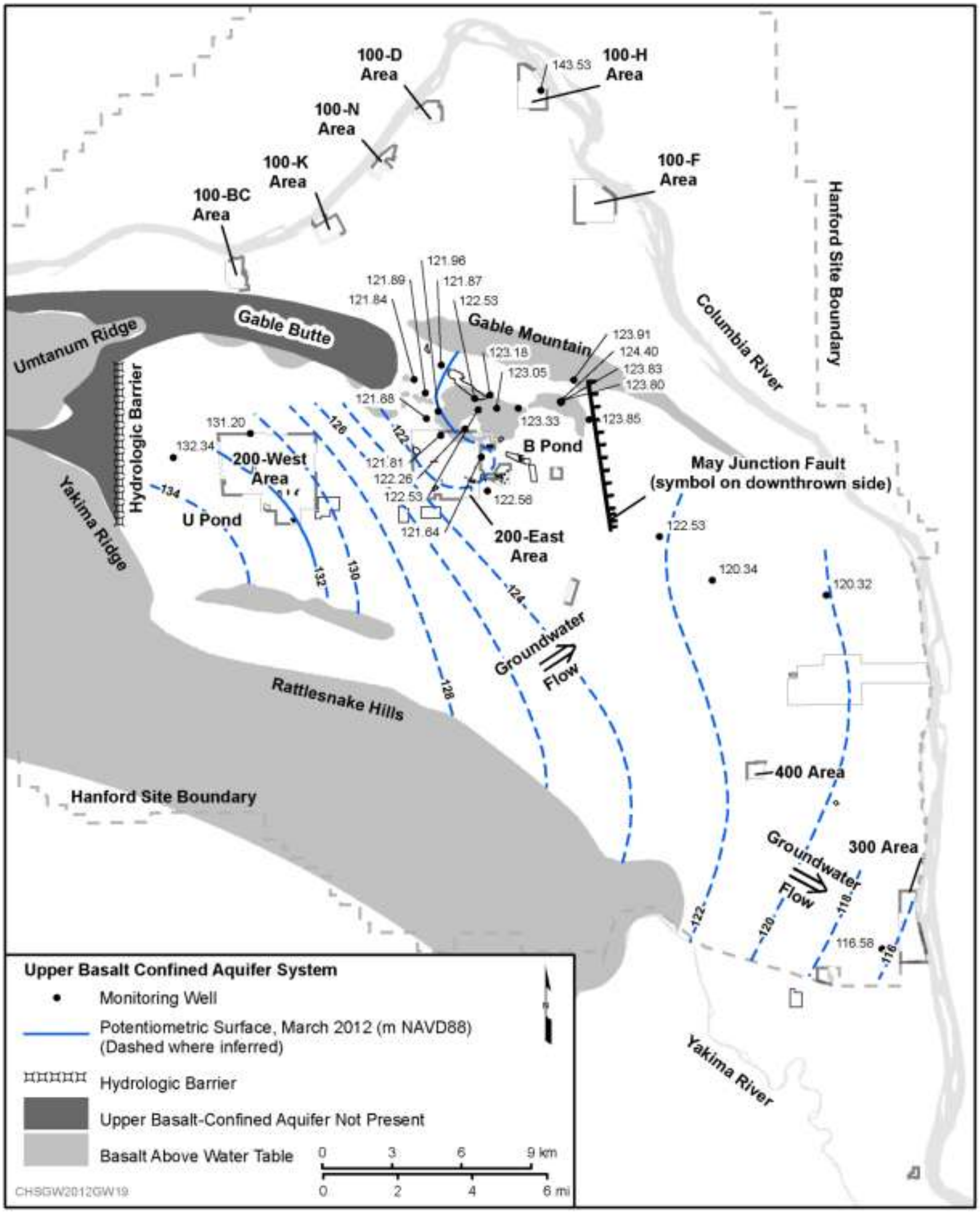

Figure 6-4. Potentiometric Surface for Upper Basalt-Confined Aquifer, March-April 2012

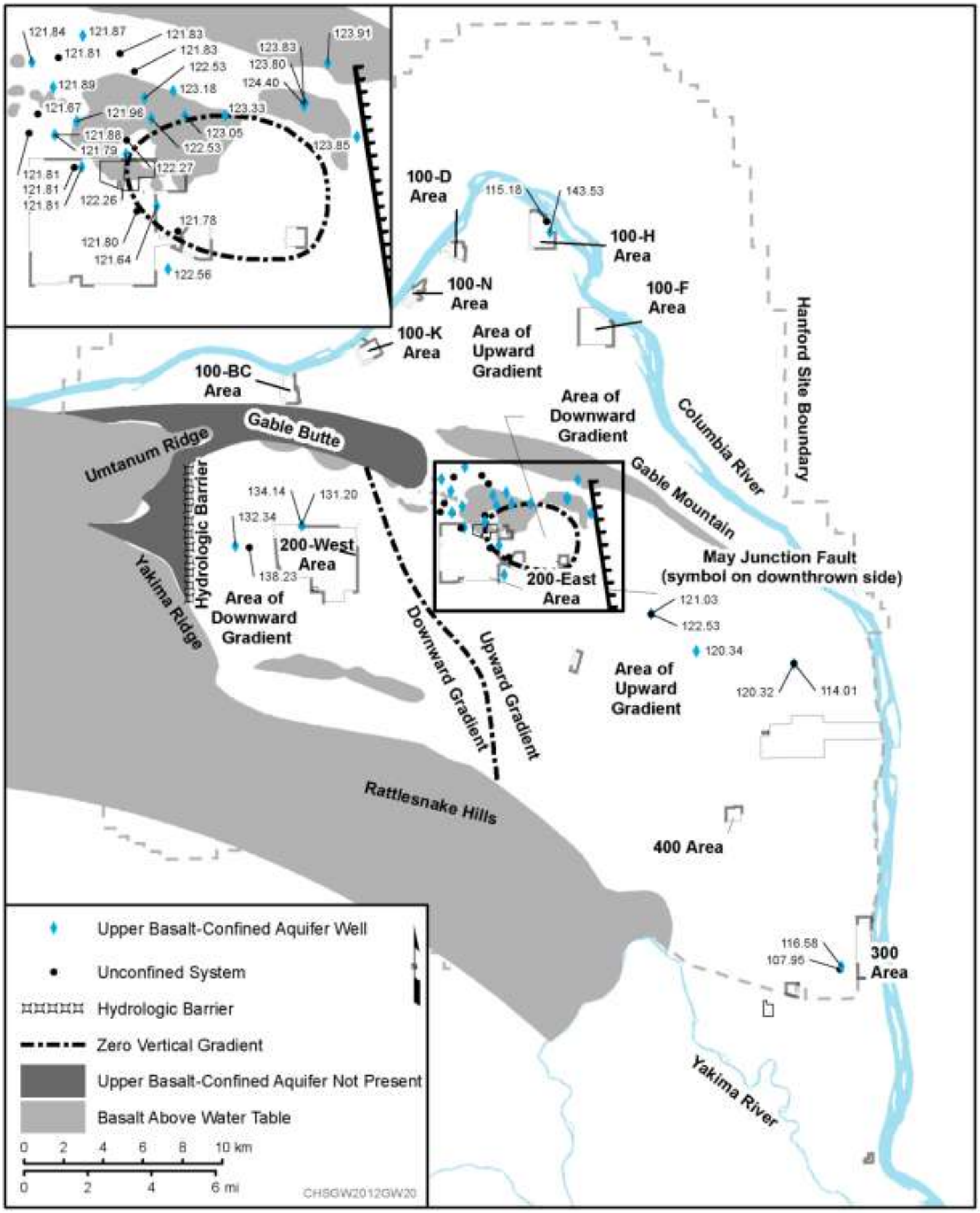

Figure 6-5. Comparison of Observed Heads for Upper Basalt-Confined Aquifer and Overlying Unconfined Aquifer, 2012

7 Well Installation, Maintenance, and Decommissioning

This chapter describes well installation, maintenance, and decommissioning activities on the Hanford Site in 2012. Numerous water wells were drilled or hand dug by early settlers for drinking water supplies, beginning in the early half of the 20th Century. Several thousand wells have been drilled since the early 1940s to support the Site's nuclear weapons production program. Since the 1990s, many additional wells have been drilled to support the Site's environmental cleanup mission.

All well types are tracked on the Hanford Site through the Well Information and Document Lookup (WIDL) database, which is available to users of the Hanford Local Area Network. Much of this information (borehole geophysical logging reports and data sheets) is also available to the public through the DOE Environmental Dashboard Application. Other data can be accessed via borehole summary reports (report numbers prefixed by SGW) that are generated for each drilling campaign.

Recognized well types onsite include aquifer tubes, borings, groundwater wells, hosted piezometers, independent piezometers, piezometer hosts, soil tubes, lysimeters, and vadose wells (Table 7-1). All wells (cased and uncased), borings, aquifer tubes, soil tubes, piezometers, and other subsurface excavations are required to receive a unique Hanford well identification (ID) number. A total of 11,470 unique well ID numbers had been assigned on the Hanford Site by the end of 2012. The Washington State Department of Ecology (Ecology) also assigns a well ID number to each of these well types.

Figure 7-1 presents the categorization of unique well ID numbers taken from WIDL and their approximate geographic designations.

During 2012, 3,983 of these unique well ID numbers were documented to be in use, representing 2,963 wells, 122 piezometers within host wells, 78 lysimeters within host lysimeters, 487 aquifer tubes, and 332 soil tubes. Thus, of the 11,470 wells drilled, 7,487 wells are no longer used or have been decommissioned.

7.1 Monitoring Well Installation

DOE works with the appropriate regulatory agencies to define the need for new wells at the Hanford Site. Each year, DOE proposes new wells to meet the requirements of RCRA detection and assessment groundwater monitoring requirements; characterization, remediation, and monitoring for CERCLA; and long-term monitoring of regional groundwater plumes in accordance with DOE orders based on AEA requirements. These efforts may include new or ongoing RCRA assessment of groundwater contamination, replacement of monitoring wells that go dry because of the declining regional water table, replacement of wells that need to be decommissioned, improvement of spatial coverage for different monitoring networks and plume monitoring, and characterization of subsurface contamination.

New RCRA, CERCLA, and AEA monitoring well proposals are reviewed, prioritized, and approved annually in accordance with the Tri-Party Agreement (Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order*) Milestone M-024. All new wells are constructed as either resource protection wells or water supply wells in accordance with WAC 173-160. Well requirements are integrated, prioritized, and documented through the budget development process, discussions between DOE and the regulatory agencies, and specific monitoring and characterization requirements.

During 2012, only five wells were installed[3] at the Hanford Site (Table 7-2). The approximate locations of the new wells are shown in Figure 7-2.

[3] Wells completed (accepted) in 2012. In some cases, drilling began in 2011.

Water well reports for all newly constructed wells, as required by WAC 173-160, were submitted to Ecology. Detailed well information such as geologic and geophysical descriptions, characterization activities (that is, sediment and groundwater sampling, aquifer testing), and construction records for the new wells are stored in WIDL and consolidated in borehole summary reports. Much of this information is also accessible and available through the DOE Environmental Dashboard Application.

7.2 Borings

During 2012, no borings were drilled.

7.3 Maintenance

During 2012, well maintenance was conducted 650 times on the different well types. Surface modifications included repair or replacement of locking well caps, surface casing repairs, diagnosis and repair of electrical wiring, labeling, electrical bonding, and modifications to surface pump and riser pipe discharge components and fittings. Subsurface tasks typically included repair and replacement of sampling pumps, downhole camera surveys, pump and equipment retrieval, and replacement of discharge tubing. Well rehabilitation activities included surging, swabbing, screen brushing, chemical treatment, and over-pumping to improve well performance.

Documentation for well maintenance activities is entered into the Well Maintenance Application database and accessible through WIDL. This information is also accessible externally through the DOE Environmental Dashboard Application.

7.4 Decommissioning

As part of DOE asset management, wells, boreholes, or other subsurface installations are identified for decommissioning when they are no longer useful for achieving the Hanford Site environmental cleanup mission. Well decommissioning is driven by DOE/RL-2005-70, *Hanford Site Well Decommissioning Plan*. Decommissioning is defined therein as the properly completed and documented sealing of water or resource protection wells in compliance with state groundwater protection laws (WAC 173-160). The plan lays out the basis, decision logic, and implementation process for prioritizing and decommissioning Hanford Site wells.

All candidate wells for decommissioning must be reviewed and approved by Hanford Site contractors, DOE, Ecology, EPA, and other potential well users such as the Pacific Northwest National Laboratory prior to decommissioning. The initial phase of decommissioning includes a thorough records review and physical inspection of each well to confirm the well's location and configuration (well attributes). Normally, a well becomes a candidate for decommissioning under one of the following conditions:

- The well is no longer used for water level or contaminant monitoring, contaminant extraction, in situ remedial treatment of contaminated groundwater, permitted injection of treated effluent from a remedial action, water supply, research, or technology demonstration.
- The well has no specified future purpose.
- The well is unusable, abandoned, or permanently discontinued.
- The well is in such disrepair that its continued use is impractical.
- The well is an environmental, safety, or public health hazard (for example, it does not meet WAC 173-160 requirements for well completion; however, there are special provisions for continued use of a non-WAC 173-160 compliant well).

- The well interferes with environmental remediation, excavation, and/or construction activities.

In 2012, 28 borings and wells (Table 7-3) were physically decommissioned. Decommissioning is performed in accordance with WAC 173-160-460 ("What Is the Decommissioning Process for Resource Protection Wells?"), applicable well decommissioning variances, and conditions defined in the Hanford Facility RCRA Permit (WA78900008967).

Decommissioning typically involves backfilling a well with impermeable material in both the annular space and the casing to prevent vertical movement of water and/or contaminants into the vadose zone and groundwater. For wells that are constructed according to WAC 173-160 requirements (compliant), decommissioning is performed by filling the well screen and the casing with an impermeable material (e.g., bentonite or cement grout). For older, noncompliant wells, the casing is either removed and the borehole is filled with seal material, or the casing is perforated and pressure grouted to create an external annular seal and then internally grouted to the surface. As far as possible, all casing is removed from the ground. A brass survey marker identifying the former well is typically set in cement grout at the ground surface over the decommissioned location. Decommissioning activities result in the permanent removal of a well, borehole, or piezometer from service and from the Hanford Site active well inventory.

A completed water well report form is required to be transmitted by the contractor or in-house driller to Ecology when a well is decommissioned. The report provides the details on the well's final construction and the steps taken to decommission the well.

No wells were administratively decommissioned in 2012. Administratively decommissioned wells may be wells that can no longer be located and are determined to no longer exist; more generally, they are wells that were physically decommissioned but still require documentation describing this in the well database.

Each year a very limited number of previously unknown wells are usually discovered during the conduct of field activities. Once discovered, these wells are assigned a unique well ID number, assigned an appropriate well status, and added to WIDL. There were no well discoveries in 2012.

Table 7-1. Hanford Site Well Types

Well Category	Description
Aquifer Tube	A groundwater monitoring site installed along the river shoreline. Generally consists of a small diameter tube (less than one inch) and screen installed using push technology near the water table.
Boring	A borehole or direct push that was decommissioned immediately after drilling. Decommissioning generally would have been performed before the drill rig was removed from the site.
Groundwater Well	A well constructed with the open interval extending below the water table. This is the general case and should not be used if the site could be otherwise classified as an aquifer tube, piezometer, or piezometer host.
Hosted Piezometer	Groundwater monitoring well constructed inside of a host well. In most cases, hosted piezometers are one and one-half inch in diameter with the open interval extending below the water table.
Independent Piezometer	Small diameter, independent, groundwater monitoring well not constructed inside of a host well. In most cases, the independent piezometers are one and one-half inch in diameter.
Lysimeter	Generally an in situ open bottom cylindrical core where the top is coincident with the ground surface, and with walls that prevent horizontal movement of moisture. A lysimeter is used to measure moisture or contaminant changes through time over a

Table 7-1. Hanford Site Well Types

Well Category	Description
	specific depth interval.
Piezometer Host	A well with one or more piezometers constructed inside it.
Soil Tube	Vadose zone monitoring site. A small diameter tube (less than two inches in diameter) and possibly a screen are left in place after the drilling is completed for sampling.
Vadose Well	A vadose zone monitoring site where casing (greater than two inches in diameter) is left in place after drilling activities are completed. May have a screen, open bottom, or may be closed.

Table 7-2. Wells Installed in 2012

Operable Unit	Well Name	Well ID	Well Purpose	Construction Depth (ft bgs)	Drilled Depth (ft bgs)	Acceptance Date
200-BP-5	299-E33-267	C8242	Treatability Test Monitoring	259.87	263	2/15/2012
200-BP-5	299-E33-268	C8243	Treatability Test Extraction	262.46	265.4	2/15/2012
200-BP-5 Total = 2						
200-UP-1	699-42-67	C8069	200 West Pump-and-Treat Expansion-Injection	519.7	523.37	2/9/2012
200-UP-1 Total = 1						
200-ZP-1	699-43-67B	C8386	200 West Pump-and-Treat Expansion-Injection	509.27	509.27	2/9/2012
200-ZP-1	699-44-67	C8068	200 West Pump-and-Treat Expansion-Injection	479.5	482.4	2/9/2012
200-ZP-1 Total = 2						
Grand Total = 5						

bgs = below ground surface

ID = identification

Table 7-3. Wells and Borings Decommissioned in 2012

Operable Unit or Location	Well Name	Well ID	Out of Service Date
100-HR-3-D	199-D5-98	C5391	11/12/2012
100-HR-3-D	199-D5-99	C5392	11/12/2012
100-HR-3-D	199-D5-102	C5398	11/12/2012
100-HR-3-D	199-D5-119	C5933	11/12/2012
100-HR-3-D	199-D5-120	C5934	11/12/2012
100-HR-3-D	199-D5-121	C5935	11/12/2012
100-HR-3-D	199-D5-122	C5936	11/12/2012
100-HR-3-D	199-D5-144	C8668	11/12/2012
100-HR-3 Total = 8			
100-KR-4	C8307	C8307	7/9/2012
100-KR-4	C8308	C8308	7/9/2012
100-KR-4	C8309	C8309	7/9/2012
100-KR-4	C8310	C8310	7/9/2012
100-KR-4	C8311	C8311	7/9/2012
100-KR-4	C8312	C8312	7/9/2012
100-KR-4	C8313	C8313	7/9/2012
100-KR-4	C8314	C8314	7/9/2012
100-KR-4	C8315	C8315	7/9/2012
100-KR-4	C8658	C8658	7/9/2012
100-KR-4	C8659	C8659	7/9/2012
100-KR-4	C8660	C8660	7/9/2012
100-KR-4	C8661	C8661	7/9/2012
100-KR-4	C8662	C8662	7/9/2012
100-KR-4	C8663	C8663	7/9/2012
100-KR-4	C8664	C8664	7/9/2012
100-KR-4	C8665	C8665	7/9/2012
100-KR-4	C8666	C8666	7/9/2012
100-KR-4	C8667	C8667	7/9/2012
100-KR-4 Total = 19			
100-NR-2	199-N-16	A4665	11/12/2012
100-NR-2 Total = 1			
Grand Total = 28			

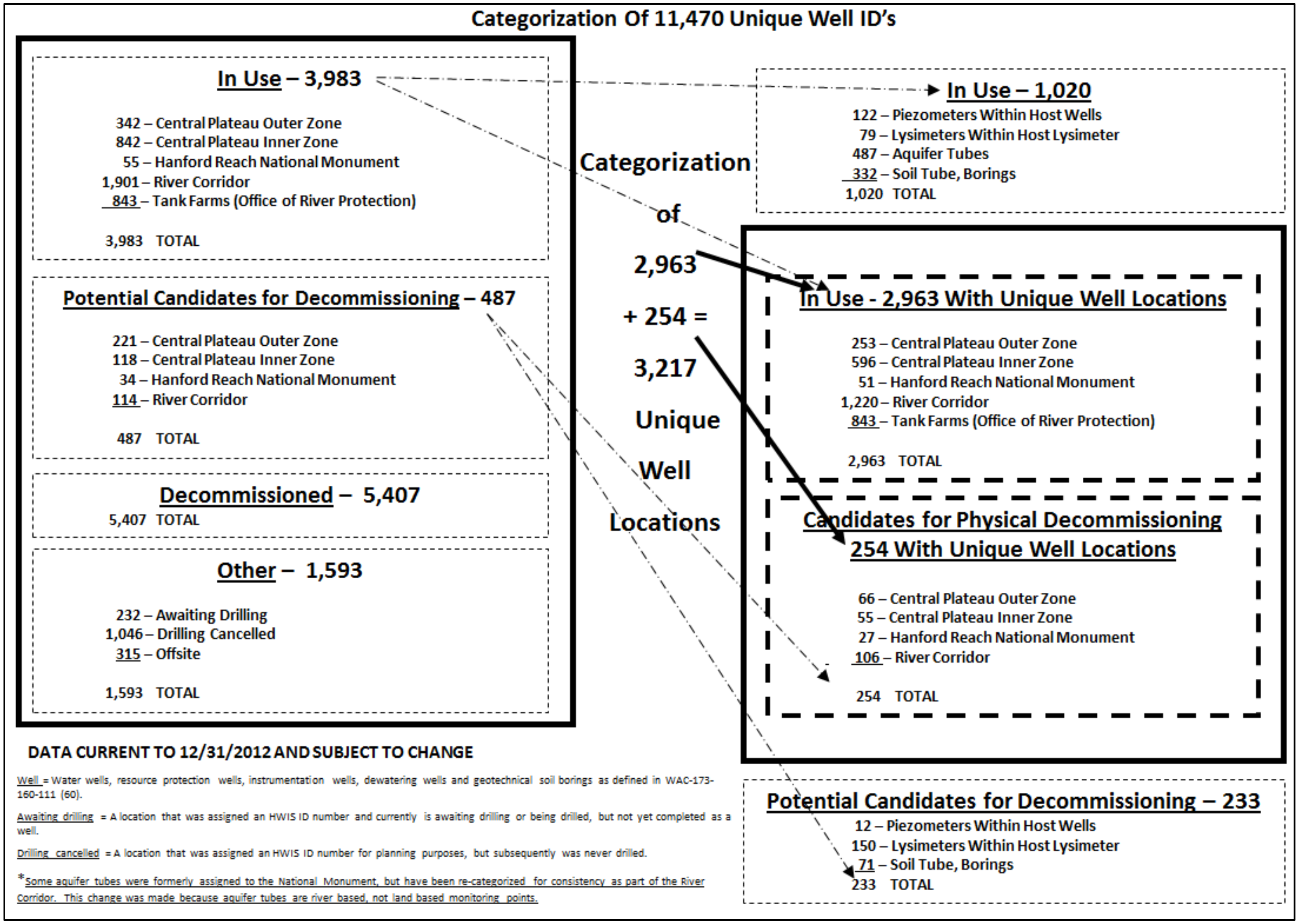

Figure 7-1. Categorization of Unique Well Identification Numbers

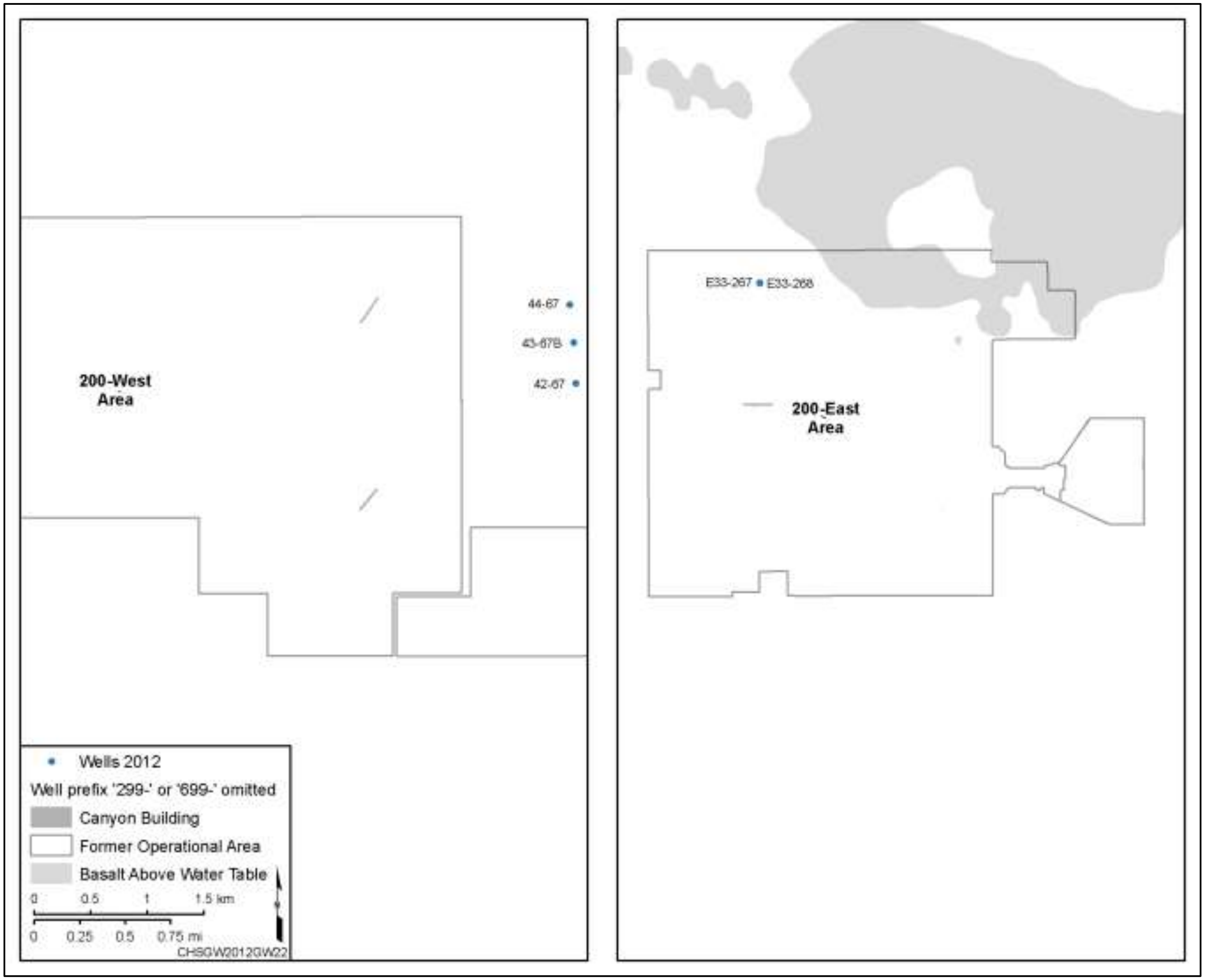

Figure 7-2. 200 East Area and 200 West Area Well Installations, 2012

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