DOE/RL-2001-27
Revision 2

Remedial Design/Remedial Action Work Plan for the 100-NR-2 Operable Unit

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

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Title: *Remedial Design/Remedial Action Work Plan for the 100 NR 2 Operable Unit*

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Executive Summary

This revision of the remedial design/remedial action work plan (RD/RAWP) sets forth the approach for implementing the interim remedial actions selected for the 100-NR-2 Groundwater Operable Unit (OU), as specified in the *Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units*[1] (hereafter referred to as the Interim Action Record of Decision [ROD]). This RD/RAWP includes the activities necessary to install and maintain an apatite permeable reactive barrier (PRB) for the 100-NR-2 OU, as specified in the *100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*[2] (hereafter referred to as the Interim Action ROD, as amended).

The Interim Action ROD, as amended, revised the selected interim remedial action for the strontium-90 in the 100-NR-2 OU located within the U.S. Department of Energy's 100-N Area of the Hanford Site near Richland, Washington. The revised interim remedial action replaces the pump and treat (P&T) system with an apatite PRB. This amended interim remedial action decision, based on information contained in the Administrative Record for the 100-NR-2 OU, is necessary to protect the public health and welfare and the environment from actual or potential releases of strontium-90.

The selected remedy combines apatite sequestration,[3] monitored natural attenuation, and institutional controls to prevent human and ecological exposure and to reduce the strontium-90 flux to the Columbia River. The mass of apatite to be emplaced within the PRB footprint is designed to sequester strontium-90 entering the PRB from the upgradient portion of the plume over the next 300 years. Completion of the PRB (in combination with implementation of a final remedial action to be identified in the 100-N Area remedial investigation/feasibility study report and Proposed Plan) will

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[1] EPA/ROD/R10-99/112, 1999, *Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Seattle, Washington. Available at: http://www.epa.gov/superfund/sites/rods/fulltext/r1099112.pdf.

[2] EPA, 2010, *U.S. Department of Energy 100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*, U.S. Environmental Protection Agency, Seattle, Washington. Available at: http://www.epa.gov/region10/pdf/sites/hanford/100/rod-amend-092810.pdf.

[3] Apatite sequestration is an exchange process where strontium-90 and other divalent ions substitute for calcium in the apatite crystal matrix.

support attainment of the interim action remedial action objectives along the 100-N Area shoreline. Concurrent with or following completion of the apatite PRB injections, the former interim remedial action P&T system will be decommissioned.

This RD/RAWP is organized into the following eight chapters:

- Chapter 1 identifies the purpose for the RD/RAWP and describes the history and environmental setting of the 100-N Area.
- Chapter 2 presents the basis for the selected remedy as described in the Interim Action ROD, as amended.
- Chapter 3 provides a conceptual design for the individual remedy components.
- Chapter 4 describes the project management team, facility procurement, and construction and operational approaches to implement the interim remedial action.
- Chapter 5 summarizes the environmental management controls associated with waste management, health and safety, emergency response, and the quality assurance program.
- Chapter 6 discusses interim remedial action completion requirements.
- Chapter 7 provides an initial cost estimate for fiscal year 2014 through fiscal year 2018, as well as a planning-level schedule for apatite PRB buildout activities.
- Chapter 8 contains a list of the references cited.

This RD/RAWP was prepared to fulfill Tri-Party Agreement[4] Milestone M-015-60.

[4] Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

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Terms

amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
bgs	below ground surface
Ca-citrate-PO_4	calcium-citrate-phosphate
CCP	comprehensive conservation plan
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M HILL Plateau Remediation Company
COC	contaminant of concern
COPC	contaminant of potential concern
Cr(VI)	hexavalent chromium
DOE	U.S. Department of Energy
DWS	drinking water standard
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
ERDF	Environmental Restoration Disposal Facility
FS	feasibility study
FY	fiscal year
gpm	gallons per minute
HHE	human health and the environment
HRNM	Hanford Reach National Monument
IC	institutional control
ITRD	Innovative Treatment and Remediation Demonstration
IX	ion exchange
LWDF	Liquid Waste Disposal Facility
MNA	monitored natural attenuation

MTCA	"Model Toxics Control Act—Cleanup" (WAC 173-340)
N/A	not applicable
NCP	National Contingency Plan (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan")
NEPA	*National Environmental Policy Act of 1969*
NHPA	*National Historic Preservation Act of 1966*
O&M	operations and maintenance
OU	operable unit
P&T	pump and treat
ppm	parts per million
PRB	permeable reactive barrier
PRZ	periodically rewetted zone
QA	quality assurance
QC	quality control
RAG	remedial action goal
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1976*
RD/RAWP	remedial design/remedial action work plan
RDR	remedial design report
RI	remedial investigation
RL	DOE Richland Operations Office
ROD	record of decision
S&GRP	Soil and Groundwater Remediation Project
SAP	sampling and analysis plan
TAG	Technical Advisory Group
TD	total depth
TPA	Tri-Party Agreement
TPH	total petroleum hydrocarbon
TPH-D	total petroleum hydrocarbon-diesel
TPH-G	total petroleum hydrocarbon-gasoline

Tri-Parties	U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
UIC	Underground Injection Control
UPR	unplanned release
USFWS	U.S. Fish and Wildlife Service

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1 Introduction

Groundwater beneath the 100-N Area of the Hanford Site has been contaminated with radionuclides, metals, petroleum hydrocarbons, and ionic constituents from wastewater disposal practices and unplanned releases (UPRs) associated with N Reactor operations. In accordance with the Tri-Party Agreement (TPA) requirements (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*), and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) (as amended by the *Superfund Amendments and Reauthorization Act of 1986*), cleanup actions have been initiated at the 100-N Area (Figure 1-1).

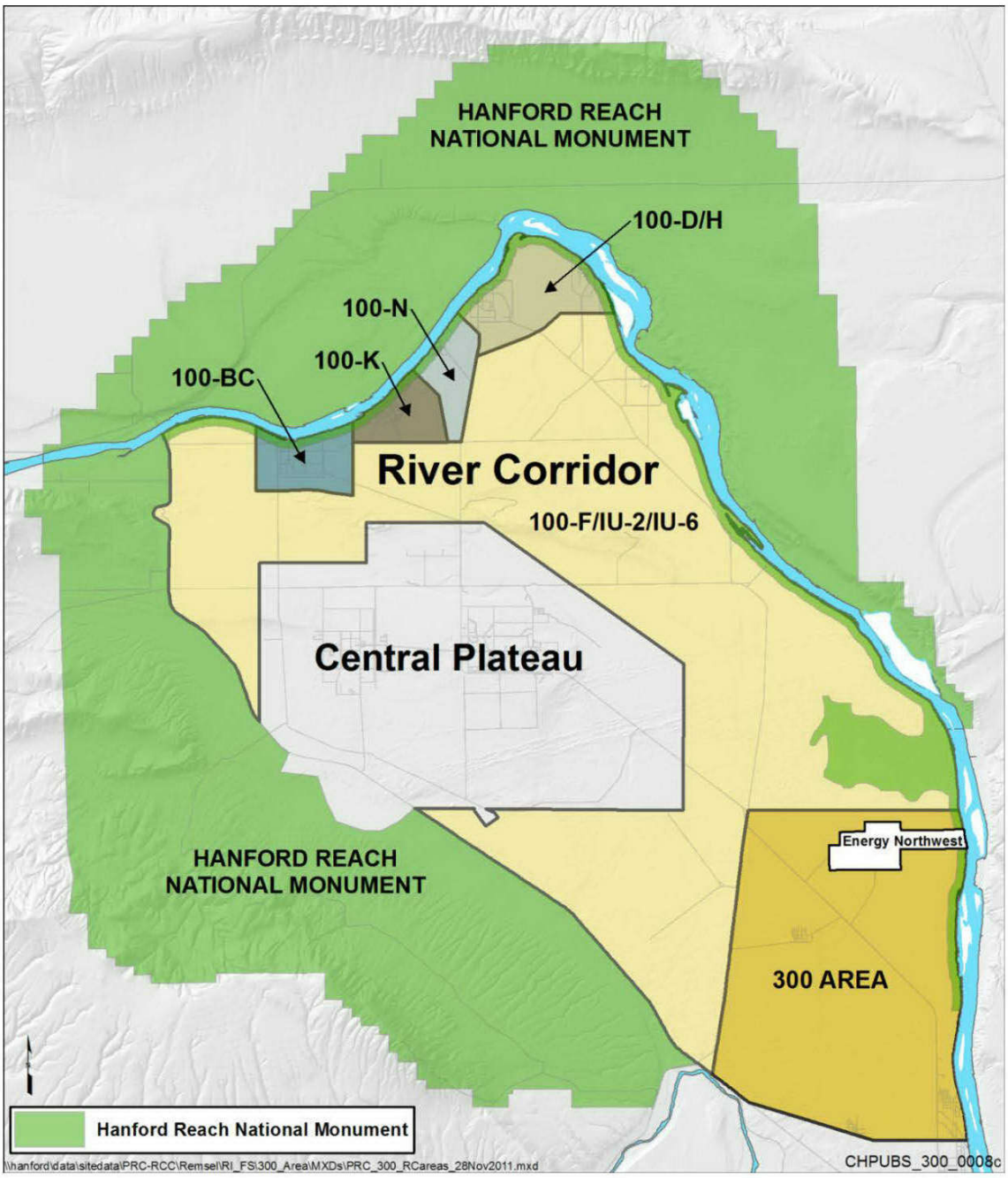


Figure 1-1. Location of the 100-N Area at the Hanford Site

The 100-N Area is divided into two operable units (OUs), identified as 100-NR-1 and 100-NR-2 (Figure 1-2). The 100-NR-1 OU consists of the 100-N source waste sites and includes four treatment, storage, and disposal (TSD) units (Figure 1-3): 116-N-1 (1301-N Liquid Waste Disposal Facility [LWDF]), 116-N-3 (1325-N LWDF), 120-N-1 (1324-NA Percolation Pond), and 120-N-2 (1324-N surface impoundment). These four TSD units are regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA). Interim remedial actions for the 100-NR-1 OU waste sites are addressed in DOE/RL-2005-93, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*.

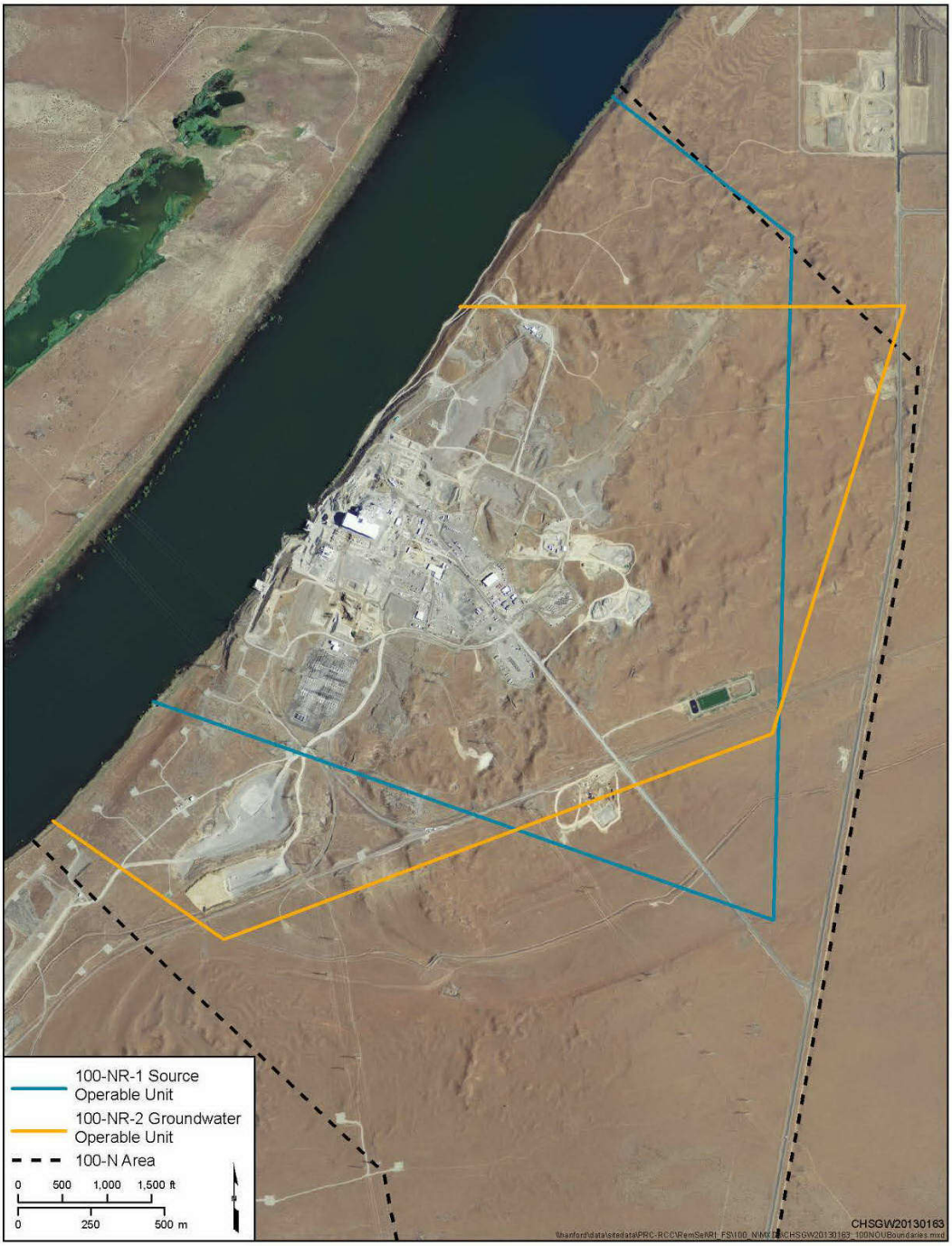


Figure 1-2. 100-N Area OU Boundary Map

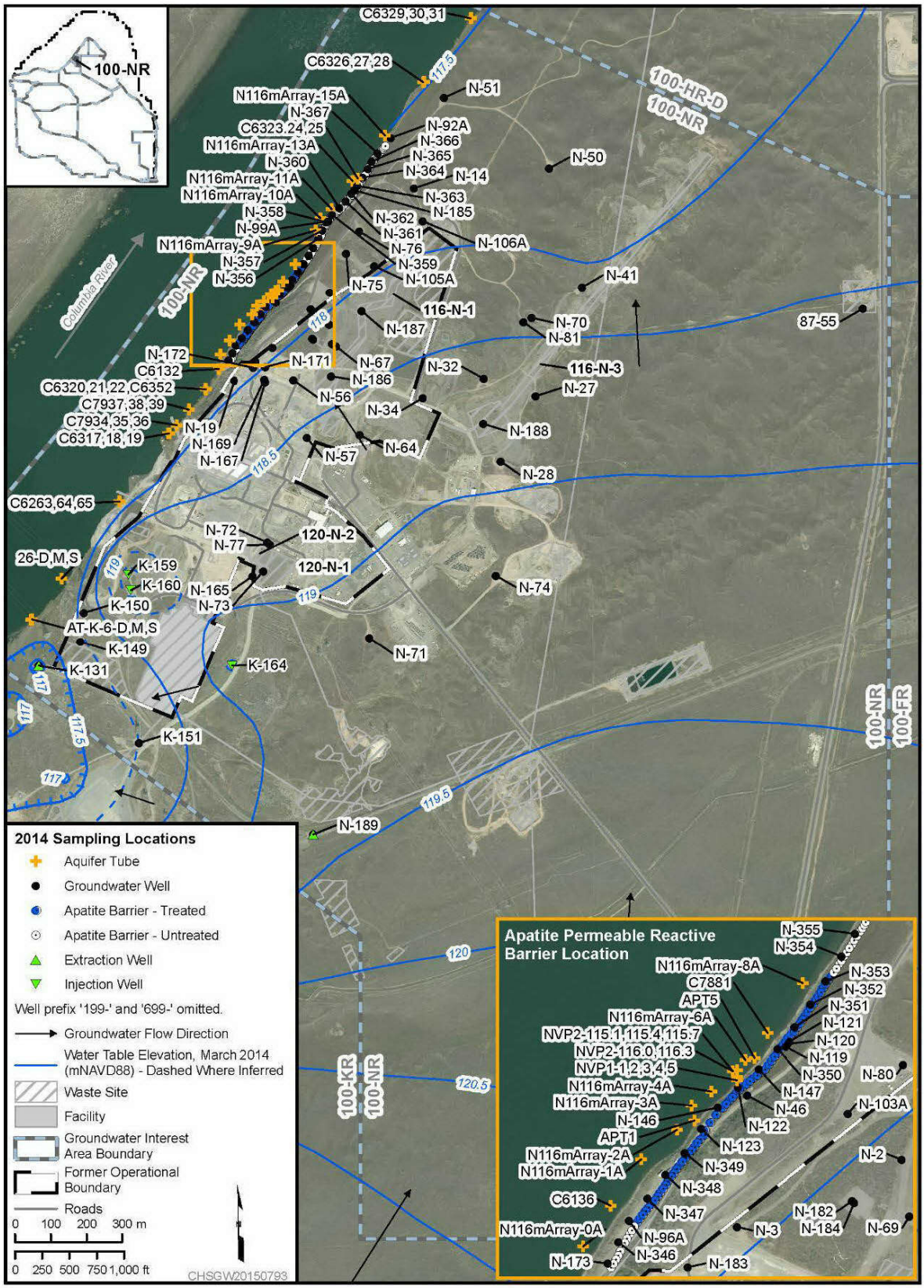


Figure 1-3. Site Map of the 100-N Area

The contaminated groundwater beneath the 100-N Area constitutes the 100-NR-2 OU. Groundwater contaminants of concern (COCs) include nitrate, sulfate, total petroleum hydrocarbon (TPH), hexavalent chromium (Cr(VI)), manganese, tritium, and strontium-90. Of primary concern in the 100-NR-2 OU is the presence of strontium-90 at concentrations above the drinking water standard (DWS) that enters the nearby Columbia River via natural groundwater upwelling through the river bottom. Historically, groundwater also entered the river through riverbank seeps identified as N-Springs. The site-related riverbank seeps, resulting from historical groundwater elevation mounding beneath the 100-N Area, are no longer present.

On September 30, 1999, EPA/ROD/R10-99/112, *Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (hereafter referred to as the Interim Action Record of Decision [ROD]) was signed by the U.S. Department of Energy (DOE), Richland Operations Office (RL); the Washington State Department of Ecology (Ecology); and the U.S. Environmental Protection Agency (EPA). The 1999 Interim Action ROD addressed the source waste sites, the shoreline site, the petroleum hydrocarbon site, and groundwater. The RCRA TSD waste sites are addressed in a separate ROD (EPA/ROD/R10-00/120, *Interim Remedial Action Record of Decision for the 100-NR-1 Operable Unit, Hanford Site, Benton County, Washington*). The 1999 Interim Action ROD required pump and treat (P&T) for strontium-90, institutional controls (ICs), and further technology evaluation for strontium-90 removal from groundwater. The original remedial design/remedial action work plan (RD/RAWP) for the 100-NR-2 OU (DOE/RL-2001-27, Rev. 0) provided the details necessary for implementing the interim remedy.

Based on the results of the strontium-90 technology evaluations and subsequent field evaluations, the 1999 Interim Action ROD was amended on September 30, 2010 (EPA, 2010, *U.S. Department of Energy, 100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*, hereafter referred to as the Interim Action ROD, as amended). The Interim Action ROD, as amended, replaced the strontium-90 groundwater P&T system with a subsurface apatite permeable reactive barrier (PRB). The rationale for amending the 1999 Interim Action ROD is described in DOE/RL-2009-54, *Proposed Plan for Amendment of 100-NR-1/NR-2 Interim Action Record of Decision*. This RD/RAWP provides information associated with the development of a remedial design and remedial action implementation strategy for the remedy selected in the Interim Action ROD, as amended, for the 100-NR-2 OU.

The remedial design establishes the general size, scope, and character of the project and identifies the technical requirements of the remedial action. The RD/RAWP presents the design basis and the remedial design, and it describes the remedial action work elements, including construction methods, construction management and oversight, estimated construction schedules and cost, operations and maintenance (O&M), and remedy performance metrics. Implementation of the remedy selected in the Interim Action ROD, as amended (EPA, 2010), in conjunction with remedial actions to be identified in a final ROD, will contribute to progress in meeting the remedial action objectives (RAOs).

1.1 Purpose

In accordance with the TPA (Ecology et al., 1989a), a remedial design report (RDR) and an RAWP are required to describe how the selected remedy and related activities specified in the Interim Action ROD, as amended, will be implemented. The purpose of this RD/RAWP is to describe the design and implementation of the interim remedial action pertaining to the 100-NR-2 OU, as described in the Interim Action ROD, as amended (EPA, 2010). A sampling and analysis plan (SAP) is also required for selected remedies. Sampling and analysis to support saturated and vadose zone apatite injection activities, and the

requirements for performance monitoring of the PRB for the 100-NR-2 OU are included in the SAP (provided as Appendix A).

This document is a companion document to the 100-N Area RDR/RAWP (DOE/RL-2005-93, Rev. 1), which describes interim actions under way to address vadose zone soil contamination.

1.2 Scope

This RD/RAWP includes the remedial actions that will be implemented to meet the requirements of the Interim Action ROD, as amended (EPA, 2010). The amended interim action remedy for the 100-NR-2 OU is a combination of in situ groundwater treatment using an apatite PRB, monitored natural attenuation (MNA), petroleum hydrocarbon recovery, and ICs. A majority of the interim remedial actions described in this RD/RAWP are specific to strontium-90 and emplacement of sufficient apatite mass to provide for a 300-year design life.

The TPA (Ecology et al., 1989a) specifically lists the remedial design and the RAWP as two separate documents. This document streamlines this requirement by combining the remedial design and RAWP into a single submittal. This document addresses the following:

- Installation of the apatite PRB in the saturated zone and vadose zone
- Decommissioning of the existing treatment components for the 100-NR-2 OU P&T system installed in 1994 under an ERA
- Petroleum hydrocarbon recovery
- ICs for the 100-N Area
- Groundwater monitoring and reporting to assess effectiveness of the apatite PRB in reducing strontium-90 flux to the Columbia River
- Other O&M activities necessary to maintain the integrity of all interim remedial actions, including the apatite PRB, until a final remedy is selected and implemented

The remedial design and remedial action activities for the 100-NR-1 OU are presented in the 100-N Area RDR/RAWP (DOE/RL-2005-93). The remedial design and remedial action activities associated with the RCRA TSD units are presented in DOE/RL-2000-16, *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units*. However, because of the RCRA Permit requirements (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*) and the potential for impact to the groundwater from the source and TSD waste sites, all interim remedial actions and final remedial actions in the 100-N Area will require a coordinated effort, as described in the Interim Action ROD, as amended (EPA, 2010).

A remedial action/feasibility study (RI/FS) work plan for the entire 100 Area was prepared in 2008 and was approved in 2010 (DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*). This document outlined the overall process for developing and completing an RI/FS, a Proposed Plan, and a final ROD for each of the Hanford Site's 100 Area sites. Separate addenda to the RI/FS work plan (specific to the individual 100 Area sites) were then prepared. The 100-N Area is addressed in DOE/RL-2008-46-ADD5, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 5: 100-NR-1 and 100-NR-2 Operable Units*. This document identifies specific data necessary to select a final remedial action for the 100-NR-1 and 100-NR-2 OUs.

1.3 Site Description and Background

The description of the 100-N Area and historical background information are summarized in this section, and a map of the 100-N Area is provided on Figure 1-3. The information presented in this section was compiled from the references listed in Table 1-1.

Table 1-1. Reference Documents Used to Prepare This RD/RAWP (Rev. 2)

Document Number	Document Title
DOE/RL-94-132, Draft A	*Letter Report for Modeling Evaluation of N-Springs Barrier and Pump-and-Treat Systems*
DOE/RL-93-81, Rev. 0	*Limited Field Investigation Report for the 100-NR-2 Operable Unit: Hanford Site, Richland, Washington*
BHI-00055, Rev. 01	*Qualitative Risk Assessment for the 100-NR-2 Operable Unit*
DOE/RL-95-111, Rev. 0	*Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units*
DOE/RL-95-110, Rev. 0	*N-Springs Expedited Response Action Performance Evaluation Report*
PNL-10899	*Strontium-90 Adsorption-Desorption Properties and Sediment Characterization at the 100-N Area*
DOE/RL-96-102, Rev. 0	*Proposed Plan for Interim Remedial Actions at the 100-NR-1 Source Sites Operable Unit and the 100-NR-2 Groundwater Operable Unit*
EPA/ROD/R10-99/112	*Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington*
DOE/RL-2001-27, Rev. 0	*Remedial Design Report/Remedial Action Work Plan for the 100-NR-2 Operable Unit*
FH-0403540	"Transmittal of the Draft Letter Report, Evaluation of Strontium-90 Treatment Technologies for the 100-NR-2 Groundwater Operable Unit"
DOE/RL-2004-21, Rev. 0	*Calendar Year 2003 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit (OU) Pump & Treat Operations*
DOE/RL-2009-54, Rev. 0	*Proposed Plan for Amendment of 100-NR-1/NR-2 Interim Action Record of Decision*
EPA, 2010	*U.S. Department of Energy, 100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*
DOE/RL-2010-29, Rev. 0	*Design Optimization Study for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit*
DOE/-RL-2010-68, Rev. 0	*Jet Injection Design Optimization Study for the 100-NR-2 Groundwater Operable Unit*
DOE/RL-2015-07, Rev. 0	*Hanford Site Groundwater Monitoring Report for 2014*
DOE/RL-2008-46-ADD5, Rev. 0	*Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 5: 100-NR-1 and 100-NR-2 Operable Units*
DOE/RL-2015-05, Rev. 0	*Calendar Year 2014 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*
PNNL-20252	*100-NR-2 Apatite Treatability Test: An Update on Barrier Performance*
DOE/RL-2011-119, Rev. 0	*Hanford Site Environmental Report for Calendar Year 2011*
DOE/RL-2012-15, Draft A	*Remedial Investigation/Feasibility Study for 100-NR-1 and 100-NR-2 Operable Units*

The 100-N Area is adjacent to the Columbia River in the northern portion of the Hanford Site, between the 100-D and 100-K Areas (Figure 1-1). It comprises approximately 9 km^2 (3.5 mi^2) of the total River Corridor area. The section of the Columbia River along the 100-N Area is part of the Hanford Reach, which is an important ecological, cultural, historical, and recreational feature that extends from Priest Rapids Dam to Lake Wallula near the southern boundary of the 300 Area.

The 100-N Area contains one dual-purpose production reactor (N Reactor), the adjoining Hanford Generating Plant, and associated infrastructure. The N Reactor was a pressurized, lightwater reactor that operated from 1964 until 1987. A chronology of key 100-N Area activities is provided in Table 1-2.

Table 1-2. Chronology of 100-N Area Key Events

Date	Milestone
May 13, 1959	Construction of N Reactor began.
September 1963	Construction of the Hanford Generating Plant began.
December 1963	N Reactor began into production.
January 1964	N Reactor reached full power.
1964	116-N-1 Crib/Trench was activated.
October 1972	Sodium dichromate was replaced with hydrazine for cooling water corrosion control.
1982	Increased strontium-90 concentrations were measured at N-Springs.
1985	Strontium-90 concentration in N-Springs reached 5,000 pCi/L.
September 1985	Replacement LWDF (116-N-3 Trench) was activated. Original LWDF (116-N-1 Trench) was deactivated.
December 12, 1986	N Reactor was placed in stand-down status.
February 1988	N Reactor was placed in cold standby.
1989	N Reactor was defueled and irradiated fuel was shipped to 100-K Area fuel storage basins.
October 1991	N Reactor was ordered to be shut down; 116-N-3 Trench was deactivated.
1995	N-Springs P&T system went online.
1999	EPA/ROD/R10-99/112, *Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington*, was issued to provide direction for evaluating technologies for strontium-90 removal.
2004	FH-0403540, "Evaluation of Strontium-90 Treatment Technologies" (letter report), was presented at public meeting.
2006	N-Springs P&T system was placed in standby mode.
2006-2007	Pilot testing of low-concentration apatite solution began (groundwater PRB).
2008	Pilot testing of high-concentration apatite solution began (groundwater PRB).
2009	Pilot testing for solid-phase apatite jet injections began (vadose zone PRB).
2009-2010	Installation of multipurpose and monitoring wells began to complete 2,500 ft groundwater PRB buildout.

Table 1-2. Chronology of 100-N Area Key Events

Date	Milestone
2010	Amended the 1999 100-N Area interim action ROD (EPA/ROD/R10-99/112) directive for expansion of the groundwater PRB to 2,500 ft, and jet injections for vadose zone PRB.
2011	Expansion of groundwater PRB to 274 m (900 ft) was performed in accordance with design optimization study (DOE/RL-2010-29, *Design Optimization Study for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit*).
2011	DOE/RL-2008-46-ADD5, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 5: 100-NR-1 and 100-NR-2 Operable Units*, was completed.
2013	DOE/RL-2012-15, *Remedial Investigation/Feasibility Study for 100-NR-1 and 100-NR-2 Operable Units* (Draft A) was issued for review.
2014	DOE/RL-2001-27, *Remedial Design/Remedial Action Work Plan for the 100-NR-2 Operable Unit* (Rev. 1) was issued.

Notes: This table is modified from DOE/RL-90-22, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-NR-1 Operable Unit, Hanford Site, Richland, Washington*.

Information for the period prior to 1990 was obtained from DOE/RL-91-59, *Closure Report for N Reactor*.

Complete reference citations for the documents listed in this table are provided in Chapter 8.

LWDF = Liquid Waste Disposal Facility

P&T = pump and treat

PRB = permeable reactive barrier

ROD = record of decision

1.3.1 History and Conceptual Model of Strontium-90 Release

The following summary of 100-N Area operations (adapted from DOE/RL-95-110, *N-Springs Expedited Response Action Performance Evaluation Report*) summarizes the early history of strontium-90 contamination at the 100-N Area.

In 1963, the 1301-N LWDF, located approximately 244 m (801 ft) from the Columbia River, was constructed for the disposal of water from the N Reactor primary cooling loop, spent fuel storage basins, and other reactor-related sources. At the start of the reactor's operation, monitoring wells were installed between the LWDF and the Columbia River. Mobile contaminants (e.g., tritium) were observed almost immediately in the N-Springs, appearing along the river bank. The 1301-N LWDF received approximately 7,950 L/min (2,100 gallons per minute [gpm]) of radiologically contaminated water, causing a mound 6 m (20 ft) to form on the water table underlying the LWDF. The near-field, groundwater flow system that formed beneath the LWDF extended outward from the LWDF, with discharged liquids ultimately reaching the river.

By the late 1970s, strontium-90, which moves much more slowly than tritium, was detected at elevated levels in the groundwater near the Columbia River. To mitigate strontium-90 entry into the river, the 1325-N LWDF was constructed farther inland from the river and placed into partial service in 1983 and in full service in 1985. The flow rate to the 1325-N LWDF was estimated at 1,514 L/min (400 gpm) from 1983 to 1985; 5,300 L/min (1,400 gpm) in 1986; and approximately 1,325 L/min (350 gpm) from

1986 to 1991. Discharges to the 1301-N and 1325-N LWDFs[1] ceased in 1985 and 1991, respectively (DOE/RL-95-110).

An inventory of the strontium-90 discharged to the LWDFs (Figure 1-4) shows its fate and distribution within the 100-NR-1 and 100-NR-2 OUs based on 1995 values presented in DOE/RL-2008-46-ADD5. The following assumes a strontium-90 half-life of 29.1 years, 755 Ci remain in the vadose zone soil, and 58 Ci in the unconfined aquifer as of January 2013 (DOE/RL-2012-15, Draft A, *Remedial Investigation/ Feasibility Study for 100-NR-1 and 100-NR-2 Operable Units*).

- An estimated 2,998 Ci of strontium-90 were contained in the liquid effluent discharged to the LWDFs during N Reactor operation.
- 46 Ci of strontium-90 were estimated to have entered the Columbia River through the LWDF and groundwater flow pathway.
- Approximately 1,126 Ci of strontium-90 decayed through 1995.
- An estimated 572 Ci of strontium-90 were contained in the soil removed from the 116-N-1 and 116-N-3 LWDFs.
- An estimated 1,254 Ci (decayed to 1995 levels) remained in the subsurface, with 1,165 Ci present in the vadose zone soil beneath the LWDFs and 89 Ci in the underlying unconfined aquifer.

A conceptual model for strontium-90 release from the LWDFs (Figure 1-5) illustrates how strontium-90 discharged to the LWDFs was carried vertically downward through the soil column by infiltrating water and, under the influence of an elevated hydraulic gradient, was transported toward the river. Strontium-90 adsorbed to aquifer solids in the periodically rewetted zone (PRZ) (or zone of water table fluctuation) is subject to remobilization during river-stage fluctuations.

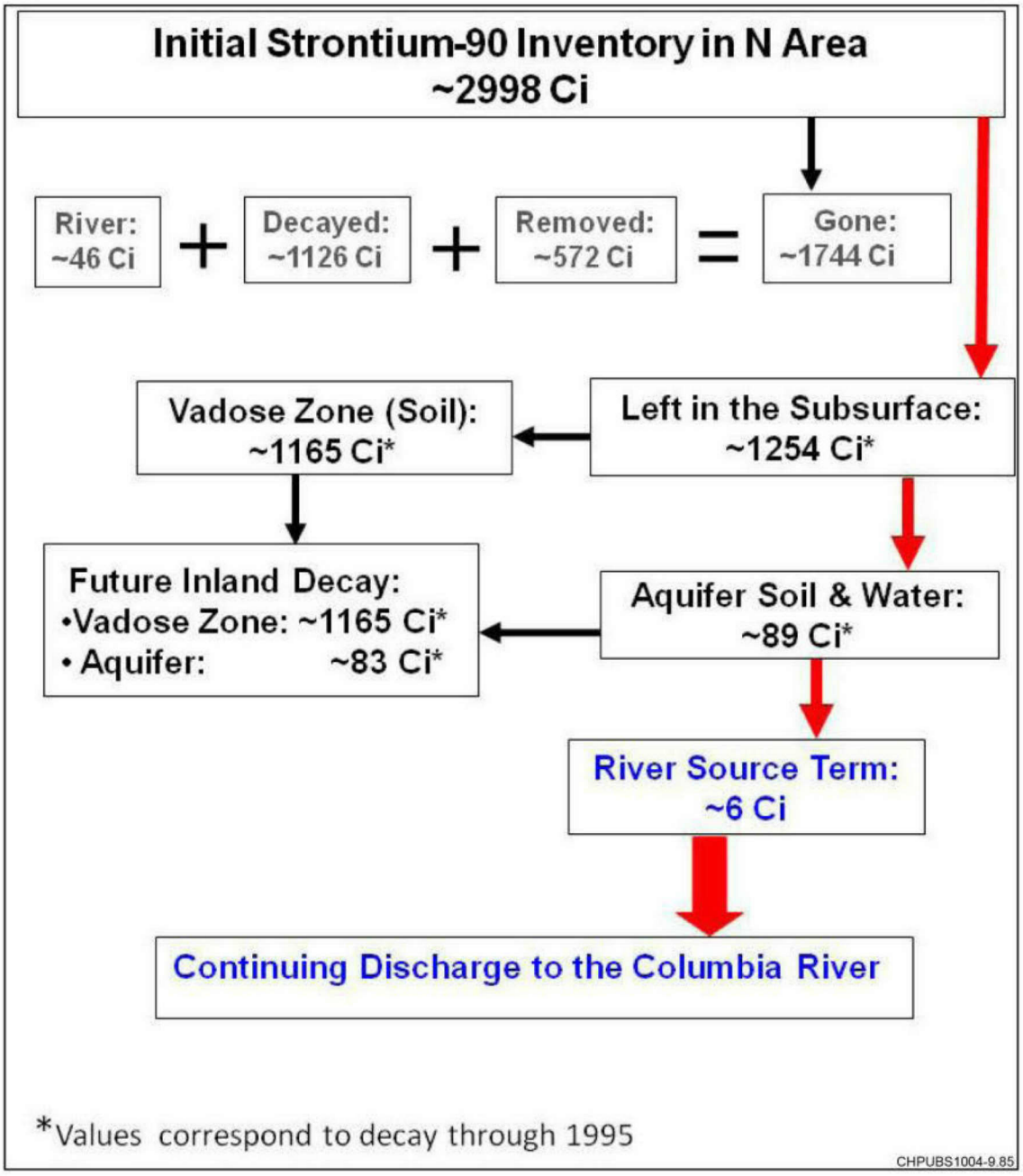
Other nonradiological contaminants were also discharged to the LWDFs. The following contaminants were identified as groundwater COCs for the 100-NR-2 OU in the Interim Action ROD (EPA/ROD/R10-99/112): manganese, Cr(VI), nitrate, sulfate, strontium-90, tritium, total petroleum hydrocarbon-diesel (TPH-D), and TPH-gasoline (TPH-G).

1.3.2 Response Action Status — Interim Action Record of Decision

Because of concern regarding the release of strontium-90 to the Columbia River, Ecology and EPA issued Ecology and EPA, 1994, "Action Memorandum: N Springs Expedited Response Action Cleanup Plan, U.S. Department of Energy Hanford Site, Richland, WA," to RL on September 23, 1994. The ERA required RL to take immediate action, which consisted of installing and operating a groundwater P&T system and a sheet-pile barrier wall at N-Springs.

In a letter dated March 23, 1995 (Stanley and Sherwood, 1995, "Re: USDOE Request to Change N Springs Action Memorandum"), Ecology and EPA agreed that a sheet-pile construction test in December 1994 showed that the installation of the jointed hinge, sheet-pile wall could not be achieved in the manner specified. Ecology and EPA directed RL to proceed with installation of the P&T system. Additionally, RL was directed to continue accurately assessing the flux of strontium-90 to the river, further characterize geologic and hydrologic conditions, and assess design and installation alternatives related to modified barriers and expected performance.

[1] The 1301-N and 1325-N LWDFs (active site designation) are also referred to in this document by their respective 116-N-1 and 116-N-3 TSD post-remediation designations.



Reference: DOE/RL-2008-46-ADD5, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 5: 100-NR-1 and 100-NR-2 Operable Units*.

Figure 1-4. Strontium-90 Mass Balance Estimate

The N-Springs P&T system, which was completed in August 1995, began full operation in September 1995, meeting TPA (Ecology et al., 1989a) Milestone M-16-12D. The 1999 Interim Action ROD (EPA/ROD/R10-99/112) required continued operation of the P&T system in accordance with the design configuration described in DOE/RL-97-34, *N-Springs Pump and Treat System Optimization Study*, and continued groundwater monitoring (not related to the performance of the ERA P&T system) as interim actions. The objectives for the ERA were to substantially reduce the flux of strontium-90 to the Columbia River and to obtain data sufficient to establish final remedial actions. The 1999 Interim Action

ROD included additional requirements to address petroleum hydrocarbon-contaminated groundwater, assess strontium-90 impacts on aquatic and riparian receptors, and evaluate technologies for strontium-90 removal from groundwater.

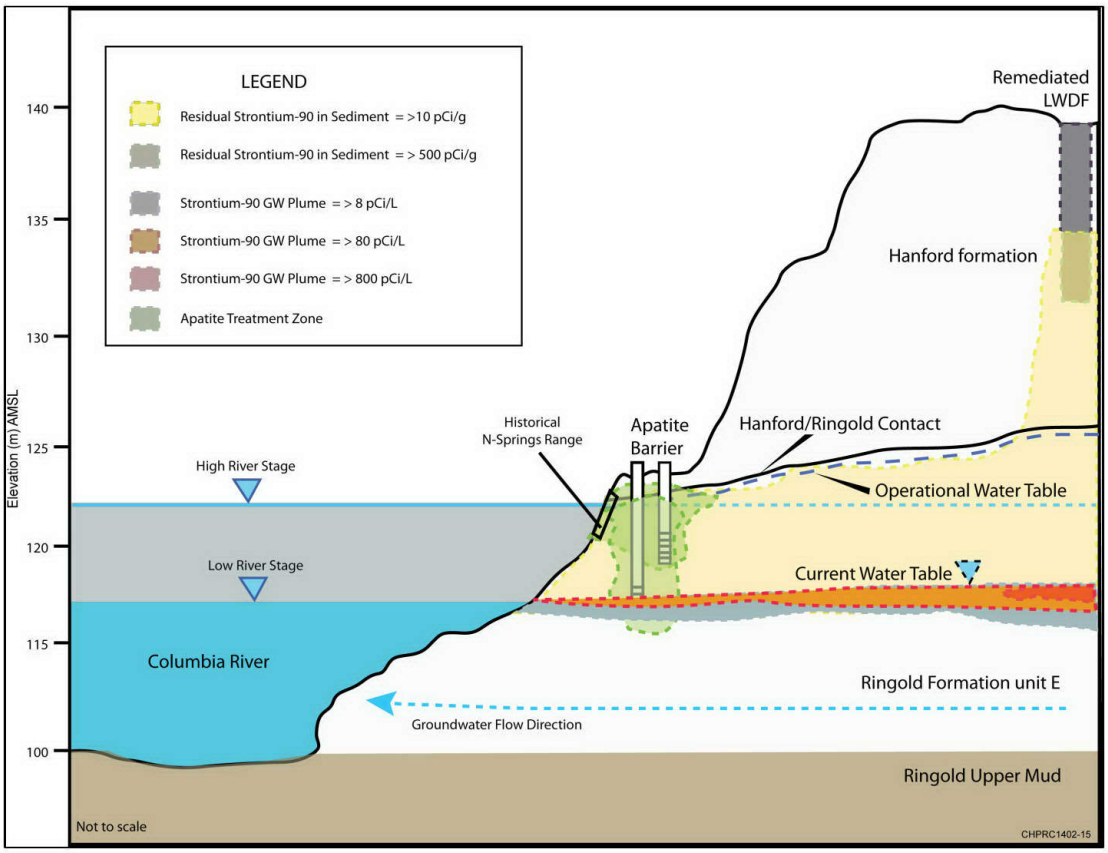


Figure 1-5. Conceptual Model of Strontium-90 Release from the LWDF

The actions described in the following subsections were implemented to fulfill the requirements of the Interim Action ROD (EPA/ROD/R10-99/112).

1.3.2.1 Pump and Treat Operations and Groundwater Monitoring for Strontium-90

The P&T system consisted of four extraction wells, a treatment system for strontium-90 removal, and two injection wells to return the treated water to the aquifer (Figure 1-6). This system operated between 1995 and 2006. Approximately 1.1 billion L (305 million gal) of groundwater containing 1.8 Ci of strontium-90 were removed from the aquifer and treated. The 0.2 Ci of strontium-90 removed each year by P&T operations was estimated to be 10 times less than the amount removed by natural radioactive decay (DOE/RL-2004-21, *Calendar Year 2003 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit (OU) Pump & Treat Operations*). This amount represented a small percentage of the 1,866 Ci (decayed to 1995) of strontium-90 estimated to remain in the subsurface. Because the P&T system had limited success in removing strontium-90 from the aquifer as a result of strontium's strong affinity for adhering to aquifer sediments, the system was placed in standby mode in March 2006 following approval by EPA, Ecology, and DOE (also known as the Tri-Parties) in February 2006 with TPA (Ecology et al., 1989a) Change Control Form M-16-06-01.

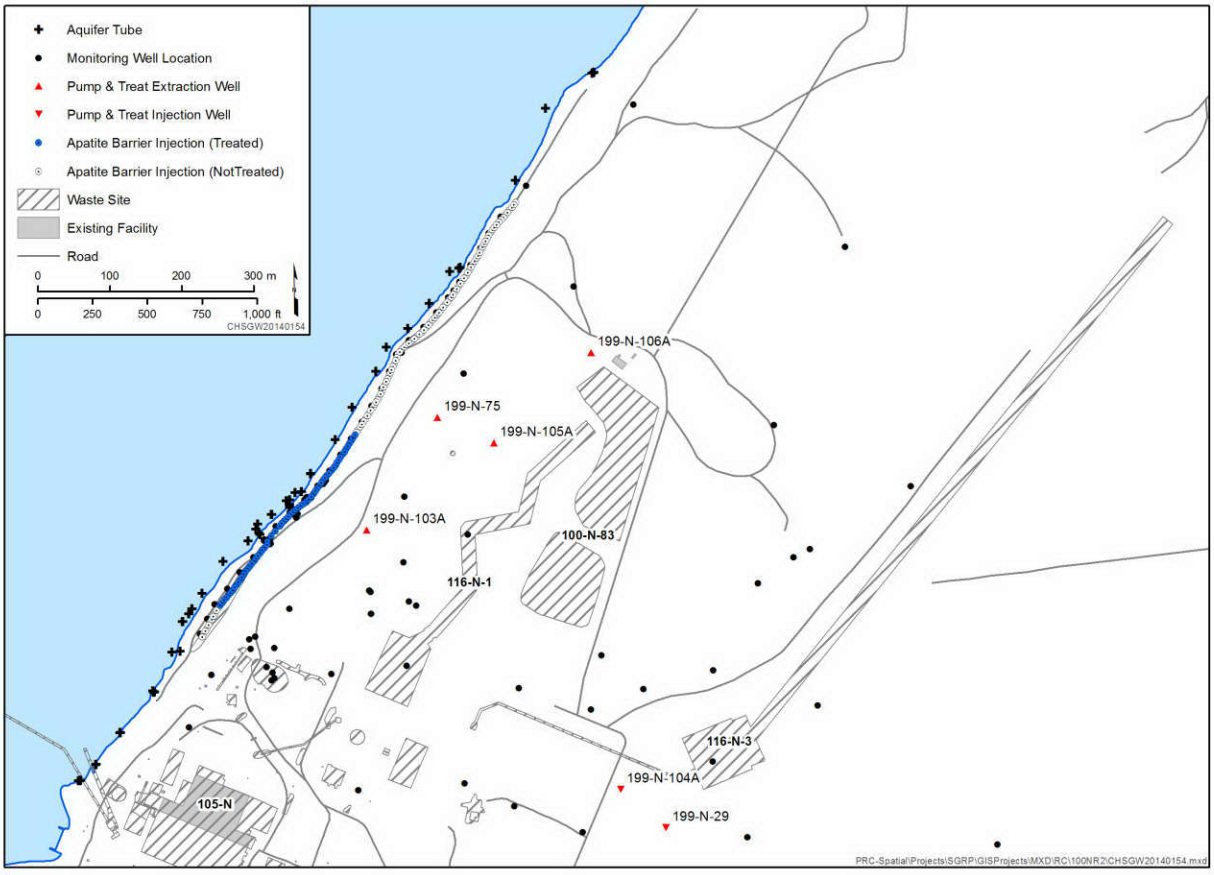


Figure 1-6. Location of 100-NR-2 OU P&T System Wells

The original ERA performance monitoring requirements were modified twice using TPA change control procedures; the first modification occurred under TPA Change Control Form M-16-96-04, which was approved on August 2, 1996 (Ecology et al., 1989a). This agreement was superseded by 100 National Priorities List (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List") Agreement/Change Control Form, Control No. 113, which was approved on March 25, 1997. It required monitoring of strontium-90 concentrations in the P&T system influent and effluent. Collecting water quality data from wells or similar monitoring sites to monitor the performance of the P&T system was not required under this agreement.

Additional groundwater monitoring that is not related to the performance of the ERA P&T system includes obtaining data to support remediation decisions under CERCLA, TSD facility requirements under RCRA, the Interim Action ROD (EPA/RPD/R10-99/112) requirement for petroleum hydrocarbon monitoring, and Sitewide surveillance under the *Atomic Energy Act of 1954*. A consolidated program to meet these requirements has been developed, and an agreement is documented in TPA (Ecology et al., 1989a) Change Control Form M-15-96-08, dated October 1996.

The ERA performance monitoring program and the consolidated groundwater monitoring program are described in BHI-00164, *N-Springs Expedited Response Action Performance Monitoring Plan*. Following shutdown of the ERA P&T system in 2006, performance monitoring of the system was discontinued.

1.3.2.2 Petroleum Hydrocarbon Recovery

Routine groundwater monitoring at the 100-N Area has included testing for TPH-D to assess the nature and extent of a historical petroleum hydrocarbon release from a fuel storage tank (166-N Tank Farm facility) in the 1960s (site code UPR-100-N-17). Figure 1-7 shows the distribution of petroleum hydrocarbons in groundwater. The estimated size of the plume footprint is currently approximately 0.003 km^2 (0.0012 mi^2) and is centered in the vicinity of monitoring Well 199-N-18 (DOE/RL-2012-15).

The Interim Action ROD (EPA/ROD/R10-99/112) requires remediation of floating petroleum hydrocarbon (product) observed in 100-N Area wells. A passive removal method (Smart Sponge®) was initiated in 2003 to remove the small amount of free product present at Well 199-N-18. This approach was taken because the layer of floating petroleum was too thin for removal by active methods. A total of 9.2 kg of product was removed from Well 199-N-18 between 2003 and 2009. The rate of product recovery has decreased from 3.5 kg in 2004 to 0.13 kg in 2009. Well 199-N-18 was replaced by Well 199-N-183 in 2011 for groundwater monitoring, but it continues to be used for petroleum recovery.

Remediation of the petroleum source waste sites is addressed in the 2006 RD/RAWP for the 100-N Area (DOE/RL-2005-93, Rev. 1). A pilot test was commissioned in 2009 to evaluate the effectiveness of bioventing to promote bioremediation of petroleum hydrocarbon contamination (primarily No. 2 diesel fuel oil and No. 6 Bunker C) present in vadose zone soil. The bioventing system (Figure 1-8) was activated in 2012. A description of the bioventing system and its operation and results is presented in WCH-600, *Annual Operations and Monitoring Report for UPR-100-N-17: November 2012 – February 2014.*

As a result of these ongoing remediation efforts and natural attenuation processes (e.g., biodegradation, dispersion, and adsorption) that occur in soil and groundwater at the 100-N Area, the contaminant mass in the TPH-D plume in the unconfined aquifer at the 100-N Area is being reduced. Groundwater monitoring results collected between 2010 and 2012 show that TPH-D present near the shoreline occurs along a 200 m (650 ft) section. In 2010, multipurpose wells for the apatite PRB injections were installed (Section 3.1.1.1). TPH-D concentrations in samples collected from these wells between 2010 and 2012 ranged from nondetect to 3,800 µg/L. In samples collected from Aquifer Tube N116mArray-0A, TPH-D concentrations ranged from nondetect to 840 µg/L (SGW-47791, *Borehole Summary for the Installation of One Hundred and Seventy One Wells at 100-NR-2 Operable Unit, FY 2009-2010*) (Figure 1-9).

Any additional remedial actions deemed necessary to address TPH-D contamination in the final ROD will be addressed in the final RDR/RAWP for the 100-N Area.

1.3.2.3 Aquatic and Riparian Receptor Evaluation

The 1995 ecological qualitative risk assessment presented in BHI-00055 focused on the hypothetical effects of contaminants on selected aquatic organisms in or near the Columbia River. The scope of this assessment was limited; therefore, the 1999 Interim Action ROD (EPA/ROD/R10-99/112) included a provision for a more thorough evaluation of impacts to ecological receptors in the shoreline area. Cadmium, lead, and zinc were identified in the qualitative risk assessment as contaminants of potential ecological concern.

Published in May 2000, PNNL-13127, *Strontium-90 at the Hanford Site and its Ecological Implications*, presented an assessment of the potential for ecological impacts to salmon embryos. An ecological risk assessment was conducted in accordance with an approved SAP (DOE/RL-2005-22, *100-NR-2 Study Area Ecological Risk Assessment Sampling and Analysis Plan*), and the results were initially presented in DOE/RL-2006-26, Rev. 0, *Aquatic and Riparian Receptor Impact Information for the*

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100-NR-2 Groundwater Operable Unit. This document was later updated and reissued as DOE/RL-2006-26, Rev. 1 Reissue.

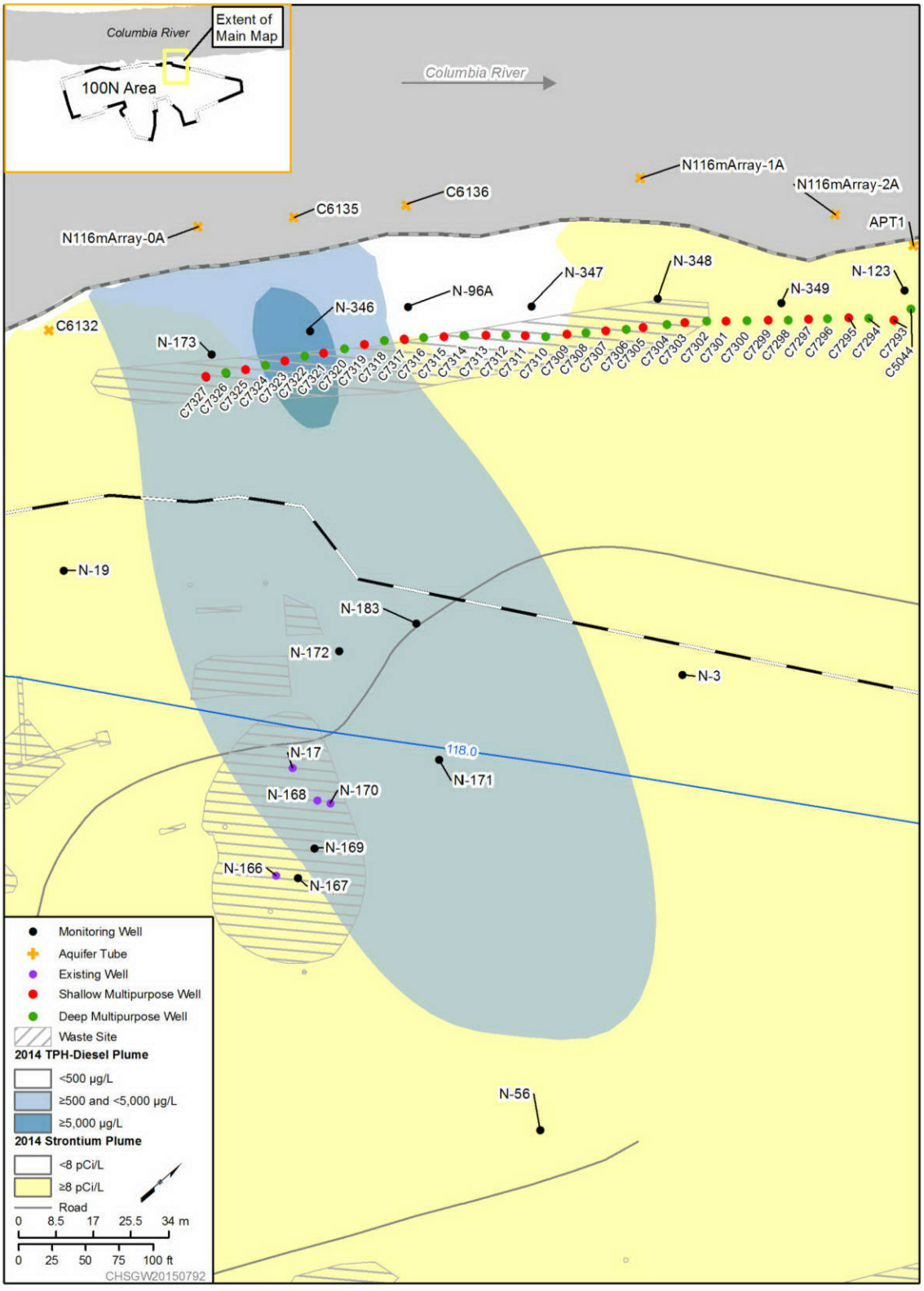

Figure 1-7. TPH-D Plume in 100-NR-2 OU Groundwater, 2014

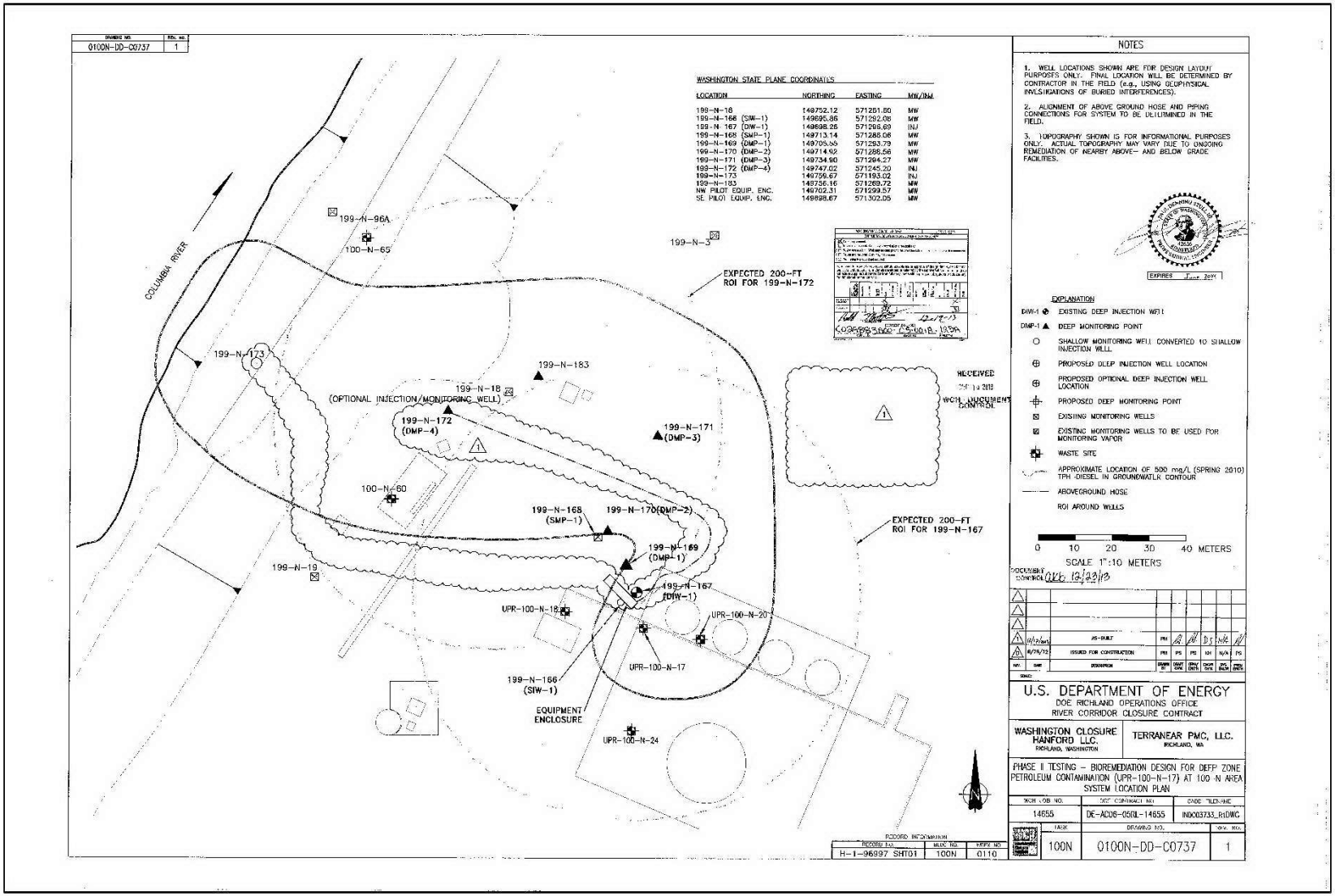

Figure 1-8. Bioventing System Well Layout for Remediation of TPH-D in 100-NR-1 OU Soil

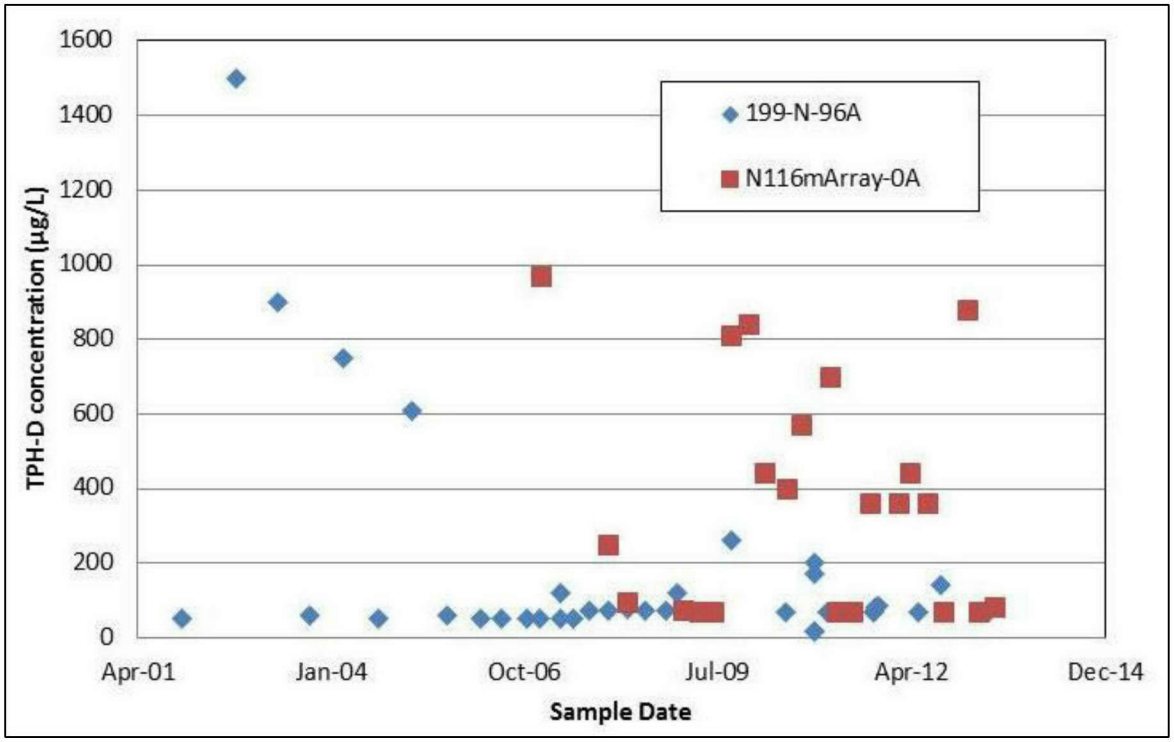

Figure 1-9. TPH-D Concentrations at the 100-N Area Shoreline

DOE/RL-2006-26 concluded that strontium-90 concentrations in Asiatic clams found along the 100-N Area shoreline were elevated relative to the upstream Vernita reference area, yet the estimated radiological dose for all biota evaluated was less than United States and international thresholds, and little indication of adverse effects from strontium-90 contamination was found in the health-status indicators surveyed. However, because of the occurrence of strontium-90 concentrations (up to 3,800 pCi/L) in aquifer tubes near the central portion of the strontium plume and the corresponding occurrence of elevated strontium-90 in Asiatic clams (up to 300 to 400 pCi/g in the shell) at the same locations, an evaluation of alternative technologies to reduce aquatic biota exposure was included within the scope of the Interim Action ROD (EPA/ROD/R10-99/112).

Soil concentrations for barium, cadmium, nickel, vanadium, and zinc in the strontium-90 plume area exceeded ecological benchmarks. Threshold exceedances of some of these metals may not be attributable to 100-N Area operations. For example, metals from upstream sources (lead/zinc mining and refinery operations in Canada and Idaho, and uranium mining near Spokane, Washington) may account for above-background concentrations of lead, cadmium, and zinc (and possibly barium and other metals) in environmental media and selected biota. Modeling using the Ecological Contaminant Exposure Model (based on median soil, water, and sediment concentrations of metals) did not indicate unacceptable risk for these metals (DOE/RL-2006-26, Rev. 1 Reissue).

Indicators of potential adverse effects associated with metals contamination were identified along a section of shoreline (approximately 150 m [492 ft] long) in the vicinity of the TPH-D contaminated area that resulted from the 1966 release. Water quality sampling data from aquifer tubes installed 10 cm (3.9 in.) beneath the riverbed indicate that the affected area contained low dissolved oxygen concentrations and elevated levels of dissolved iron and manganese that exceeded water quality benchmarks for the protection of aquatic life. Low dissolved oxygen concentrations, in combination with

elevated iron and manganese levels, indicate that microbial decomposition of petroleum hydrocarbons in groundwater is occurring (DOE/RL-2006-26, Rev. 1 Reissue).

An evaluation of the potential impact that unreacted apatite-forming minerals may have on threatened or endangered species residing in the near-shore river environment at the 100-N Area is presented in PNNL-SA-75348, *Assessment of Apatite Injection at 100-NR-2 for Potential Impact on Threatened and Endangered Species*. Three species of fish from the Hanford Reach are covered under the *Endangered Species Act of 1973*: the upper Columbia River spring Chinook salmon, the upper Columbia River steelhead, and the bull trout. The assessment concluded that only out-migrant upper Columbia River spring Chinook salmon smolts and upper Columbia River steelhead smolts are likely to be found along the 100-N Area shoreline during May and June. The assessment also concluded that adult bull trout may be found in the Columbia River, but occurrences are rare and their presence along the 100-N Area shoreline would be incidental and rare.

Potential impacts resulting from the migration of unreacted chemicals (e.g., phosphate, sodium, calcium, chloride, and citrate) with groundwater to the Columbia River were evaluated by comparing post-injection ion concentration data from groundwater wells and aquifer tubes with toxicity response values for aquatic organisms obtained from published laboratory studies. Because dissolved ions temporarily approached the lower concentration range of semi-acute (i.e., 7-day exposure) toxicity levels in aquifer tubes, it was determined that there is potential for elevated dissolved ions to create osmotic stress in fish residing in the near-shore habitat. However, several mitigating factors (including mixing with surface water and migratory behavior in smolts) may preclude extended exposure. In addition, well and aquifer tube monitoring data and surface water data were reviewed for the presence of trace metals, chloride, and conductivity to evaluate potential impacts from ions or metals that are mobilized from sediments by the high concentrations of ions in the injected material. It was concluded that post-injection monitoring data in the 100-N Area near-shore environment do not indicate exposure to elevated concentrations of toxic metals, and, under existing conditions, mixing of groundwater and surface water in the near-shore environment is of sufficient magnitude to render contaminant concentrations to levels indiscernible from river background (PNNL-SA-75348).

1.3.2.4 Shoreline Riprap Placement

Riprap material was placed over portions of the riverbank to reduce the potential for human and ecological receptor contact with contaminated groundwater seeps and springs (Figure 1-10). Under the Interim Action ROD, as amended (EPA, 2010), this riprap cover will be maintained and additional measures taken as necessary to protect against inadvertent exposure to strontium-90.

1.3.2.5 Technology Evaluation and Development for Strontium-90

The Interim Action ROD (EPA/ROD/R10-99/112) recognized the limitations of P&T technology for strontium-90 remediation by requiring that alternative treatment technologies be evaluated. The need for alternative technologies was affirmed in the first CERCLA 5-year review, which re-emphasized the need to pursue alternative remedial action technologies aggressively for the removal, mass reduction, and/or attenuation of strontium-90 from the 100-NR-2 OU aquifer sediments and to provide further reduction of strontium-90 flux to the river (EPA, 2001, *USDOE Hanford Site First Five Year Review Report*).

Figure 1-10. Riprap Material along 100-N Area Shoreline near Former N-Springs

As required by the Interim Action ROD (EPA/ROD/R10-99/112), DOE conducted a comprehensive review of strontium-90 treatment technologies. Under the Innovative Treatment and Remediation Demonstration (ITRD) Program, the Technical Advisory Group (TAG) for the 100-N Area completed a remedial options evaluation in November 2001. Based on the evaluation presented in ITRD, 2001, *Hanford 100-N Area Remediation Options Evaluation Summary Report*, TAG recommended that MNA, soil flushing, phytoremediation, stabilization by phosphate injection, impermeable barriers (sheet pile and cryogenic), and treatment barriers (clinoptilolite) be evaluated further for strontium-90 remediation. Subsequent evaluations and field trials led to the elimination of soil flushing and sheet-pile barriers as viable technologies for the 100-NR-2 OU.

A letter report (FH-0403540, "Transmittal of the Draft Letter Report, Evaluation of Strontium-90 Treatment Technologies for the 100-NR-2 Groundwater Operable Unit") was published in October 2004. This letter report and related public workshop comments, along with the 2001 ITRD report, satisfied the technology evaluation requirement specified in the Interim Action ROD (EPA/ROD/R10-99/112). Providing an evaluation of the most promising treatment alternatives, the letter report (FH-0403540) proposed a path forward for testing and selecting an alternative. Four PRB technologies were considered: (1) vertical hydrofracture, (2) aqueous injection, (3) air injection, and (4) trenching. Except for trenching (which was quickly eliminated), the PRB technologies compared closely, and a single approach was not clearly identified. However, because aqueous injection has the potential to treat sediments some distance from the injection site, the letter report (FH-0403540) recommended that aqueous injection should be the first technology tested in the field. Phytoremediation was retained for consideration in conjunction with a barrier, but it was not regarded as a stand-alone alternative for the shoreline area.

As recommended in the letter report (FH-0403540), DOE/RL-2005-96, *Strontium-90 Treatability Test Plan for 100-NR-2 Groundwater Operable Unit*, was prepared to implement field testing to evaluate strontium-90 sequestration in the saturated zone using apatite. In addition to the initial treatability test plan, three separate addenda to the treatability test plan were approved, each outlining additional testing to evaluate apatite emplacement methods or treatment areas. The first addendum (DOE/RL-2005-96-ADD1, *Treatability Test Plan Addendum for 100-NR-2 Groundwater Operable Unit*) describes injection of a high-concentration aqueous solution to follow the initial low-concentration

injection into the saturated zone. The second addendum (DOE/RL-2005-96-ADD2, *Treatability Test Plan Addendum for 100-NR-2 Groundwater Operable Unit*) described the approach for infiltrating an aqueous solution into the vadose zone along the 100-N Area shoreline. The third addendum (DOE/RL-2005-96-ADD3, *100-NR-2 Apatite Treatability Test Plan Implementation*) described the approach for the jet injection of apatite into the vadose zone. Activities completed to date in support of DOE/RL-2005-96 and its addenda are described in the following subsections.

Laboratory Studies

Laboratory-scale studies were conducted to demonstrate in situ apatite formation and strontium-90 sequestration proof of principle, characterize apatite formation and strontium-90 sequestration mechanisms important to developing a pilot field-scale test design, and optimize the calcium-citrate-phosphate (Ca-citrate-PO_4) amendment formulation to achieve site remedial objectives. The laboratory bench-scale studies are documented in PNNL-16891, *Hanford 100-N Area Apatite Emplacement: Laboratory Results of Ca-Citrate-PO_4 Solution Injection and Strontium-90 Immobilization in 100-N Sediments*, and PNNL-SA-70033, *100-NR-2 Apatite Treatability Test FY09 Status: High Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization, Interim Report*. Additional laboratory infiltration studies of the Ca-citrate-PO_4 solution were reported in PNNL-18303, *Sequestration of Sr-90 Subsurface Contamination in the Hanford 100-N Area by Surface Infiltration of a Ca-Citrate-Phosphate Solution.*

Pilot Testing

In 2006, a pilot test involving aqueous injection of a low-concentration Ca-citrate-PO_4 aqueous solution was initiated. In 2007, injections were conducted along a 90 m (300 ft) section of the 100-N Area shoreline where the highest strontium-90 concentrations had been observed. The objectives for the pilot test were to determine whether the injection resulted in apatite precipitation in the target zone and reduced strontium-90 concentrations in groundwater, and to determine the injection volume needed for a 9 m (30 ft) well spacing. These test activities were reported in PNNL-17429, *Interim Report: 100-NR-2 Apatite Treatability Test: Low-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization.*

Core Analyses

Sediment core samples collected following the initial low-concentration treatments were analyzed for apatite content and were compared with the apatite formation design target for this initial treatment. Although the apatite contents were small, they were sufficient to demonstrate the formation of phosphate mineral phases. The overlapping zone between adjacent wells received an average treatment of 110 percent of the targeted apatite content within the Hanford formation and 30 percent treatment within the Ringold Formation (PNNL-18303).

High-Concentration Solution

A high-concentration amendment solution was formulated to maximize apatite formation within the targeted treatment zone while minimizing the short-term increases in strontium-90 concentration associated with injecting high ionic-strength solutions (PNNL-19572, *100-NR-2 Apatite Treatability Test: High-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization Final Report*). In June and July 2008, high-concentration Ca-citrate-PO_4 apatite solutions were injected for the 91 m (300 ft) long apatite PRB section.

Design criteria for the high-concentration injection operations were based on amendment volume and mass injected, amendment arrival at adjacent wells, water level elevation during treatment, and injection

rate limitations associated with well plugging. Compliance with these injection design criteria was evaluated to assess operational performance.

Results from post-treatment sediment core analyses indicate that the processes accounting for the observed reduction in aqueous strontium-90 concentrations include incorporation of strontium-90 into apatite (about 39.4 percent of the total strontium-90 mass in the core), ion exchange (IX) flushing resulting from the Ca-citrate-PO_4 solution injection (about 47 percent of the mass), and a small increase in strontium-90 adsorbed to sediment and apatite precipitate (PNNL-19524, *Hanford 100-N Area In Situ Apatite and Phosphate Emplacement by Groundwater and Jet Injection: Geochemical and Physical Core Analysis*).

Based on amendment arrival responses observed during the injections (PNNL-19572), the recommended injection volume ranged from 227,125 L (60,000 gal) for wells screened in the Hanford formation and 227,125 to 454,249 L (60,000 to 120,000 gal) for wells screened in the Ringold Formation. It was recommended that in order to treat the full saturated thickness, Hanford formation treatments should be performed during the highest Columbia River stage conditions, and only the Ringold Formation should be treated during low Columbia River stage conditions to achieve an acceptable radial distribution of apatite-forming minerals.

Barrier Expansion

Optimization of the apatite groundwater PRB technology is further described in DOE/RL-2010-29, *Design Optimization Study for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit*. Additional injections (as prescribed in DOE/RL-2010-29) extended the apatite PRB from the original 91 m (300 ft) length to 274 m (900 ft). The PRB extension included injecting 24 wells upriver and 24 wells downriver of the original PRB to extend the barrier on both ends of the original PRB by 91 m (300 ft). Field testing for the design optimization study was performed by injection into multipurpose wells that were installed in accordance with DOE/RL-2009-32, *100-NR-2 Groundwater Operable Unit Sr-90 Plume Rivershore Sampling and Analysis Plan*. The test objectives of the design optimization study injections included evaluating improved methods for the delivery and emplacement of apatite-forming minerals and determining whether the new well design and injection system could complete chemical injections at various river stages, thereby eliminating the need for injections during specific river levels.

The field tests successfully demonstrated that six injection wells could be injected simultaneously with the high-concentration amendment solution with each injection skid. The field test was performed during September 2011 as river levels were transitioning to low river elevations, with river levels ranging from approximately 118.5 to 117.5 m (388.8 to 385.5 ft) above mean sea level (amsl). The overall volume of injected solution for the upriver section of the PRB extension was approximately 5,904,600 L (1,560,000 gal), for an average treatment of approximately 246,025 L (65,000 gal) per well. The overall volume of the injected solution for the downriver section was approximately 5,404,980 L (1,428,000 gal), for an average treatment of approximately 225,208 L (59,500 gal) per well.

Groundwater elevation and conductivity were measured in downgradient monitoring wells for both the upriver and downriver injections and the following 7-day apatite reaction period. Groundwater mounding was observed in the monitoring wells during injection periods and decreased rapidly when injections stopped. The amount of mounding indicates that, while peak groundwater elevation was above the average top of screen elevations in the shallow wells, the peak groundwater elevation was not sustained for the entire reaction period. As a result, less than the target apatite mass may have formed in the shallow aquifer zone. However, the groundwater conductivity in the monitoring wells (screened in the deep aquifer zone) remained high throughout the reaction period, suggesting that the injected chemicals

remained locally within the groundwater long enough to form apatite at and below the ambient water table. Performance monitoring results reported in SGW-56970, *Performance Report for the 2011 Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit*, indicate that the injections in 2011 achieved a significant reduction in strontium-90 groundwater concentrations despite less vertical apatite placement in the shallow aquifer zone due to injecting during low river stage in September.

Performance monitoring is ongoing along the 274 m (900 ft) length of the PRBs, with groundwater samples collected twice yearly at high and low river stages. Results were reported in DOE/RL-2013-13, *Calendar Year 2012 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*, and SGW-56970. Samples from performance monitoring wells generally show 90 percent reductions in strontium-90 in groundwater for the downriver extension portion of the PRB. Performance monitoring of the upriver extension of the PRB shows approximately 80 percent or better reductions of strontium-90 in groundwater. The monitoring well with the lowest percent reduction in this portion of the PRB also has the lowest strontium-90 concentration (approximately 7 pCi/L). The monitoring well in the highest concentration portion of the barrier showed a 95 percent reduction of strontium-90 in groundwater.

These results suggest that reductions of 80 to 90 percent in strontium-90 concentrations can be achieved through the injection of apatite-forming chemicals regardless of river stage; however, injections during high river stage would likely achieve a higher (shallower) apatite placement. Monitoring during injections should continue to ensure adequate radial distribution of apatite-forming chemicals.

Infiltration Testing

In 2009, wells were installed in the vadose zone to perform infiltration tests near the PRB. The test objectives were to evaluate infiltration of an aqueous solution from near ground surface through the vadose zone, and to determine the type of monitoring equipment necessary to monitor the infiltration front. Previous water-based infiltration evaluations indicated that compaction of roadbed materials may severely limit infiltration rates along the shoreline. In this test plan, the upper 1 m (3 ft) of roadbed was excavated to eliminate roadbed compaction interference.

Laboratory experiments were conducted to determine whether the unsaturated Hanford formation is conducive to apatite formation through surface application of reagents (PNNL-18303). These two-dimensional infiltration experiments showed that the infiltration rate, concentration of the Ca-citrate-PO_4 solution, and addition of water after solution infiltration all affected apatite precipitation in the vadose zone. The study described a method to infiltrate a Ca-citrate-PO_4 solution to effectively emplace apatite by rapid Ca-citrate-PO_4 infiltration followed by slow, non-phosphate water infiltration. Furthermore, this study showed that although it is difficult to emplace apatite accurately in the vadose zone due to the infiltration-rate control required, it is possible to use this method to sequester strontium-90 in the subsurface. An additional tracer infiltration test (PNNL-20322, *100-NR-2 Apatite Treatability Test: An Update on Barrier Performance*) was conducted in 2010 and concluded that an aqueous amendment solution could be delivered to depth (i.e., the vertical extent of the vadose zone) under field test conditions. Although bench- or pilot-scale field testing of this technology did not show any detriment to its use, it was determined that apatite emplacement using surface infiltration methods would not be proposed in this RD/RAWP.

Jet Injections

In 2009, a field demonstration was completed to evaluate potential strategies for jet injection of three different media: (1) a phosphate-only solution, (2) pre-formed apatite, and (3) phosphate combined with pre-formed apatite. Three separate test plots were selected for testing the amendments (Figure 1-11).

The objective for these demonstrations was to evaluate delivery technologies and effectiveness. The injections were conducted upgradient of the existing apatite PRB within a moderate-concentration region of the strontium-90 plume. The solutions were injected into the vadose zone and the upper portion of the unconfined aquifer. Sediment cores were collected from four boreholes located within the test plot footprints. Results from collected sediment cores indicated that jet injection is a viable method for emplacing phosphate and pre-formed apatite in the vadose zone. These cores also showed that jet injection is a viable method for installing a PRB in the vadose zone at a target concentration of 3.4 mg of apatite per gram of sediment (1.1 mg phosphate/g sediment). In each of the test areas, apatite concentrations met or exceeded these values in all cases but one (i.e., borehole C7307, with phosphate and pre-formed fishbone apatite). Some vertical variability in phosphate concentrations was noted, with sediment cores showing higher phosphate concentrations in fine-grained material than in coarse-grained sediment. Phosphate concentrations were also generally higher in the shallow sediments for the test areas that used phosphate than the area using only pre-formed apatite (SGW-47062, *Treatability Test Report for Field-Scale Apatite Jet Injection Demonstration for the 100-NR-2 Operable Unit*). The details of the core analyses are provided in PNNL-19524. Laboratory analysis results from sediment core testing indicate that jet injection is a viable method for emplacing phosphate and pre-formed apatite in the vadose zone, with jet injection meeting the target apatite/phosphate concentration goals within 1 m (3 ft) of the injection point (PNNL-19524).

1.3.2.6 Other Response Actions

Interim actions also were taken to address soil contamination. As specified in the 100-NR-1 TSD interim action ROD (EPA/ROD/R10-00/120), the top 4.6 m (15 ft) of contaminated soil was removed at the 116-N-1 and 116-N-3 LWDFs and transported to the 200 Area for disposal at the Environmental Restoration Disposal Facility (ERDF). As of March 2010, approximately 522,200 tons of contaminated soil and debris had been removed from the 100-N Area. Approximately 250,000 and 154,600 tons of this material were associated with the 116-N-1 and the 116-N-3 LWDFs, respectively.

In addition to the 116-N-1 and 116-N-3 LWDFs, the Interim Action ROD (EPA/ROD/R10-99/112) identified 80 waste sites in the 100-NR-1 OU as requiring interim remedial action. Cleanup of these waste sites is being implemented in an order of priority established by the Tri-Parties. Additional waste sites have since been discovered, and when the RI/FS report for the 100-N Area (DOE/RL-2012-15, Draft A) was issued in 2013, the total number of waste sites was 136 sites. As of May 2013, 38 waste sites have been recommended for no further action, generally because they pose no unacceptable risk, 3 waste sites were recommended for ICs only, and 89 waste sites were undergoing remediation. Remediation of the remaining six waste sites will not begin until after the ROD has been signed.

1.3.3 Physical Setting

The Hanford Site encompasses approximately 1,517 km^2 (586 mi^2) in the Columbia Basin of south-central Washington State (Figure 1-1). The 100-N Area extends encompasses approximately 4 km^2 (1.6 mi^2) along the Columbia River shoreline.

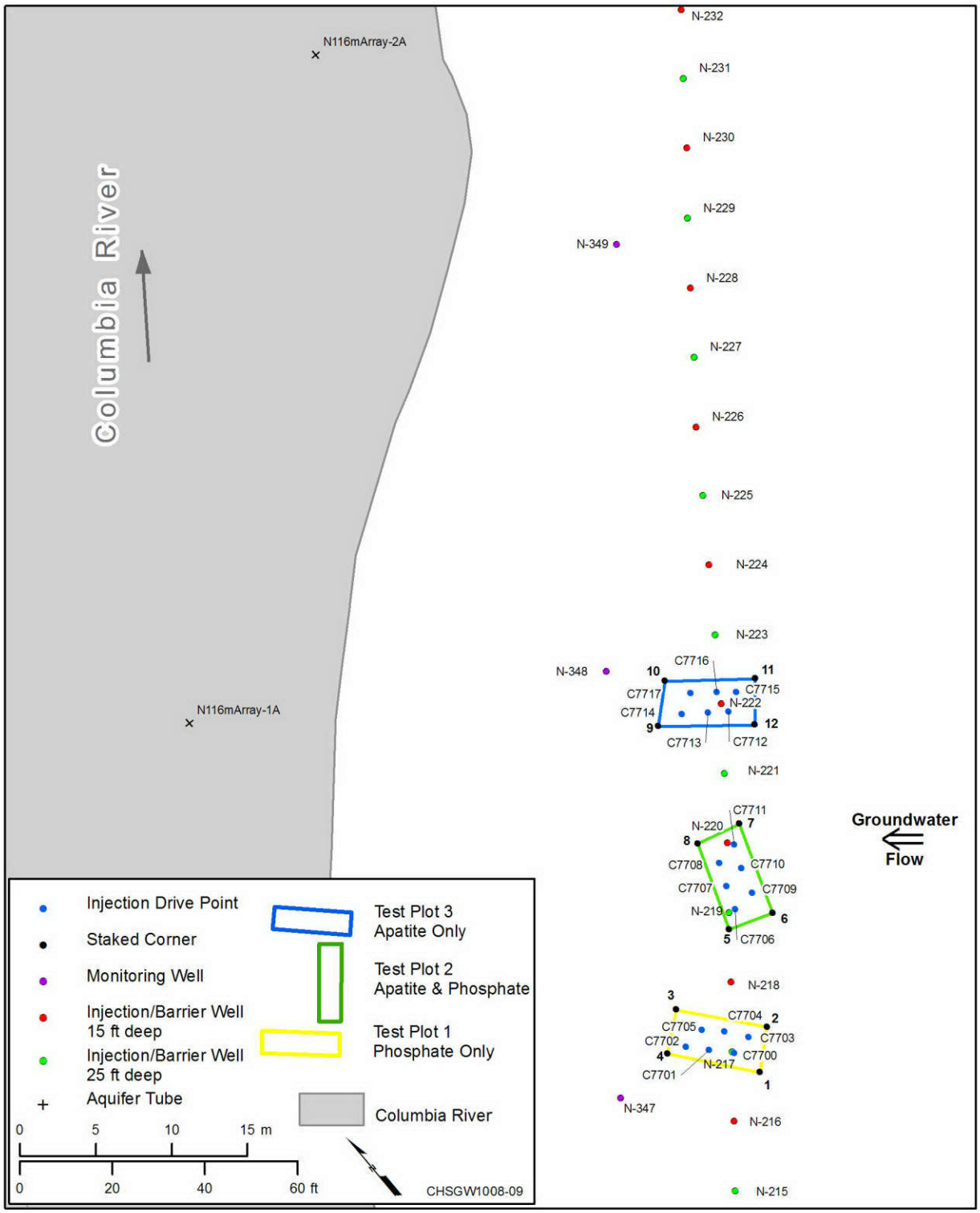

Figure 1-11. Locations of Jet Injection Test Plots

The topography in the 100-N Area is relatively gentle but marked by the presence of a steep bluff approximately 21 m (70 ft) high located along the river shoreline. The 100-N Area is also characterized by the presence of numerous small, rolling hills known as Mooli (Little Stacked Hills), which resulted from the cataclysmic flooding that occurred at the end of the Pleistocene era, approximately 10,000 years ago.

Stratigraphic units of hydrogeologic significance in the 100-N Area include the Elephant Mountain Basalt, the Ringold Formation, and the Hanford formation. As shown in Table 1-3 and Figure 1-12, the unconfined aquifer near the shoreline is composed of gravels and sands of the Ringold Formation and Hanford formation. The Ringold Formation is composed of several lithologic facies including Ringold unit E, which comprises the unconfined aquifer beneath the Hanford formation in the 100-N Area, and the underlying Ringold upper mud unit. Unit E consists of variably cemented pebble to cobble gravel, with a fine- to coarse-grained sand matrix. Sand and silt interbeds may also be present. The base of the unconfined aquifer is defined by the top of the Ringold upper mud, which is considered an aquitard rather than an impermeable unit. Unit E is approximately 5 to 20 m (16 to 66 ft) thick, and the Ringold upper mud is approximately 17 to 29 m (56 to 95 ft) thick. The uppermost stratigraphic unit in the 100-N Area is the Hanford formation, consisting of uncemented and clast-supported pebble, cobble, and boulder gravel with minor sand and silt interbeds. The matrix in the gravel is composed mostly of coarse-grained sand, and an open-framework texture is common. For most of the 100-N Area, the Hanford formation extends from ground surface to just above the water table, ranging from 6 to 23 m (20 to 75 ft) thick. Localized channels of Hanford gravels extend below the water table.

The Hanford formation is 3 to 10 times more transmissive to water than the underlying Ringold unit E. However, because of geologic heterogeneity, the hydraulic conductivity in both units is highly variable. Typical values of 15 and 182 m/d (19 and 597 ft/d) have been used for modeling purposes for the Ringold Formation and Hanford formation, respectively (HydroGeoLogic, Inc., 2001, *Strontium-90 Transport in the Near River Environment at the 100-N Area*).

Detailed hydrogeologic cross sections along the entire 762 m (2,500 ft) length of the 100-NR-2 OU PRB have been constructed based on data available from the drilling and installation of 171 injection and performance monitoring wells (SGW-47791) completed for barrier expansion and information from the existing 16 original barrier wells. The hydrogeologic cross sections are shown in Figures 1-13a through 1-13g. The expansion wells were installed systematically with alternating screen depths (in accordance with DOE/RL-2009-32) to confine future injections to intervals either within the Hanford formation (shallow screened wells) or within the deeper Ringold Formation (deeper screened wells).

The shallow and deep well designs were established primarily from the geologic Hanford/Ringold contact depth defined at the original barrier. However, based on the detailed hydrogeology assembled from the expansion borehole descriptions, it appears that the contact elevations downriver are much shallower than have been observed along the original barrier. Along the expanded barrier network, the Hanford formation is very shallow, and most of the shallow and deep well-screen pairs are actually contained in the Ringold Formation sediment. Some uncertainty remains about the elevation of the exact contact boundary due to similarities in sediment type and the gradational nature of the geologic deposits, but available data indicate that the contact is much shallower than at other locations along the river.

Groundwater flow patterns and contaminant distribution in the 100-N Area are described in several reports, including the annual Hanford Site groundwater reports (e.g., DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009 Volumes 1 & 2*). As shown in Figure 1-14, the general direction of groundwater flow in the 100-N Area is north-northwest, toward the Columbia River.

Table 1-3. Elevation and Thickness of Major Geologic Units beneath the 100-N Area

Geologic Unit	Top Elevation (m amsl)	Thickness Range (m)	Description
Hanford formation	122 to 145	6 to 23	Uncemented pebble-cobble gravel
Ringold unit E	118 to 128	5 to 20	Pebble-cobble gravel; variably cemented
Ringold upper mud	106 to 109	17 to 29	Silt and clay with minor sandy layers
Ringold unit C	80	3 to 5	Sand
Ringold paleosol (overbank interval)	75	38 to 43	Silt and sand
Ringold unit B	40	20 to 22	Sand
Ringold lower mud	10	30	Clay and silt
Ringold unit A	-20	4 to 8	Gravel
Elephant Mountain	-30	40 to 50	Basalt

Reference: WHC-SD-EN-EV-027, 1993, *Hydrogeology of 100-N Area*, *Hanford Site, Washington*; and Hanford Well Information System geologic logs.

amsl = above mean sea level

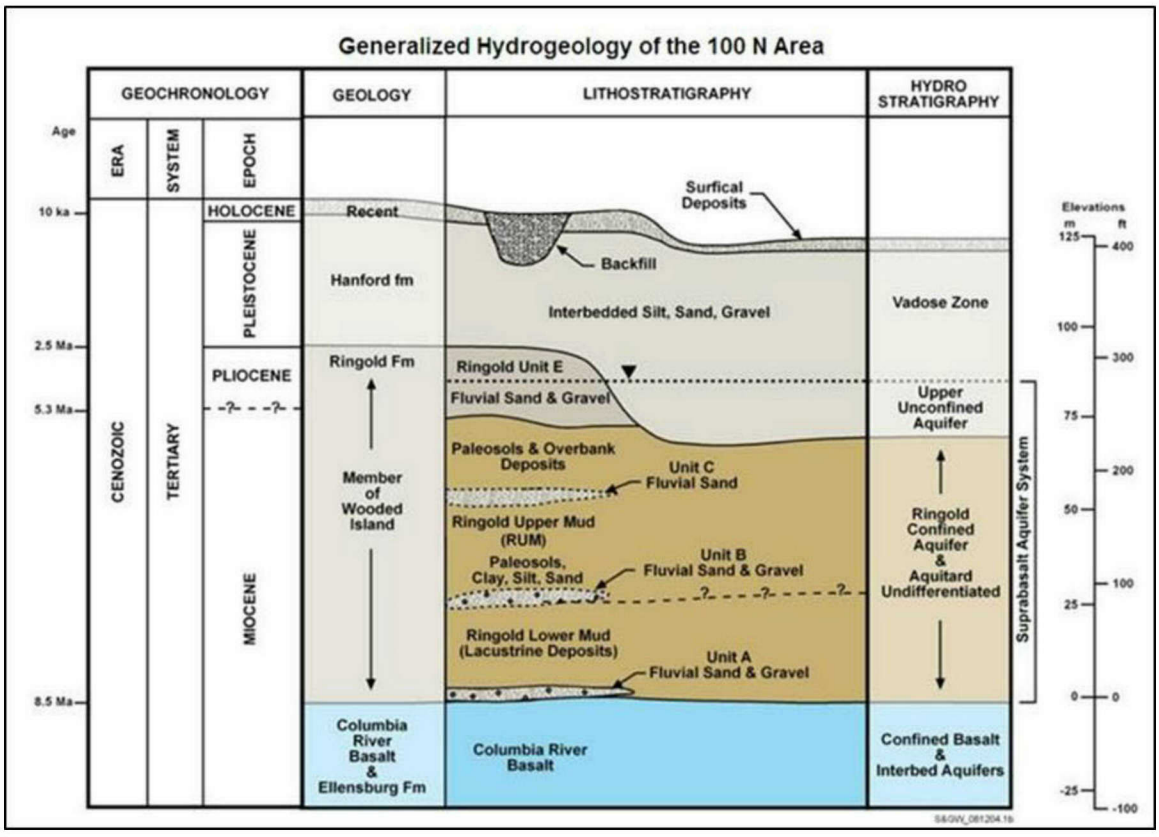

Figure 1-12. Generalized Geologic Stratigraphic Section for the 100-N Area

River-stage fluctuations along the 100-N Area shoreline influence strontium-90 flux to the river. These fluctuations, which result from hydroelectric dam operating schedules and natural seasonal variations, create groundwater elevation changes in the shoreline environment. At times, these changes reverse the hydraulic gradient, resulting in the temporary flow of water from the river to the aquifer instead of the natural flow direction where groundwater flows into the river. During high river stage, surface water moves into the river bank and exchanges with groundwater; during low river stage, the water drains back into the river. The river-stage elevation transients at the 100-N Area from 2008 through 2013 are reflected in Figure 1-15. High river stage generally falls between late April and early August, with peak stage most commonly occurring in June. The river stage typically enters the low-stage period by late August, with low river stage occurring as late as early October. The zone where surface water and groundwater mixing occurs under high river-stage conditions is located within tens of meters of the shoreline. As a result of the frequency of these gradient reversals, the volume of water that is exchanged between the river and the river bank is significantly greater than the volume of groundwater upwelling into the river as a result of the natural hydraulic gradient (DOE/RL-95-110). Historical seeps and springs and groundwater upwelling are the primary pathways for strontium-90 to enter the Columbia River.

During historical N Reactor operations, a groundwater elevation mound formed beneath the 1301-N and 1325-N LWDFs (Figure 1-5). The mound was approximately 6 m (20 ft) high and created large hydraulic gradients that increased groundwater flow rates toward the river. When N Reactor was operating, riverbank seepage was pronounced. Following shutdown of N Reactor and the LWDFs, the number of seeps and springs and their discharge volumes decreased. Since 1997, no seeps or springs have been visible along the 100-N Area shoreline where strontium-90 concentrations in groundwater are elevated (PNNL-19455, *Hanford Site Environmental Report for Calendar Year 2009*).

1.3.4 Nature and Extent of Contamination

The radionuclide- and chemical-contaminated zones underlying the 116-N-1 and 116-N-3 waste sites, which represent the primary contaminant sources for the 100-NR-2 OU, resulted from 30 years of liquid effluent discharge. Of primary concern is strontium-90 present in groundwater along the river shoreline. The Hanford formation dips into the Ringold unit E, extending below the groundwater table for approximately 305 m (1,000 ft) of shoreline at the 100-N Area. This is clearly shown on geological cross section A-A' presented in the RI/FS (DOE/RL-2012-15, Draft A) (Figure 1-16). Because the hydraulic conductivity of the Hanford formation is two to three times greater than that of the Ringold Formation, the discharge from the LWDFs funneled through this zone to the river, depositing relatively high concentrations of strontium-90 above and below the water table.

The portion of the strontium-90 groundwater plume with concentrations exceeding 8 pCi/L is estimated to be approximately 760 m (2,500 ft) wide at the river's edge (Figure 1-17) and extends inland approximately 900 m (3,000 ft). Concentrations greater than the 8 pCi/L remedial action goal (RAG) established in the Interim Action ROD (EPA/ROD/R10-99/112) occur across an estimated 58 ha (143 ac) area (DOE/RL-2010-11). The plume currently has nearly the same areal extent and shape as that observed in 1996, before startup of the 100-N Area ERA P&T system.

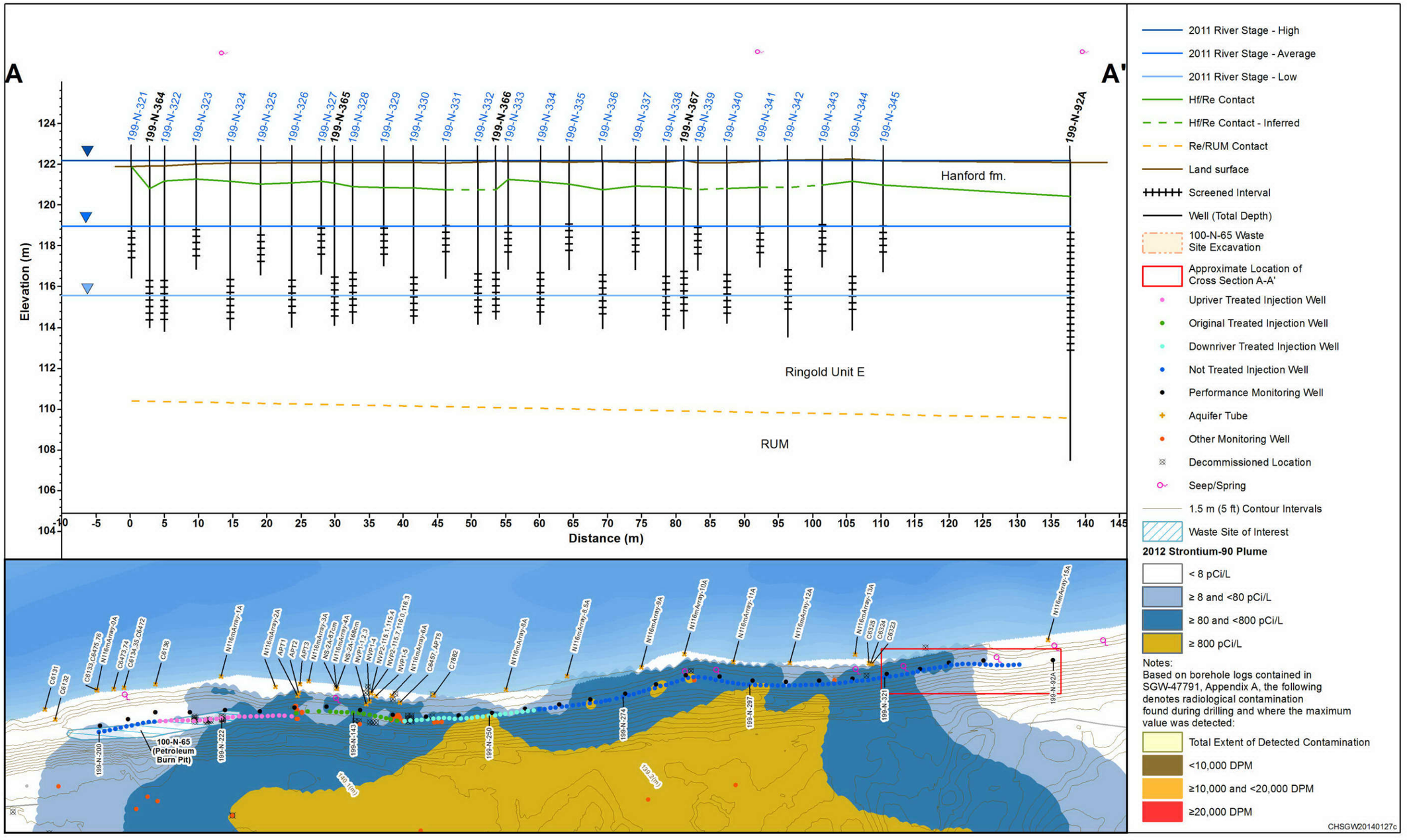

Figure 1-13a. 100-NR-2 OU PRB Cross Section A-A'

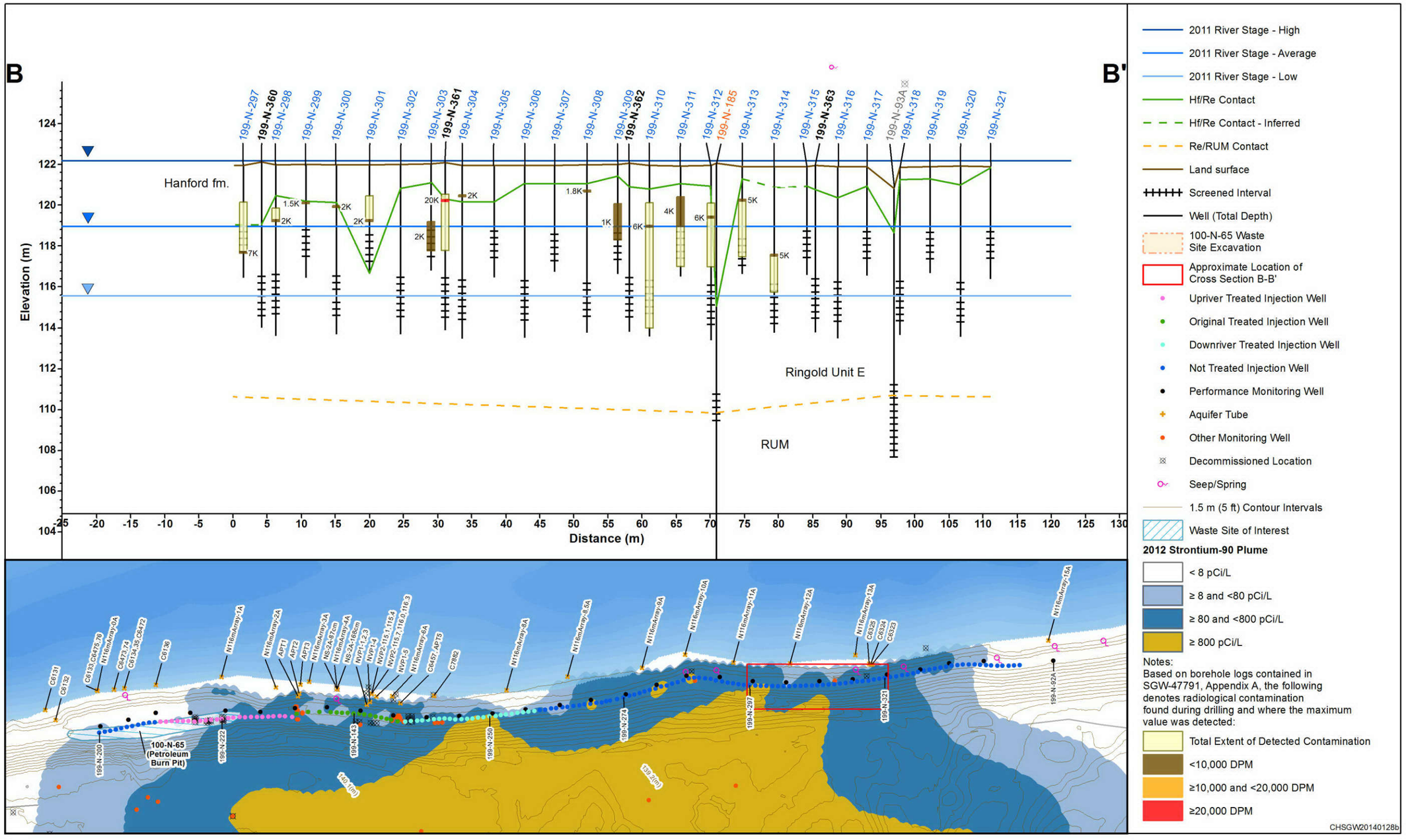

Figure 1-13b. 100-NR-2 OU PRB Cross Section B-B'

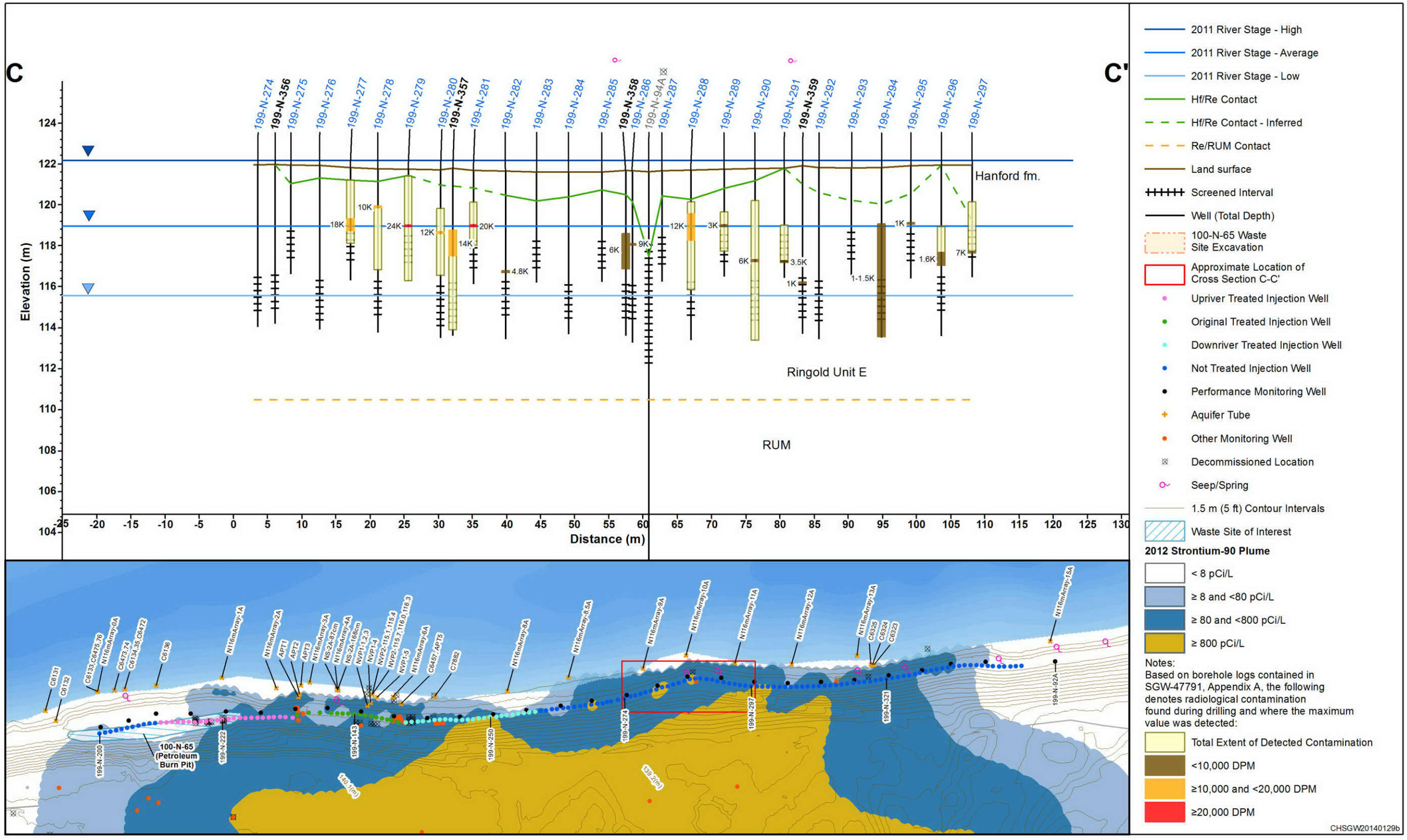

Figure 1-13c. 100-NR-2 OU PRB Cross Section C-C'

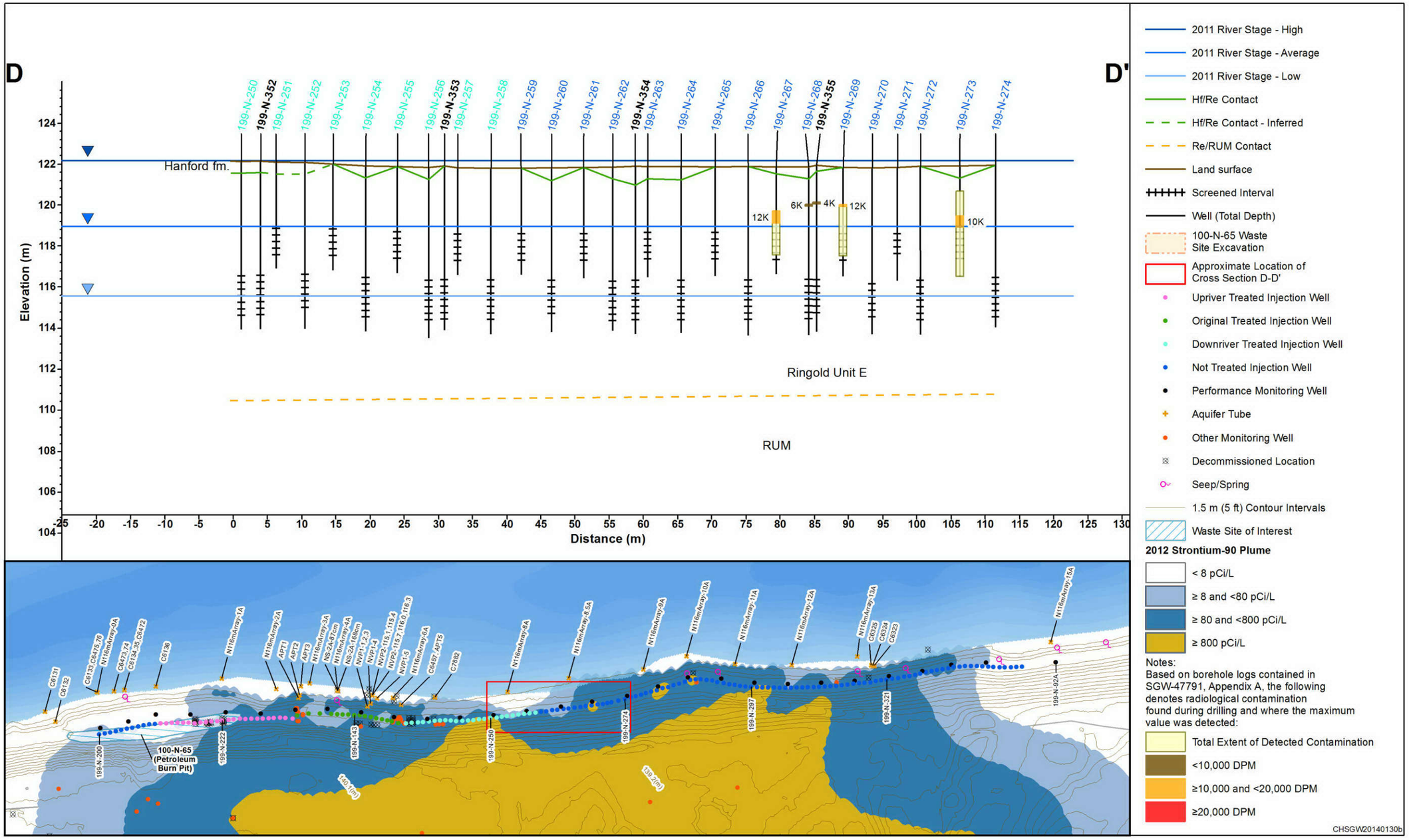

Figure 1-13d. 100-NR-2 OU PRB Cross Section D-D'

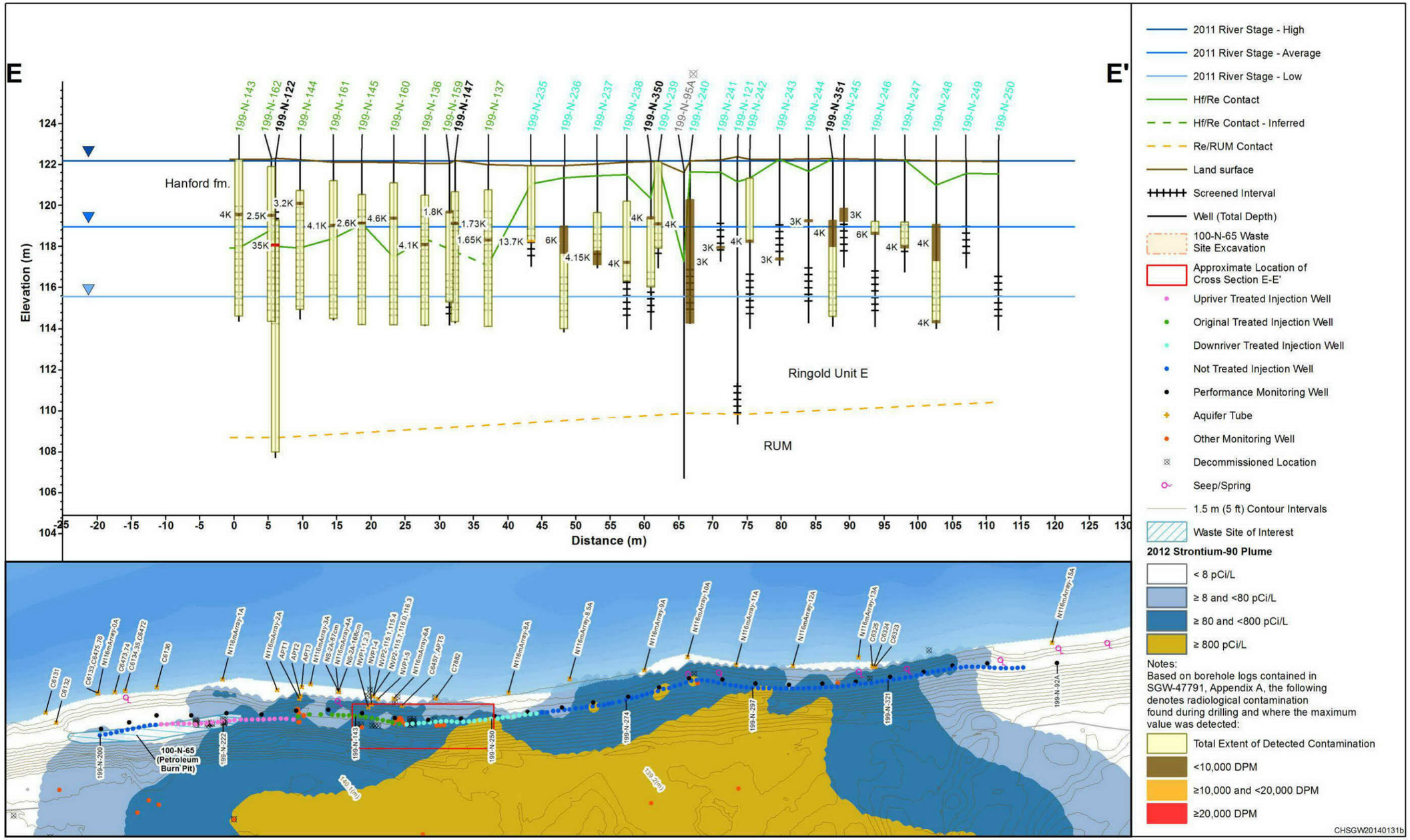

Figure 1-13e. 100-NR-2 OU PRB Cross Section E-E'

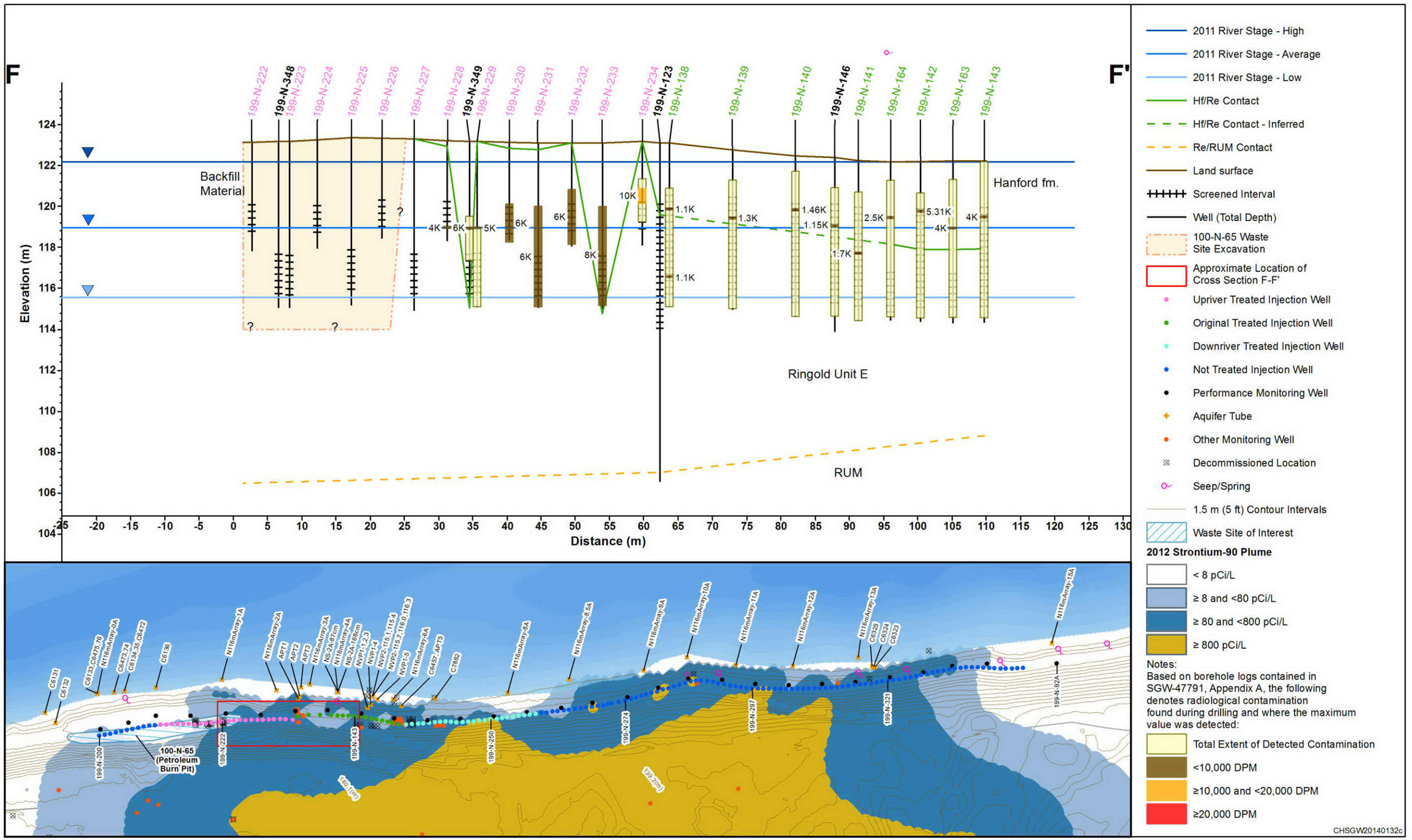

Figure 1-13f. 100-NR-2 OU PRB Cross Section F-F'

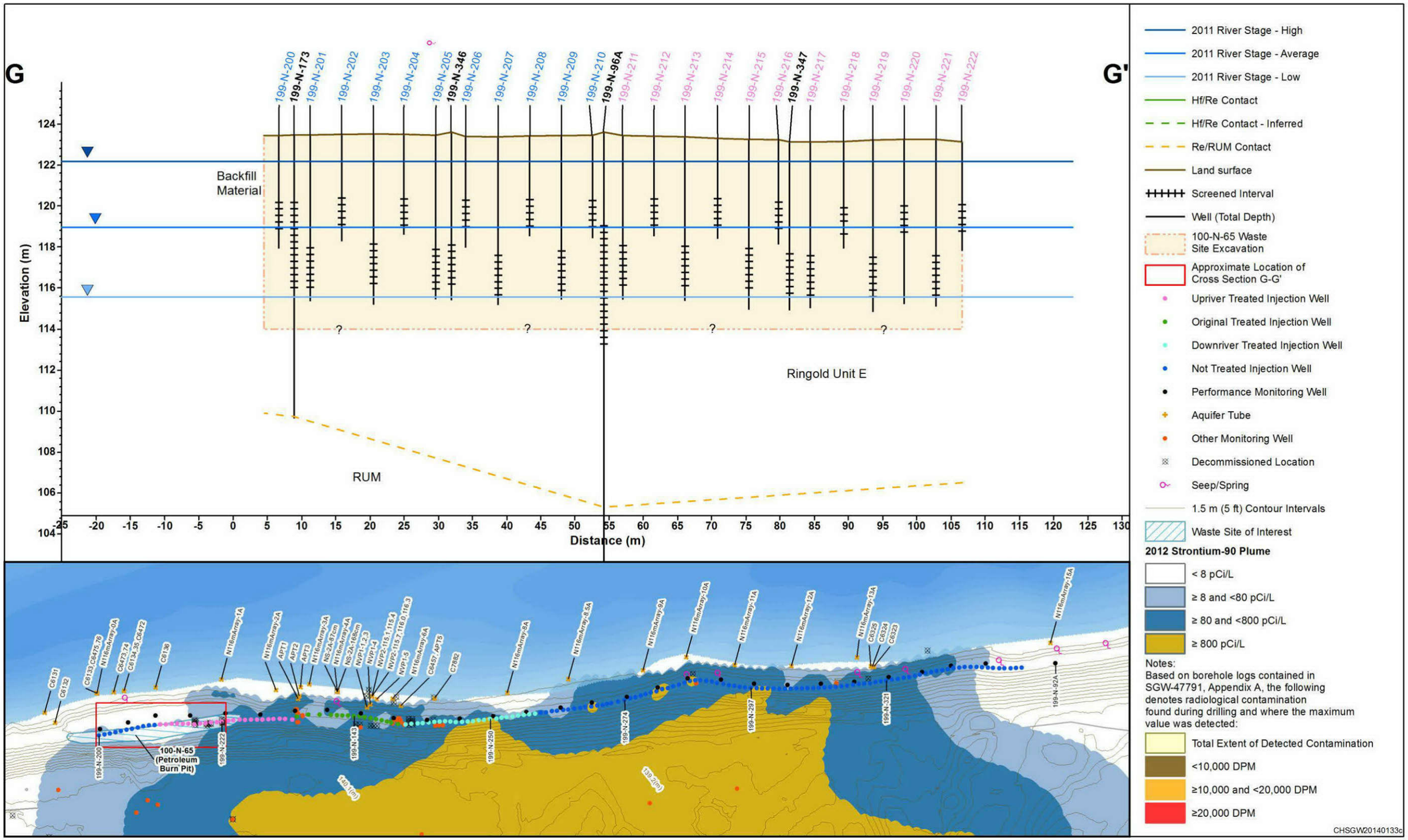

Figure 1-13g. 100-NR-2 OU PRB Cross Section G-G'

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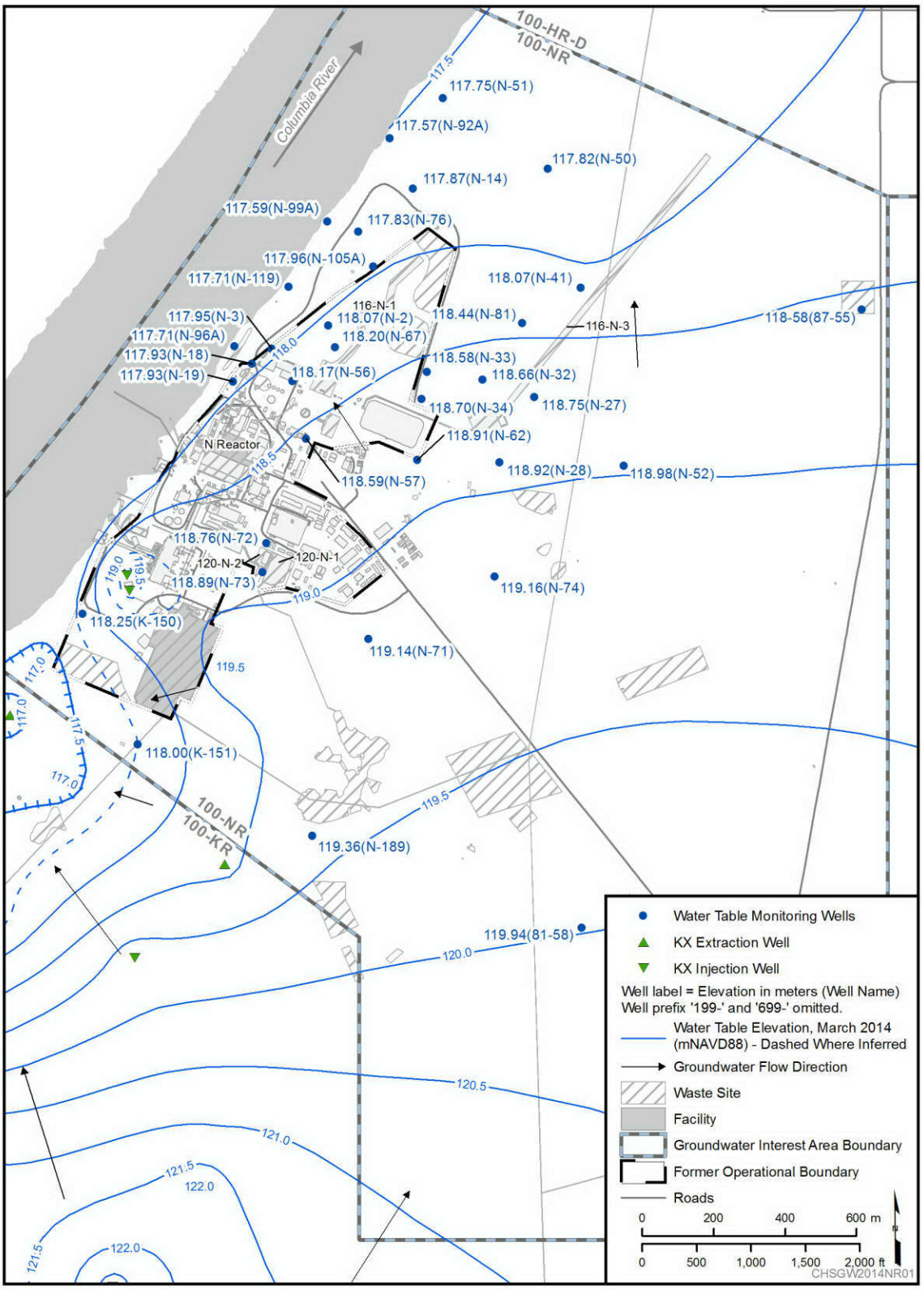


Figure 1-14. 100-N Area Water Table Map, March 2014

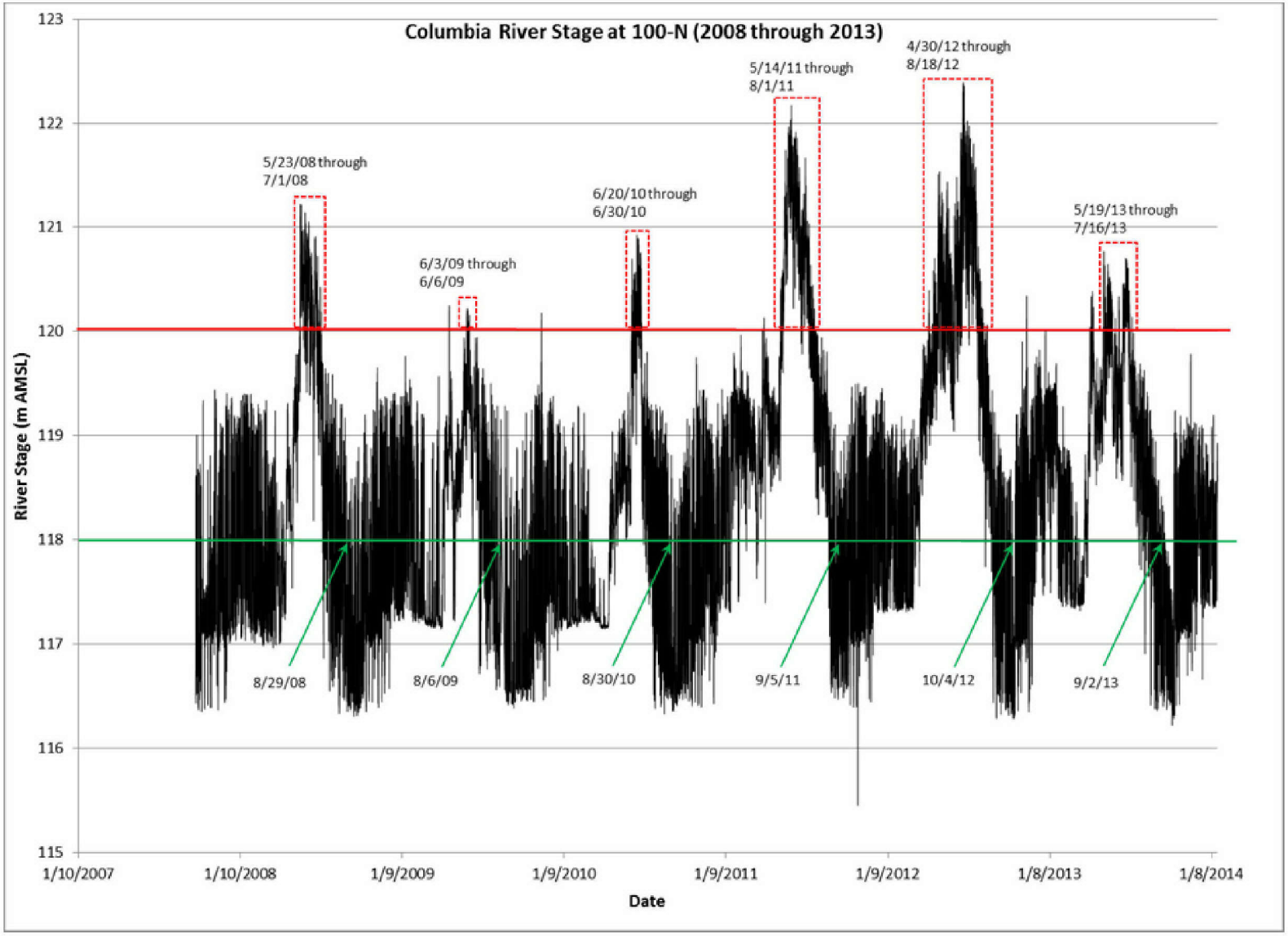


Figure 1-15. Historical Columbia River Stage Elevations at the 100-N Area Shoreline

As shown in the conceptual contaminant distribution model in Figure 1-5, the strontium-90-contaminated zone includes portions of the vadose zone that were saturated during N Reactor operations and the underlying aquifer extending from the LWDFs to the Columbia River. Using the 1995 estimates of residual strontium-90 (from Figure 1-4) and adjusting for radioactive decay, approximately 813 Ci remained in the subsurface at the 100-N Area in 2013. The majority of that inventory resides in the vadose zone (DOE/RL-2004-21). Of the 58 Ci of strontium-90 present in the aquifer, an estimated 57 Ci are sorbed to the aquifer solids and approximately 0.8 Ci is present in groundwater. Strontium-90 has a much greater affinity for sediment than for water (i.e., a high distribution coefficient), so its rate of groundwater transport to the Columbia River is considerably slower than the actual groundwater velocity. Near the LWDFs, average groundwater velocities are estimated to be between 0.03 and 0.6 m/d (0.1 and 2 ft/d), where 0.3 m/d (1 ft/d) is generally considered typical. The relative velocity of strontium-90 to groundwater is approximately 1:100 (DOE/RL-2005-96). Under these conditions, the estimated annual strontium-90 flux to the river from the 100-N Area is 0.14 to 0.19 Ci/yr (ITRD, 2001).

The majority of the strontium-90 remaining in the soil and groundwater is not expected to reach the Columbia River. As a result of its low mobility, most of the strontium-90 present in the inland portions of the 100-N Area will naturally decay before reaching groundwater and the river. With a half-life of 29.1 years, it will take approximately 300 years for the maximum concentration of strontium-90 present in the aquifer at the 100-N Area to naturally decay to a concentration less than the 8 pCi/L RAG (Figure 1-18).

Soil data have been collected from wells and borings within and around the former 1301-N and 1325-N LWDFs, as well as along the Columbia River shoreline. The majority of the strontium-90 bound to the soil in the unexcavated portion of the vadose zone underlying the former LWDFs is concentrated within a layer approximately 3 m (10 ft) thick around the current water table (Figure 1-19).

Strontium-90 concentrations in soil from wells and borings near the LWDFs show concentrations decreasing with distance from the LWDFs and with depth (PNNL-18303). The majority of the strontium-90 contamination within the LWDFs was retained within the facilities (closer to the head end of the trench and immediately below the base). The LWDFs were excavated in 2005, and the contaminated concrete and soil were removed to a depth of 4.6 m (15 ft). The excavations were backfilled in 2006 (DOE/RL-2006-76, *Calendar Year 2006 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations*).

Strontium-90 concentrations in the soil samples collected from wells and borings farther from the former LWDFs along the 100-N Area shoreline indicate that the majority of the strontium-90 in this area is located in the top of the Ringold unit E and the bottom of the Hanford formation (Figure 1-20). The water table near the Columbia River is located in the top of the Ringold Formation during low river-level conditions (July through March) but rises up into the Hanford formation when river levels rise during spring (late March to June) runoff periods. The majority of the contamination in soil along the Columbia River is in the immediate vicinity of the current apatite PRB, between wells 199-N-123 to 199-N-121 (PNNL-16894, *Investigation of the Strontium-90 Contaminant Plume along the Shoreline of the Columbia River at the 100-N Area of the Hanford Site*).

In addition to strontium-90, the following contaminants were identified as groundwater COCs for the 100-NR-2 OU in the Interim Action ROD (EPA/ROD/R10-99/112): manganese, Cr(VI), nitrate, sulfate, tritium, TPH-D, and TPH-G.

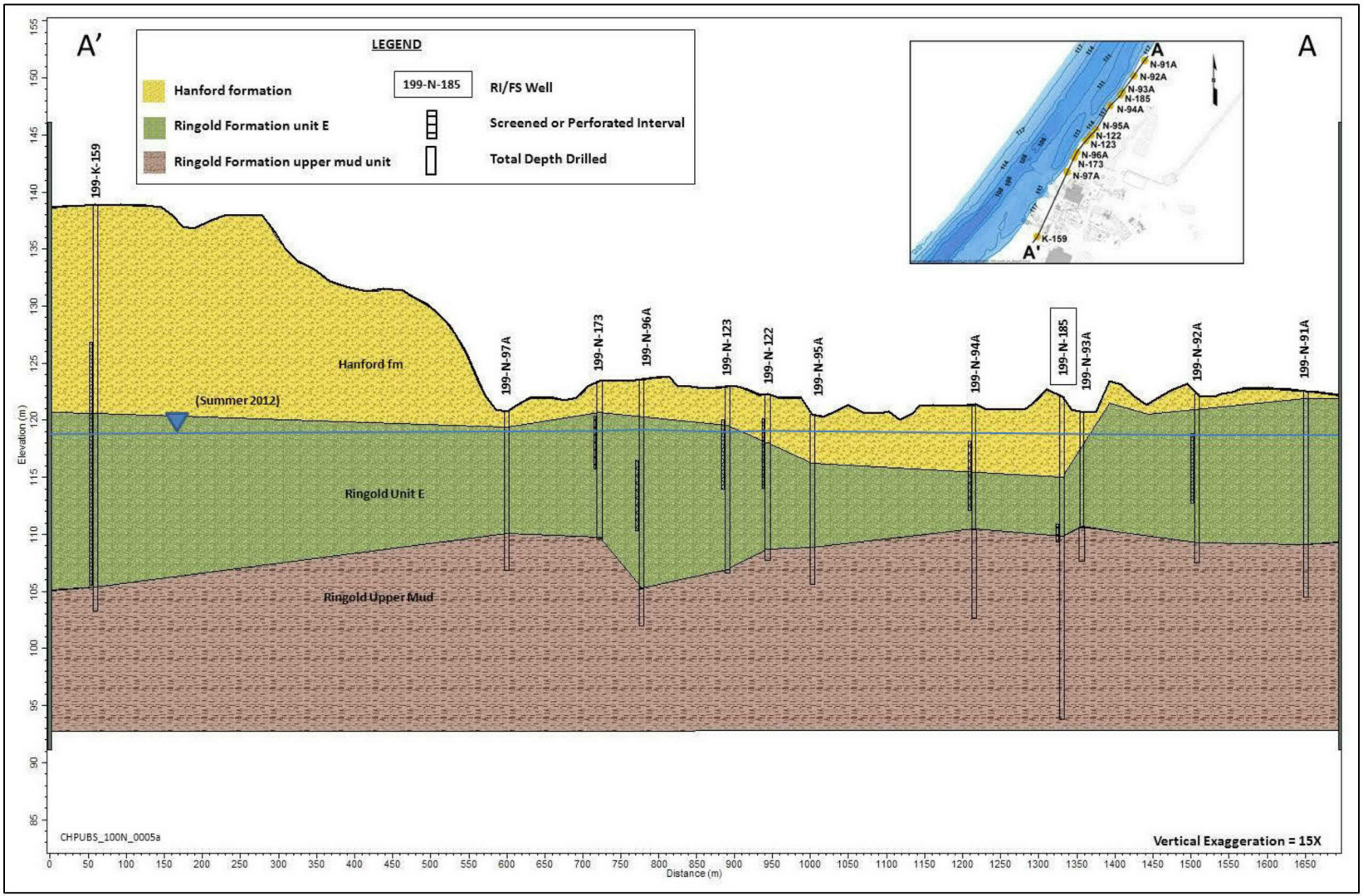


Figure 1-16. Geologic Cross-Section A-A

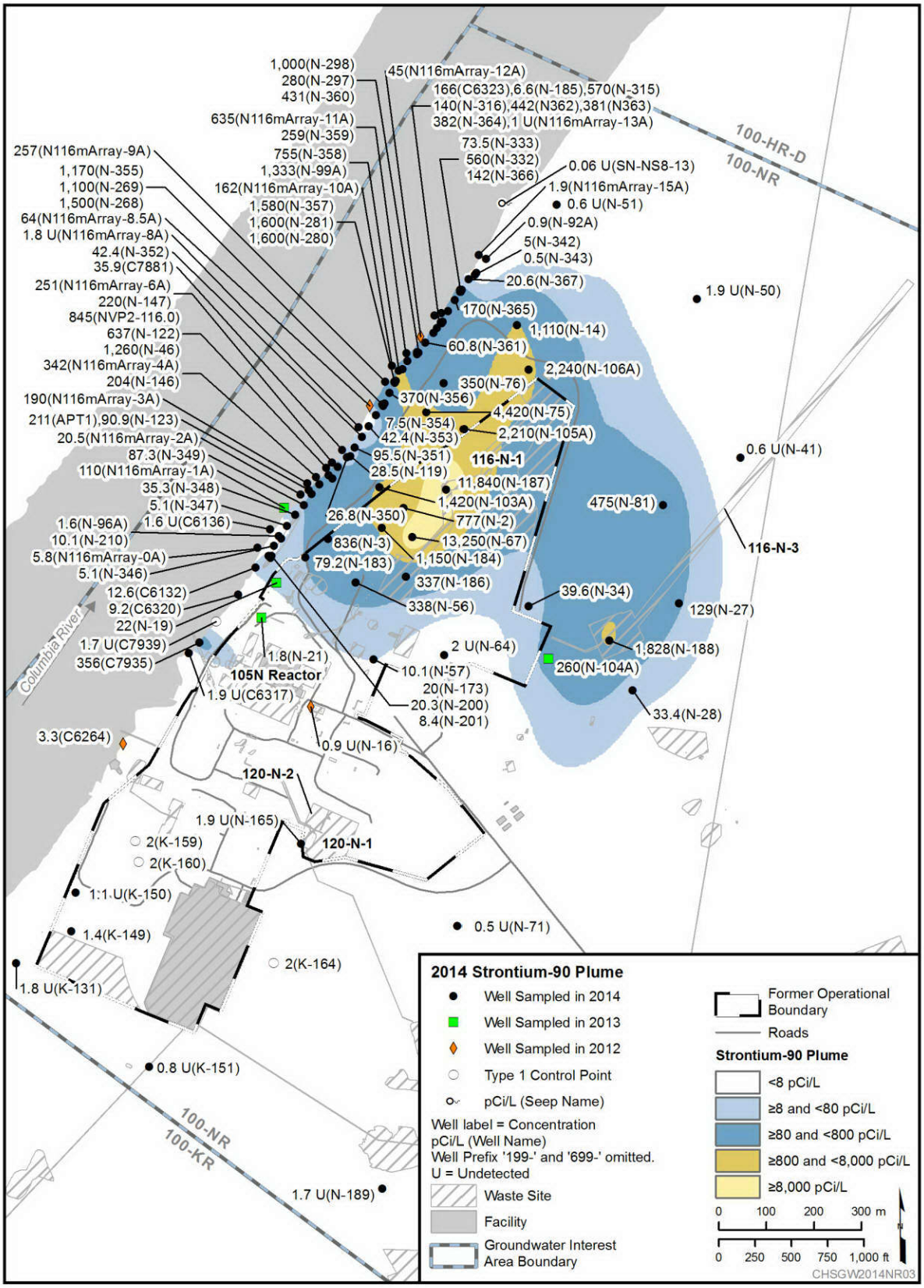


Figure 1-17. Strontium-90 Distribution in Groundwater, 2014

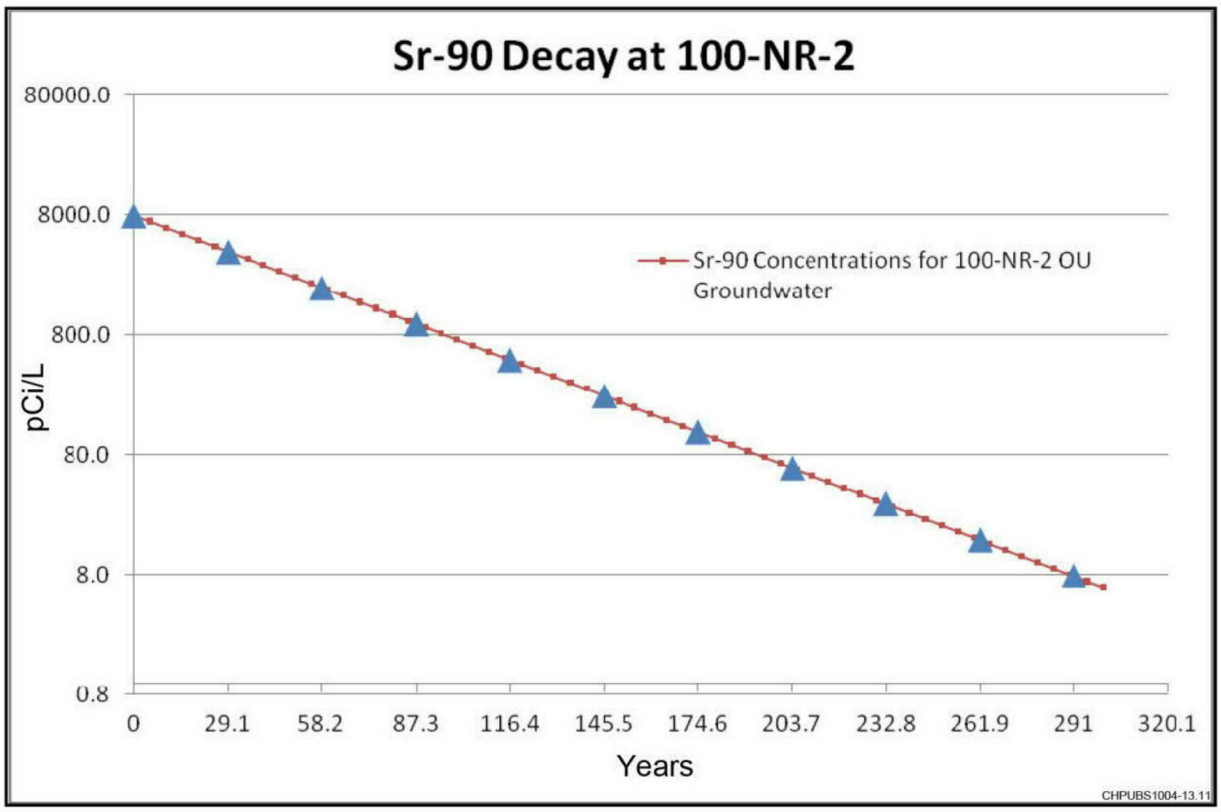
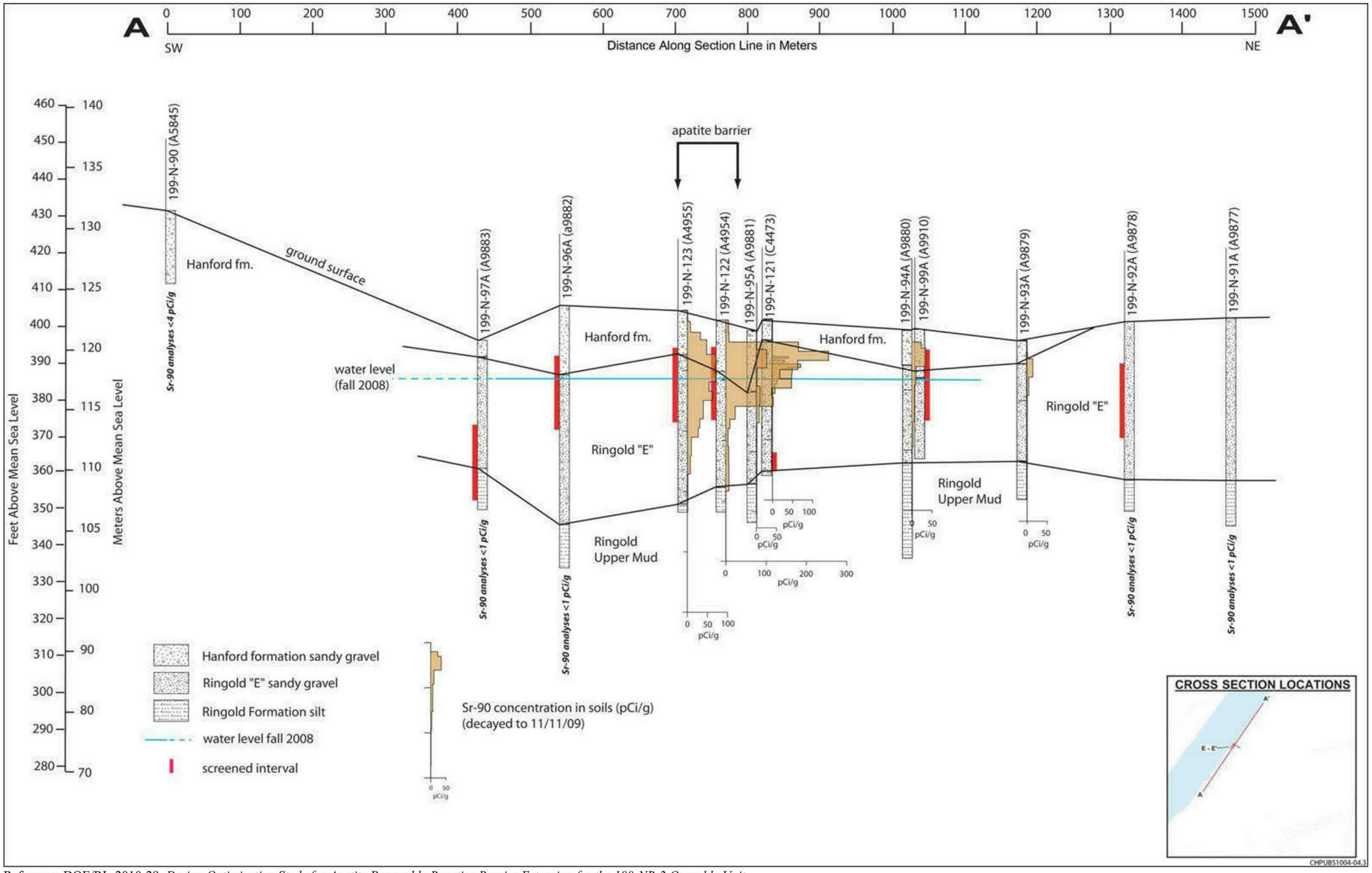


Figure 1-18. Strontium-90 Decay at the 100-NR-2 OU

Chromium has been detected in groundwater samples collected from the southwestern (upgradient) portion of the 100-NR-2 OU. Although these monitoring wells are located within the 100-NR-2 OU, they are located downgradient from the 100-KR-4 OU and reflect chromium and Cr(VI) that has migrated from this area (Figure 1-21). The 100-KR-4 OU is actively being remediated for chromium and Cr(VI) via a network of P&T groundwater extraction wells (DOE/RL-2006-75, Rev. 1, *Supplement to the 100-HR-3 and 100-KR-4 Remedial Design Report and Remedial Action Work Plan for the Expansion of the 100-KR-4 Pump and Treat System*). Since 1997, the three 100-KR-4 P&T systems have removed 660 kg of Cr(VI) from the aquifer. Additional details are provided in DOE/RL-2015-05, *Calendar Year 2014 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*, and DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*.



Reference: DOE/RL-2010-29, *Design Optimization Study for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit.*

Figure 1-19. Strontium-90 Vertical Concentration Profiles for the 100-NR-1 and 100-NR-2 OUs

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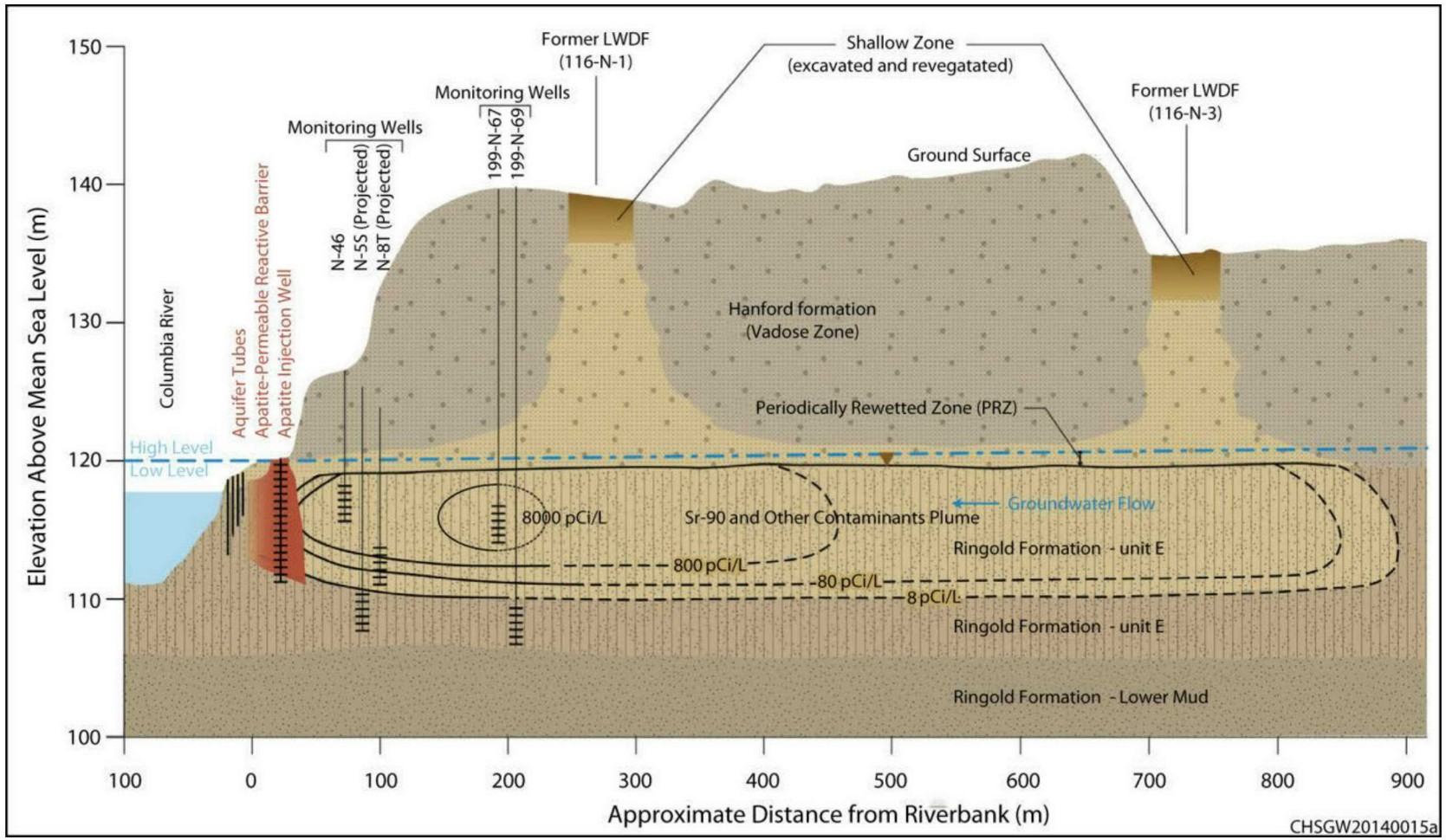

Figure 1-20. Conceptual Contaminant Distribution Model for Strontium-90 in the 100-NR-1 and 100-NR-2 OUs

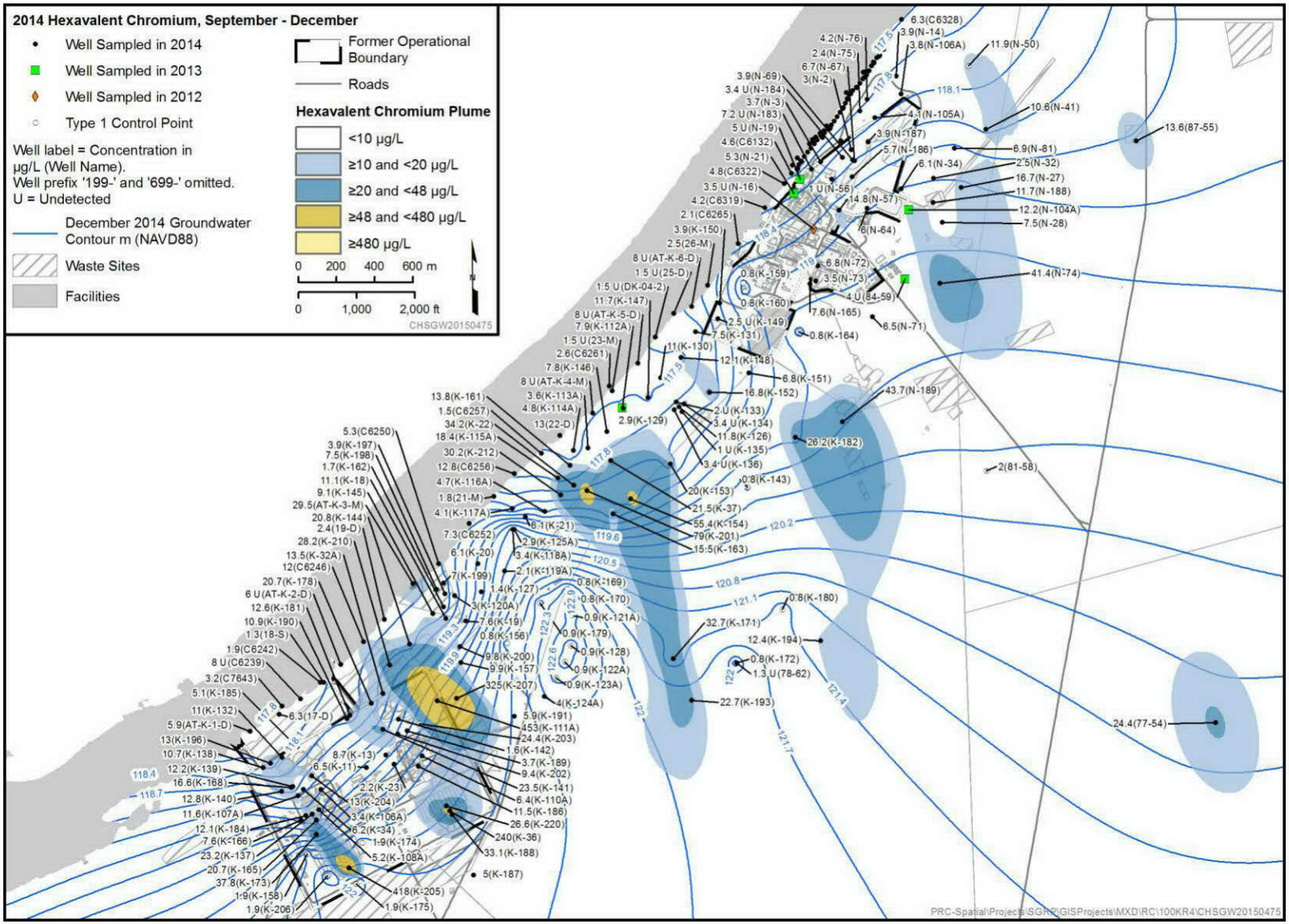

Figure 1-21. 100-KR-4 OU Cr(VI) Plume (Low River Stage), 2014

2 Basis for Remedial Action

Following evaluation of potential strontium-90 treatment technologies (presented in Section 1.3.2.5) and their applicability under 100-NR-2 OU hydrogeologic conditions, the Tri-Parties agreed that the long-term strategy for groundwater remediation at the 100-N Area should include apatite sequestration as the primary treatment technology (DOE/RL-2006-20, *The Second CERCLA Five-Year Review Report for the Hanford Site*). This agreement was based on the results of an evaluation of remedial alternatives that identified the apatite PRB technology as the approach showing the greatest promise for reducing strontium-90 flux to the Columbia River at a reasonable cost. The Interim Action ROD, as amended (EPA, 2010), replaces the strontium-90 groundwater P&T system with a subsurface PRB comprised of apatite injected into both the saturated zone and the vadose zone.

This chapter presents a brief description of the interim action remedy and presents the basis for the remedial design, including the RAOs identified in the Interim Action ROD, as amended (EPA, 2010).

The interim remedial action for the 100-NR-2 OU, described in the Interim Action ROD, as amended (EPA, 2010), is designed to meet the RAOs described in Section 2.2 and to meet the TPA (Ecology et al., 1989a) target date for Milestone M-016-110-T03 by December 31, 2016. This milestone states, "DOE shall take actions necessary to contain the strontium-90 groundwater plume at the 100-NR-2 Operable Unit such that the default ambient water quality standard (8 pCi/L) for strontium-90 is achieved in the hyporheic zone and river water column."

The major TPA (Ecology et al., 1989a) Milestone M-016-00 will also be partially fulfilled by completion of these interim remedial actions. This milestone states "Complete remedial actions for all non-tank farm and non-canyon operable units" by September 30, 2024.

Implementation of the strontium-90 remedy described in the Interim Action ROD, as amended (EPA, 2010), and this RD/RAWP will be complete before the target date. Water quality data collected during and following implementation of the remedy will be used to assess achievement of this milestone.

2.1 Remedy Selected in the Interim Action Record of Decision, as Amended

The remedy for strontium-90 was amended based on the evaluation of alternatives presented DOE/RL-2009-54 and following a review of public comments received on the Proposed Plan. The selected amended remedy for strontium-90 is described in the Interim Action ROD, as amended (EPA, 2010). The selected interim action remedy for 100-NR-2 OU groundwater in the Interim Action ROD, as amended, includes the following components:

- Extend the length of the existing apatite PRB from 90 m (300 ft) to approximately 760 m (2,500 ft) in both the saturated zone and vadose zone.
- Perform additional apatite injections at a subset of injection well locations within 5 years of completing all first-round apatite injections, as determined through performance monitoring of the PRB.
- Decommission existing 100-NR-2 groundwater P&T system components, including the treatment building, IX vessels and hardware, and aboveground conveyance pipelines.
- Allow MNA for strontium-90 in groundwater upgradient of the PRB.
- Maintain riprap along the river at the former N-Springs location to prevent exposure to elevated strontium-90 soil contamination.

- Perform groundwater monitoring for strontium-90.
- Maintain ICs for specific groundwater areas as required to protect human health and the environment (HHE) until cleanup levels are achieved.
- Perform remedy performance monitoring.
- Remove petroleum hydrocarbons from Well 199-N-18 when visible free product is present.
- Maintain the groundwater monitoring well network to monitor contaminant of potential concern (COPC) concentration changes.

Additional information on each of these remedy elements is presented in the following subsections.

2.1.1 Apatite Permeable Reactive Barrier

A PRB is a subsurface treatment zone that immobilizes or transforms target contaminants as they are transported by natural groundwater flow through a reactive media. The extended apatite PRB will be constructed in the 100-NR-2 OU by injecting apatite-forming solutions or pre-formed apatite into the subsurface in a liquid or powder form.

The reactive media, apatite, is a natural calcium phosphate mineral occurring in the earth's crust as phosphate rock. It is also a primary component in the teeth and bones of animals. Apatite minerals sequester elements into their molecular structures via isomorphic substitution, whereby elements of similar physical and chemical characteristics replace calcium, phosphate, or hydroxide in the hexagonal crystal structure. Because of the extensive substitution into the general apatite structure, more than 350 apatite minerals have been identified. Apatite minerals are very stable and practically insoluble in water. The substitution of strontium for calcium in the crystal structure is thermodynamically favorable and will proceed if the two elements coexist. Strontium substitution in natural apatites is dependent on available strontium but may be as high as 11 percent (PNNL-19572).

As described in PNNL-16891, the method of emplacing apatite in subsurface sediments at the 100-N Area involves injecting an aqueous solution containing a calcium-citrate complex and sodium phosphate. Citrate is needed to keep calcium in solution long enough (days) to migrate into the subsurface; a solution containing Ca^{2+} and phosphate only will rapidly precipitate, forming mono- and di-calcium phosphate. The relatively slow biodegradation of the calcium-citrate complex (days) allows sufficient time for injection and transport of the reagents to the areas of the aquifer where treatment is required. As calcium-citrate is degraded, the free calcium and phosphate combine to form amorphous apatite that, in a few weeks, transforms into crystalline apatite.

Apatite can remove soluble strontium and strontium-90 from groundwater both during and after its formation (PNNL-19572). Removal can occur via any of the following methods:

- **Precipitation of strontium in solution with phosphate anion:** Homogeneous nucleation generally occurs only at metals concentrations greater than 10 parts per million (ppm).
- **Adsorption to the apatite surface:** The apatite itself serves as a small but sufficient source of phosphate to solution and, with low concentrations of cations (e.g., strontium or calcium), heterogeneous nucleation occurs on the surface of the apatite seed crystal (Lower et al., 1998, "Aqueous Pb sorption by hydroxylapatite: Applications of atomic force microscopy to dissolution, nucleation and growth studies"). The precipitation reaction is nearly instantaneous on the molecular scale, and adsorption to the apatite surface is approximately 55 times stronger than to Hanford sediment.

- **Slow substitution into the apatite structure:** Initially, the precipitate formed is amorphous apatite; however, over time it transforms into a more stable apatite crystal, permanently sequestering the metals (months to years timescale).

Stable strontium and other competing cations in groundwater, especially the divalent transition metals (e.g., cadmium, zinc, iron, lead, and manganese), can also be incorporated in the apatite structure. The average concentrations of stable strontium and competing cations present in groundwater will dictate the mass of apatite needed for long-term sequestration. The effect of competing cation concentrations is to reduce the in situ apatite longevity for a given mass loading. To achieve a desired longevity (e.g., a 300-year period during which most of the strontium-90 will have decayed), the loading rate has been increased to account for the competing cation effect.

To date, apatite has been used to install a 274 m (900 ft) PRB in the saturated zone. Information and experience gained from this work have been used to optimize the injection design for the full-scale buildout of the apatite PRB to its final 760 m (2,500 ft) length (see Section 3.1.1). To complete the selected remedy, a 305 m (1,000 ft) long PRB will be installed to target the vadose zone and PRZ that provides a continuing source of strontium-90 contamination to groundwater (see Section 3.1.2).

2.1.2 Decommissioning of the Pump and Treat System

Concurrent or following extension of the apatite PRB, DOE will decommission the treatment components of the existing 100-NR-2 OU groundwater P&T system. The decommissioning work will include removing any residual IX media and disposing this material at the ERDF, dismantling all noncontact treatment system hardware and salvaging reusable components, and cutting the high-density polyethylene conveyance piping into short lengths for transportation and disposal at ERDF. Wells will remain in place and will be reconfigured for monitoring purposes. The status of the decommissioning work will be provided at unit managers' meetings, and a summary of the decommissioning work will be provided in a future Hanford Site groundwater monitoring and performance report or an interim action status report.

2.1.3 Groundwater Monitoring Program

The sampling requirements and groundwater monitoring wells and aquifer tubes comprising the 100-NR-2 OU network are listed in the 100-NR-2 Data Quality Objectives Summary Report (Appendix A, Insert A1). Long-term and routine monitoring for the 100-NR-2 OU under CERCLA are defined in Table A-10 in the SAP (Appendix A), and lists the specific constituents to be analyzed and the sampling frequency for those wells that have been selected for monitoring.

The 116-N-1 Facility is included in the Hanford Facility RCRA Permit (WA7890008967), which states that RCRA monitoring during closure activities will follow the requirements of BHI-00725, *100-N Pilot Project Proposed Consolidated Groundwater Monitoring Program*. The plan and a subsequent supplemental plan (PNNL-13914, *Groundwater Monitoring Plan for the 1301-N, 1324-N/NA, and 1325-N RCRA Facilities*) were used to define sampling that was performed to satisfy RCRA requirements. These same plans were also used for the three remaining TSD units in the 100-N Area (116-N-3, 120-N-1, and 120-N-2).

2.1.4 Monitored Natural Attenuation

MNA is another important component of the selected remedy for strontium-90. MNA is the reliance on natural processes, within the context of a carefully controlled and monitored cleanup, to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in affected media. MNA will play an important role in upland groundwater remediation of strontium-90 (radioactive decay and sorption to aquifer materials). Because strontium-90 is strongly retarded and has a relatively short half-life, the majority of the strontium-90 present in the aquifer and associated sediments upgradient of the apatite

PRB will attenuate in place through radioactive decay. MNA will be used to monitor this plume and confirm that strontium-90 concentrations decline as expected, and it will also be used to monitor and confirm the rate of natural degradation. Monitoring of the MNA will be conducted in accordance with the well network and schedule outlined in the Interim Action ROD (EPA/ROD/R10-99/112). Long-term monitoring results will be presented in future Hanford Site groundwater monitoring and performance reports.

2.1.5 Free-Phase Petroleum Hydrocarbon Removal

The 1999 Interim Action ROD (EPA/ROD/R10-99/112) requires the remediation of free-phase hydrocarbon product observed in any 100-N Area monitoring well. This element of the interim action currently consists of removing free product (diesel) from Well 199-N-18. If observed in other wells in the future, this remedy would also apply. The passive remediation approach involves the use of a polymer (Smart Sponge) that selectively absorbs petroleum product from the surface of water. Every 2 months, two sponges are lowered to the surface of the water table in Well 199-N-18. The sponges are weighed before emplacement in the well and after removal from the well, and the difference in weight between the two measurements is the amount of product or diesel fuel contamination removed from the well. Volumetric statuses of removed petroleum will be provided at unit managers' meetings. (Note that groundwater monitoring is no longer conducted at Well 199-N-18; however, monitoring Well 199-N-183 has been installed nearby for groundwater sampling.) The historical volumetric status of removed petroleum from Well 199-N-18 through 2013 is provided in Table 2-1 (DOE/RL-2014-25, *Calendar Year 2013 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation Operations*).

2.1.6 Institutional Controls

The remedy selected in the Interim Action ROD (EPA/ROD/R10-99/112) requires the maintenance of ICs. The following ICs are required as part of the Interim Action ROD, as amended (EPA, 2010):

- DOE will continue to use a badging program and control access to the sites associated with the Interim Action ROD for the duration of the interim action. Visitors entering any of the sites associated with the Interim Action ROD are required to be escorted at all times.
- DOE will use the onsite excavation permit process to control land use, well drilling, and excavation of soil within the 100 Area OUs to prohibit any drilling or excavation, except as approved by Ecology.
- DOE will maintain existing signs prohibiting public access.
- Trespass incidents will be reported to the Benton County Sheriff's Office for investigation and evaluation for possible prosecution.
- DOE will notify Ecology upon discovery of any trespass incidents.
- DOE will take the necessary precautions to add access restriction language to any land transfer, sale, or lease of property that the U.S. Government considers appropriate while ICs are compulsory, and Ecology will have to approve any access restrictions before transfer, sale, or lease.
- Until final remedy selection, DOE shall not delete or terminate any IC requirement established in the Interim Action ROD unless Ecology has provided written concurrence on the deletion or termination, and appropriate documentation has been placed in the Administrative Record.

Table 2-1. Amount of Product Removed from Well 199-N-18

Year	Product Removed (g)	Notes
2003[a]	~1,200[b]	Estimate provided per information provided in table note; data records lost when original work package was lost in the field.
2004	3,475	Changed out twice per month.
2005	780	Changed approximately every 2 months.
2006	1,370	Changed every 2 months.
2007	1,294	Changed every 2 months.
2008	920	Changed every 2 months.
2009	1,380	Changed approximately every 2 months.
2010	225.5	Changed only twice prior to June 2010; Smart Sponge broke apart in well. No removal for the second half of 2010.
2011	500	Changed every 2 months.
2012	600	Changed in January, April, June, and August 2012.
2013	750	Changed in January, March, May, July, September, and November 2013.
Total		**12,494.5 g (approximately 12.5 kg) removed through the end of 2013**[c]

a. DOE/RL-2004-21, *Calendar Year 2003 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit (OU) Pump & Treat Operations*, reports that product removal started in October 2003.

b. DOE/RL-2005-18, *Calendar Year 2004 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations*, states that the average mass removal for fiscal year 2004 (October 2003 through October 2004) was approximately 0.4 kg/month; therefore, an estimate is provided for the 3 months missing in 2003.

c. DOE/RL-2014-25, *Calendar Year 2013 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations*.

DOE will evaluate the implementation and effectiveness of ICs for the 100-NR-1 and 100-NR-2 OUs annually. DOE shall submit a report to Ecology by July 31 of each year summarizing the results of the evaluation for the preceding calendar year. At a minimum, the report shall contain an evaluation of whether the IC requirements continue to be met, a description of any deficiencies discovered, and measures taken to correct problems. All ICs relevant to this remedial design are included in DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions*.

2.1.7 Riprap Cover Maintenance

DOE will maintain the existing riprap cover that was placed over the historical groundwater seeps and springs along the shoreline. Maintenance will consist of periodic visual monitoring of the riprap cover along the shoreline and replacement of any cover material that is eroded. Any maintenance performed will be described in future annual Hanford Site groundwater monitoring and performance reports.

2.1.8 Lower Road Surface

The lower road surface shall be maintained, which will consist of periodic visual monitoring of the road, especially after heavy rain storms. Any cover material that is eroded will be repaired. In areas susceptible to erosion, diversions may be installed.

2.2 Remedial Action Objectives

RAOs are narrative statements that define the extent to which the OU requires cleanup to protect HHE. The Interim Action ROD (EPA/ROD/R10-99/112) specifically defines four RAOs:

- **RAO #1:** Protect the Columbia River from adverse impacts from the 100-NR-2 groundwater so designated beneficial uses of the Columbia River are maintained. Protect associated potential human and ecological receptors using the river from exposure to radioactive and nonradioactive contaminants present in the unconfined aquifer. Protection will be achieved by limiting exposure pathways, reducing or removing contaminant sources, controlling groundwater movement, or reducing concentrations of contaminants in the unconfined aquifer.
- **RAO #2:** Protect the unconfined aquifer by implementing remedial actions that reduce concentrations of radioactive and nonradioactive contaminants present in the unconfined aquifer.
- **RAO #3:** Obtain information to evaluate technologies for strontium-90 removal and evaluate ecological receptor impacts from contaminated groundwater.[6]
- **RAO #4:** Prevent destruction of sensitive wildlife habitat. Minimize the disruption of cultural resources and wildlife habitat in general and prevent adverse impacts to cultural resources and threatened or endangered species.

2.3 Remedial Action Goals

RAGs are contaminant-specific numerical cleanup criteria developed to ensure that remedial actions meet the RAOs set forth in the Interim Action ROD, as amended (EPA, 2010).

Based on results presented in DOE/RL-95-111, the *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units*, the Interim Action ROD (EPA/ROD/R10-99/112) concluded that no groundwater COCs exceeded ecological remedial action goals based on EPA and Ecology's ambient

[6] Note that this RAO was achieved with the issuance of FH-0403540 and DOE/RL-2006-26.

water quality criteria (AWQC) for protection of freshwater aquatic life. No federal or Washington State AWQC standard has been established for strontium-90; therefore, the Tri-Parties agreed to adopt the 8 pCi/L federal DWS as the RAG for strontium-90 in surface water.

2.4 Applicable or Relevant and Appropriate Requirement Compliance

This section discusses the applicable or relevant and appropriate requirements (ARARs) identified in the 1999 Interim Action ROD (EPA/ROD/R10-99/112). The Interim Action ROD includes a combined list of ARARs for surface waste sites (100-NR-1 OU) and for groundwater (100-NR-2 OU). Some of the ARARs listed are primarily applicable to the surface waste sites within the 100-NR-1 OU and do not necessarily apply to the groundwater interim remedial actions.

The National Contingency Plan (NCP) (40 CFR 300) requires that remedial actions comply with federal and state ARARs, as established in the Interim Action ROD, as amended (EPA, 2010). All activities associated with the remedial actions covered under the Interim Action ROD (EPA/ROD/R10-99/112) will take place onsite, as defined in the NCP (40 CFR 300). Therefore, the remedial actions need only meet the substantive requirements of the ARARs established in the Interim Action ROD.

As detailed planning documents are prepared for the interim remedial action in the Interim Action ROD, as amended (EPA, 2010), compliance with ARARs will be evaluated. This section may be revised as necessary to incorporate any new activities that are subject to the ARARs. If a new ARAR (e.g., under WAC 173-340, "Model Toxics Control Act—Cleanup" [MTCA]) is promulgated, the requirement will be reviewed by DOE to determine if the interim remedial action is still protective based on the new requirement. This determination will be documented by the Tri-Parties in the Administrative Record.

2.4.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs are typically health- or risk-based numerical regulatory values or methodologies applied to site-specific media and are used to establish cleanup criteria. The chemical-specific ARARs identified in the Interim Action ROD (EPA/ROD/R10-99/112) are as follows:

- RCW 70.105D, "Hazardous Waste Cleanup -- Model Toxics Control Act;" and WAC 173-340
- *Safe Drinking Water Act of 1974*; 40 CFR 141, "National Primary Drinking Water Regulations;" and 40 CFR 143, "National Secondary Drinking Water Regulations"
- *Federal Water Pollution Control Act of 1977*; and 40 CFR 131, "Water Quality Standards"
- WAC 173-201A, "Water Quality Standards for Surface Waters of the State of Washington"

An interim action waiver for some of these ARARs was granted for the P&T system on the basis that the interim action will be followed by a final action that will meet all ARARs. The Interim Action ROD (EPA/ROD/R10-99/112) states:

> *This interim action ROD hereby grants a waiver to the following regulations: (1) Safe Drinking Water Act of 1974 (SDWA) (40 U.S.C. 300, et seq.), "National Primary Drinking Water Regulations" (40 Code of Federal Regulations [CFR] 141) due to the treated groundwater that will be re-injected into the aquifer may/will exceed the drinking water standard or maximum contaminant level of 8 picocuries/liter (pCi/L) for Sr-90, based on system design, as well as 20,000 pCi/L for tritium, and 45 milligrams/liter (mg/L) for nitrate; and (2) WAC 173-218, "Underground Injection Regulation" due to the treated groundwater may exceed the drinking water standard or maximum*

contaminant level for Sr-90, tritium, and nitrate. Although this interim remedial action is designed primarily for Sr-90, a waiver is still necessary for tritium and nitrates based on the co-existence of the contaminants in the groundwater.

Currently, there are no promulgated DWSs for apatite-forming minerals (calcium citrate and sodium phosphate).

Washington State's MTCA (WAC 173-340) regulation establishes numerical concentration values and methodologies used for deriving cleanup goals. The regulation includes requirements that cleanup of, and residual contamination remaining in, an onsite medium (e.g., soils and groundwater) does not affect other media, either onsite or offsite (WAC 173-340-700(4)(b) and (7)(h), "Overview of Cleanup Standards"). These requirements were considered in the cleanup criteria for the selected interim remedial action. In addition to the cleanup criteria contained in MTCA (WAC 173-340), the *Federal Water Pollution Control Act*, and WAC 173-201A define the criteria that must be met to demonstrate that the contaminated groundwater from the 100-NR-2 OU or contamination desorbed from the vadose zone during high river stage is not affecting the Columbia River. Implementation of the selected interim 100-NR-2 OU remedial actions will help achieve chemical-specific ARARs for strontium-90 and TPH-D in groundwater and surface water at the 100-N Area.

2.4.2 Action-Specific Applicable or Relevant and Appropriate Requirements

Action-specific ARARs typically are technology- or activity-based regulatory requirements or limitations triggered by a particular action (e.g., well drilling or waste handling).

Activities associated with the 100-NR-2 OU interim remedial action that generate waste will comply with the substantive requirements in the action-specific waste management ARARs identified in this section and in the Interim Action ROD (EPA/ROD/R10-99/112). The primary waste that will be produced during the 100-NR-2 OU amended interim remedial action is waste material associated with decommissioning of the P&T system, unused apatite-forming chemicals and pre-formed apatite, drill cuttings, purgewater and pore water, sample residuals, and miscellaneous nonhazardous solid waste. The Interim Action ROD provides the necessary regulatory authority to dispose this material at ERDF after it has been treated (as necessary) in accordance with WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*. WCH-191 specifies application of the waste management ARARs for any waste disposed at ERDF, including the following:

- WAC 173-340, "Model Toxics Control Act—Cleanup"
- RCW 70.105, "Hazardous Waste Management;" and WAC 173-303, "Dangerous Waste Regulations"
- 40 CFR 268, "Land Disposal Restrictions"
- 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart X, "Miscellaneous Units"
- RCW 70.95, "Solid Waste Management—Reduction and Recycling;" and WAC 173-304, "Minimum Functional Standards for Solid Waste Handling"
- *Toxic Substances Control Act of 1976*, implemented via 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions"
- 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
- WAC 173-216, "State Waste Discharge Permit Program"

- WAC 173-218, "Underground Injection Control Program"

WAC 173-216 is a substantive (nonpermitting) requirement applicable to remedial activities that result in any liquid discharge to the ground, including requirements for all known available and reasonable methods of prevention, control, treatment, and discharge limits. Routine liquid discharges to the ground surface are not anticipated as part of the amended interim remedial action. However, discharge of unused apatite-forming minerals and pre-formed apatite may occur as a supplement to vadose zone emplacement. Discharges to the groundwater are addressed in WAC 173-218.

WAC 173-218 is a substantive (nonpermitting) requirement applicable to remedial alternatives that discharge liquid through wells that may endanger groundwater of the state. Apatite-forming chemicals will be injected into the aquifer as part of the amended interim remedial action. These chemicals will react to form solid-phase apatite. Some residual chemicals may migrate beyond the treatment zone. The effects of unreacted chemicals (transported to the river by groundwater) on threatened and endangered species are summarized in Section 1.3.2.3. An exemption to this ARAR was granted in the Interim Action ROD (EPA/ROD/R10-99/112) to provide for reinjection of treated groundwater with strontium-90 concentrations above the 8 pCi/L DWS. A continuation of this exemption is necessary to provide for injection of apatite-forming solutions.

The following action-specific ARARs are also listed in the Interim Action ROD (EPA/ROD/R10-99/112):

- *Clean Air Act of 1977*; and 40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants"
- RCW 70.94, "Washington Clean Air Act;" and WAC 173-400, "General Regulations for Air Pollution Sources"
- WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides"
- RCW 70.98, "Nuclear Energy and Radiation;" and WAC 246-247, "Radiation Protection-Air Emissions"
- WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

The radionuclide air emission standards (40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities;" WAC 173-480; and WAC 246-247) apply to the selected interim remedial action. Particulates and dust created by drilling and soil boring could cause radioactive and nonradioactive emissions. WAC 173-400 establishes the requirements for emissions of nonradioactive air pollutants.

Standards for the construction, operation, and decommissioning of resource protection (i.e., monitoring and injection) wells are specified in WAC 173-160. WAC 173-160-460, "What Is the Decommissioning Process for Resource Protection Wells?" identifies the decommissioning process for monitoring and treatment wells, as well as soil borings. All new wells required under the interim remedial action will be constructed and decommissioned in accordance with these standards.

2.4.3 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs are restrictions placed on hazardous substance concentrations or remedial actions based on the specific location of the substance or action. The location-specific ARARs established in the Interim Action ROD (EPA/ROD/R10-99/112) include the following:

- *Archeological and Historical Preservation Act of 1974* (implemented via 36 CFR 65, "National Historic Landmarks Program")
- *Archeological Resources Protection Act of 1979* (implemented via 43 CFR 7, "Protection of Archaeological Resources")
- *National Historic Preservation Act of 1966* (NHPA) (implemented via 36 CFR 800, "Protection of Historic Properties")
- *Migratory Bird Treaty Act of 1918* (not specifically identified in the Interim Action ROD ARARs listing)
- *Endangered Species Act of 1973* (implemented via 50 CFR 17, "Endangered and Threatened Wildlife and Plants;" 50 CFR 22, "Eagle Permits;" 50 CFR 25, "Administrative Provisions;" 50 CFR 226, "Designated Critical Habitat;" 50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1973, as Amended;" and 50 CFR 424, "Listing Endangered and Threatened Species and Designating Critical Habitat")
- RCW 77.12.655, "Powers and Duties," "Habitat Buffer Zone for Bald Eagle—Rules" (implemented via WAC 232-12-292, "Permanent Regulations," "Bald Eagle Protection Rules")
- *The Hanford Reach Study Act*

The *Archeological and Historic Preservation Act of 1974* applies when remedial activities may cause irreparable harm, loss, or destruction of significant artifacts in the 100-N Area. The *Archeological and Historic Preservation Act of 1974* requires that remedial actions at the source area sites do not cause the loss of archaeological or historical data and that any archaeological or historical data must be preserved. If any archaeological or historical artifacts are encountered during implementation of the interim remedial action, the appropriate authorities will be notified and the artifacts will be preserved in accordance with DOE/RL-98-10, *Hanford Cultural Resources Management Plan*.

The *Archeological Resources Protection Act of 1979* applies when remedial activities may cause possible harm or destruction of 100-N Area sites having religious or cultural significance. If any archaeological or historical artifacts are encountered during implementation of the interim remedial action, the appropriate authorities will be notified and the artifacts will be preserved in accordance with DOE/RL-98-10.

The NHPA requires that agencies undertaking projects must evaluate impacts to properties listed, or eligible for inclusion, on the National Register of Historic Places. Consideration of historically significant properties will be evaluated if the interim remedial action needs to be extended beyond the currently defined alignment.

The *Migratory Bird Treaty Act of 1918* was implemented in the 1916 Convention between the United States and Great Britain (for Canada) for the protection of migratory birds. Later amendments implemented treaties between the United States and Mexico, the United States and Japan, and the United States and the Soviet Union (now Russia). Public Law 95-616 also ratified a treaty with the Soviet Union, specifying that both nations will protect ecosystems of special importance to migratory birds against pollution, detrimental alterations, and other environmental degradations. Implementation of the selected interim remedial action is not expected to affect migratory bird ecosystems. (While not specifically identified in the Interim Action ROD ARARs listing, it is discussed in the Interim Action ROD [EPA/ROD/R10-99/112].)

The *Endangered Species Act of 1973* requires that federal agencies consult with the Department of the Interior, National Marine Fisheries Service, and other appropriate agencies to ensure that actions authorized, funded, or implemented do not jeopardize the continued existence of endangered or threatened species or adversely affect their critical habitat. Because several listed and candidate endangered or threatened species have been identified in and around the Hanford Site, the interim remedial action described in this document will be managed so these species will not be jeopardized or have their habitat adversely affected.

RCW 77.12.655 and WAC 232-12-292 are applicable if the areas of remedial activities include bald eagle habitat. The interim remedial action will comply with this ARAR.

The Hanford Reach Study Act is applicable to remedial activities that could result in any direct and adverse impacts to the Columbia River. Consultation with the U.S. National Park Service is required if the river is impacted. The interim remedial action is designed to protect the Columbia River from any adverse impacts, therefore achieving compliance with this ARAR.

2.4.4 Other Criteria, Advisories, or Guidance to Be Considered

Information to be considered generally consists of federal, state, and local criteria, advisories, and proposed standards that are not legally binding (i.e., are not promulgated regulations) but that may be useful in establishing cleanup goals or remedial alternatives that are protective of HHE. The information to be considered was identified in the Interim Action ROD (EPA/ROD/R10-99/112) and includes the following:

- **ERDF waste acceptance criteria:** Waste acceptance criteria (e.g., concentration limits and waste form limitations) have been developed for ERDF (WCH-191). The ERDF waste acceptance criteria provide the primary requirements that must be met for waste to be accepted for disposal at ERDF. The criteria also cite specific regulations to direct the user to the level of detail necessary for criteria implementation.

- **Drummond, 1992, *The Future for Hanford: Uses and Cleanup, the Final Report of the Hanford Future Site Uses Working Group*:** Provides stakeholder input on potential future uses of the 100 Areas.

Other documents that were not identified in the Interim Action ROD (EPA/ROD/R10-99/112) at the time but might be considered now include the following:

- **DOE/EIS-0222-F, *Final Hanford Comprehensive Land Use Plan Environmental Impact Statement*:** DOE/EIS-0222-F evaluates the potential environmental impacts associated with implementing a comprehensive land-use plan for the Hanford Site for at least the next 50 years. With the exception of the required no action alternative, each of the six alternatives presented represents a Tribal, federal, state, or local agencies preferred alternative. DOE's preferred alternative anticipates multiple uses of the Hanford Site, including consolidating waste management operations in the Central Plateau, allowing industrial development in the eastern and southern portions of the Hanford Site, increasing recreational access to the Columbia River, and expanding the Saddle Mountain National Wildlife Refuge to include all of the Wahluke Slope and Fitzner-Eberhardt Arid Lands Ecology Reserve (managed by the U.S. Fish and Wildlife Service [USFWS]). In DOE/EIS-0222-SA-01, *Supplement Analysis: Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, DOE found no significant new circumstances or changes relevant to environmental concerns that affect the comprehensive land-use plan. DOE concluded that using the regulatory processes in place at the Hanford Site under the framework of the TPA (Ecology et al.,

1989a) is an acceptable way to make ensure that land use is being implemented consistently with the comprehensive land-use plan.

- ***Hanford Reach National Monument: Final Comprehensive Conservation Plan and Environmental Impact Statement Adams, Benton, Grant and Franklin Counties, Washington*** **(USFWS, 2008):** The Hanford Reach National Monument (HRNM) comprehensive conservation plan (CCP) provides direction to the USFWS and DOE on the management of the HRNM for the next 15 years (through the year 2023). The CCP provided the framework for making decisions on conserving natural, cultural, and recreational resources; managing visitor use; developing facilities; and addressing day-to-day operations of the HRNM. The CCP will ensure that future opportunities are realized and problems are effectively addressed.

3 Remedial Design Approach

This chapter provides remedial design information and a description of the remedial action activities necessary to support implementation of the selected remedy. The remedial design and remedial actions required by the Interim Action ROD, as amended (EPA, 2010), are necessary to reduce the flux of strontium-90 to the Columbia River.

3.1 Conceptual Design Approach

The injection design for the design optimization study (DOE/RL-2010-29), with additional specifications to ensure target apatite emplacement as learned from the 2011 barrier expansion (SGW-56970), will be used for the final buildout of the 760 m (2,500 ft) PRB discussed in Section 3.1.1.

Based on the results from treatability tests (SGW-47062), DOE/RL-2010-68, *Jet Injection Design Optimization Study for 100-NR-2 Groundwater Operable Unit*, was developed. DOE/RL-2010-68 includes a detailed design for the vertical extension of the PRB into the unsaturated vadose zone. This document is used for the design basis for the 305 m (1,000 ft) vadose zone PRB discussed in Section 3.1.2.

Access to the apatite PRB deployment construction zone will be provided by the existing ramp and gravel access road that parallels the Columbia River. Construction activities will be limited by the width of the road bench, which in some areas is only 5 m (15 ft). It is assumed that no modifications are needed to permit truck and equipment access to the construction area. Injection equipment has been built to support the injections for aqueous emplacement of the additional lengths of the apatite barrier upstream and downstream of the existing barrier.

The effectiveness of the apatite PRB will be assessed based on its ability to reduce strontium-90 concentrations. Strontium-90 concentrations downgradient of the apatite PRB are expected to decrease over time as strontium-90 is incorporated into the apatite structure. The apatite PRB technology is expected to be an important component of the final remedy to address strontium-90 in groundwater in the 100-N Area. Operating procedures and field instructions will be prepared for conducting field activities. Operational sampling and performance monitoring protocols are specified in the SAP (Appendix A, Insert A2).

The following subsections present conceptual design information for deployment of the apatite PRB design in the saturated and vadose zones.

3.1.1 Saturated Zone Permeable Reactive Barrier

The saturated zone PRB addresses the upper unconfined aquifer along the shoreline and the near-shore area capillary fringe in the 100-NR-2 OU. As of October 2011, the PRB was completed to 274 m (900 ft). The approximate elevations of the groundwater PRB are shown in Figure 3-1. The following discussion describes well construction, injection design, and operational and performance monitoring for the final buildout of the PRB to approximately 760 m (2,500 ft).

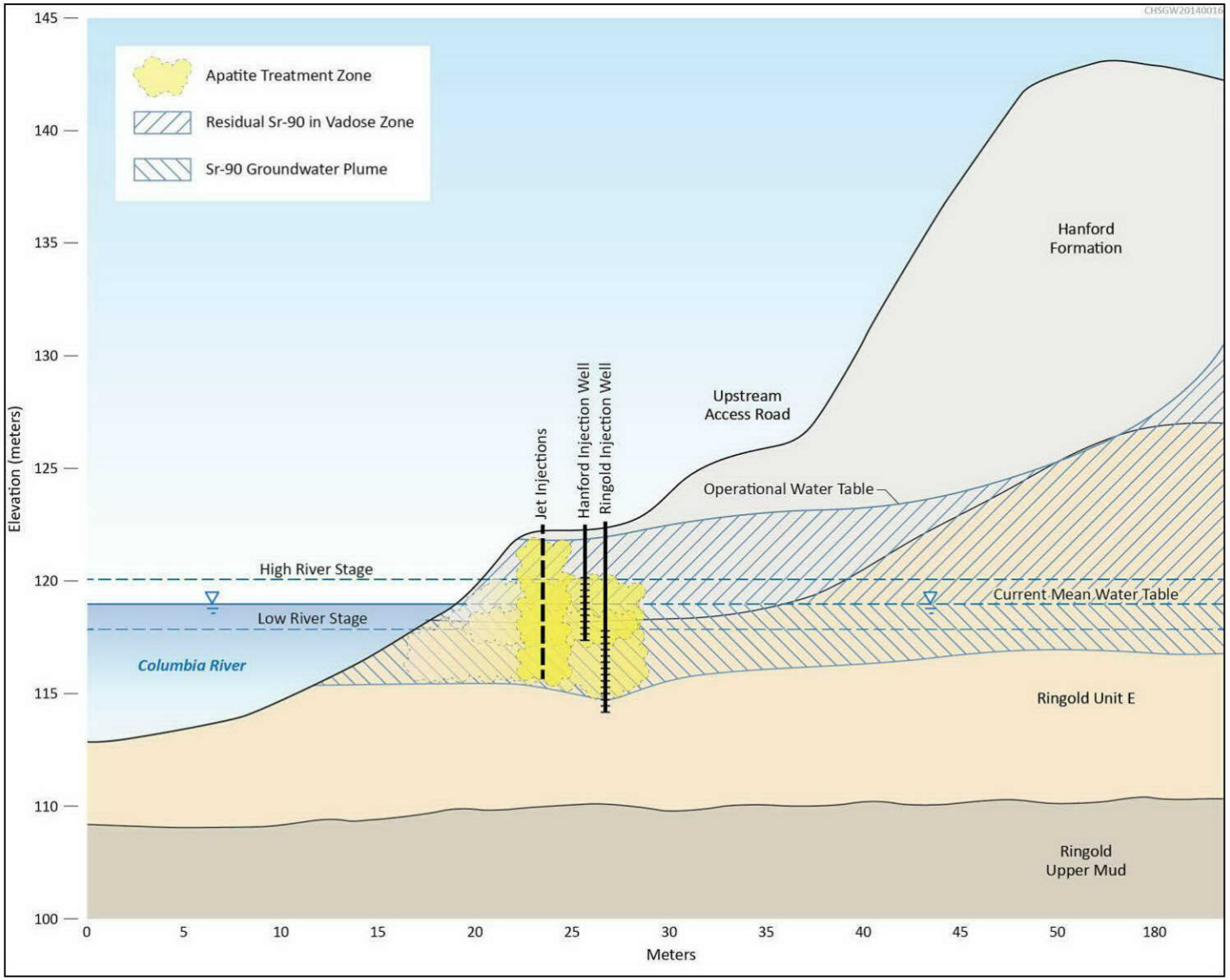

Figure 3-1. Apatite Treatment Zones for Saturated Zone PRB and Vadose Zone Jet Injections

3.1.1.1 Well Construction

In accordance with the DOE/RL-2009-32, a total of 25 monitoring wells and 146 multipurpose (injection) wells were installed upriver and downriver of the original 91.4 m (300 ft) PRB at 4.6 m (15 ft) intervals in late 2009 and early 2010. The extensions cover the entire 762 m (2,500 ft) where the strontium-90 plume intersects the Columbia River along the 100-N Area shoreline. The multipurpose wells were generally installed along the shore road or on the uphill side of the road in line with the existing injection/barrier wells, to the extent that topography and other existing wells allowed. Monitoring wells were installed between the injection/barrier wells and the Columbia River approximately every 26 m (85 ft). The field activities and the field-generated records from well drilling and construction are summarized in SGW-47791.

The design of the PRB wells alternates between wells screened in deep and shallow aquifer zones, with the typical shallow screened interval from 3 to 4.5 m (10 to 15 ft) below ground surface (bgs), and the typical deep screened interval from 5 to 7.3 m (17 to 24 ft) bgs. The monitoring wells are also screened from 5 to 7.3 m (17 to 25 ft) bgs. The intention of the design was to screen the deeper wells in the Ringold Formation to target strontium-90 in the saturated sediments at and just below the ambient water table. All wells were drilled with a 25 cm (10 in.) diameter temporary casing to allow construction of a 15 cm (6 in.) diameter well. Table 3-1 presents general construction details for the apatite PRB deployment wells. Typical well construction drawings for shallow multipurpose wells, deep multipurpose wells, and monitoring wells are shown on Figures 3-2, 3-3, and 3-4, respectively. Additional details on the borehole drilling and well construction are presented in SGW-47791.

The shallow wells were designed to be screened in the Hanford formation to build the apatite barrier in the partially saturated interval, which occurs during high water levels. Based on the updated hydrogeologic cross sections along the 100-NR-2 OU PRB (Figures 1-13a through 1-13g), the groundwater table fluctuates predominately in the Ringold Formation, and the majority of the expansion wells (shallow and deep) are screened within the Ringold Formation. However, the alternating deep and shallow screened well design for the new wells is still applicable, regardless of the Hanford/Ringold contact, because the design captures the key saturated interval containing the strontium-90 contamination. As constructed, the deeper screened wells treat the Ringold Formation at and just below the ambient water table elevation, and the shallow screened wells treat the shallower, partially to fully saturated interval that occurs during high water levels. Studies and characterization data indicate that most of the relatively immobile strontium-90 contamination occurs within a vertical interval that bounds the ambient water table (approximately 118 m [387 ft] amsl). As determined by previous investigations, data from soil borings collected along the riverbank indicated that strontium-90 concentrations in soil reach a maximum near the mean water table elevation and then decrease with depth (PNNL–SA-70033). As a result, the alternating well screen placement (Figures 3-5 through 3-9) adequately bounds the region of water table fluctuation and the most likely interval of strontium-90 contamination in groundwater, and it is suitable for treating the strontium-90 plume moving toward the Columbia River.

In 2011, a total of 48 multipurpose wells were injected with high-concentration Ca-citrate-PO_4 solution to extend the barrier from 90 to 274 m (300 to 900 ft). Ninety-eight multipurpose wells remain to be injected to complete the PRB. Figures 3-5 through 3-9 show the entire length of the saturated zone PRB, beginning from the upriver segment that was injected in 2011 (Figure 3-5), an additional portion of the upriver segment yet to be injected (Figure 3-5), the original 90 m (300 ft) barrier (Figure 3-6), the portion of the downriver segment injected in 2011 (Figure 3-7), and the downriver segments yet to be injected (Figures 3-8 and 3-9).

Table 3-1. Typical Multipurpose Well Construction Details

Well Type	Total Number of New Wells	Planned Drill Depth (ft bgs)[a]	Static Water Level at Completion (ft bgs)[a]	Screen Length (ft)	Screen Placement (ft bgs)	Filter Pack Interval (ft bgs)[b]	Bentonite Pellet Interval (ft bgs)	Bentonite Crumbles Interval (ft bgs)	Cement Seal Interval (ft bgs)
Shallow multipurpose (Hanford)	73	15	N/A to 15.6	5	10 to 15	9 to 15	7 to 9	5 to 7	0 to 5
Deep multipurpose (Ringold)	73	25	11.7 to 22.7	7	17 to 24	16 to 25	13 to 16	10 to 13	0 to10
Monitoring well	25	25	12.5 to 19.6	7	17 to 24	15 to 27	12 to 16	7 to 12	0 to 8

Note: All wells have 15 cm (6 in.) diameter polyvinyl chloride casing and screen. Drill depth, screened interval, and bentonite seal intervals vary slightly depending on location-specific conditions.

a. SGW-47791, *Borehole Summary for the Installation of One Hundred and Seventy One Wells at 100-NR-2 Operable Unit, FY 2009-2010*.

b. Filter pack interval to consist of 6- to 9-mesh Colorado silica sand or equivalent.

bgs = below ground surface

N/A = not applicable

WELL SUMMARY SHEET

Start Date: 11/23/09
Finish Date: 11/23/09
Page 1 of 1

Well ID: C7293	Well Name: 199-N-234
Location: 15' NE of 199-N-233	Project: 100-NR-2 171 Wells
Prepared By: Troy Stevens Date: 12/31/09	Reviewed By: L. D. Walker Date: 3/30/10
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
8-in Flush Mount Well Head	
Portland Cement : 1.0 - 4.7 ft	
Granular Bentonite Seal: 4.7 - 6.3 ft	
Bentonite Chips : 6.3 - 8.8 ft	
6-in I.D. PVC, Schedule 80 Permanent Casing: 0.0 - 9.37 ft	
6-in I.D. PVC, 60 Slot Screen (.060-in): 9.37 - 14.37 ft	
Primary Filter pack 6-9 Mesh Colorado Silica Sand: 8.8 - 16.8 ft	
6-in I.D. PVC Endcap: 14.37 - 14.82 ft	
All depths are in feet below ground surface.	
Borehole drilled with 10 3/4-in threaded casing: 0.0 - 16.8 ft	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0 - 6' Sandy Gravel (sG)
5		6 - 8' Gravel (G)
		8 - 16.8' Sandy Gravel (sG)
10		
15		16.8' Total Depth Drilled (11/23/2009)
		Static Water level N/A (11/23/2009)
20		
25		
30		
35		
40		

Figure 3-2. Typical Shallow Multipurpose Well Construction

WELL SUMMARY SHEET

Start Date: 11/19/09
Finish Date: 11/19/09
Page 1 of 1

Well ID: C7296	Well Name: 199-N-231
Location: 15 ft Northeast of 199-N-230	Project: 100-NR-2 171 Wells
Prepared By: Troy Stevens Date: 12/31/09	Reviewed By: L. D. Walker Date: 1-26-10
Signature: for T. Stevens	Signature:

CONSTRUCTION DATA

Description	Diagram
8-in Flush Mount Well Head	
Portland Cement : 1 - 9.2 ft	
6-in I.D. PVC, Schedule 80 Permanent Casing: 0.0 ft ags - 17.65 ft	
Granular Bentonite Seal: 9.2 - 11.0 ft	
Bentonite Chips : 11.0 - 14.9 ft	
Primary Filter pack 6-9 Mesh Colorado Silica Sand: 14.9 - 26.2 ft	
Static Water Level: 18.09 (11/19/09)	
6-in I.D. PVC, 60 Slot Screen (.060-in): 17.61 - 24.64 ft	
6-in I.D. PVC Endcap: 24.64 - 25.08 ft	
All depths are in feet below ground surface.	
Borehole drilled with 10 3/4-in threaded casing: 0.0 - 26.2 ft	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0 - 1' Gravel (G)
		1 - 26.2' Sandy Gravel (sG)
5		
10		
15		
20		
25		26.2 ft bgs, Total Depth Drilled (11/19/2009)
30		
35		
40		

Figure 3-3. Typical Deep Multipurpose Well Construction

WELL SUMMARY SHEET | Start Date: 1/11/10 | Finish Date: 1/11/10 | Page 1 of 1

Well ID: C7446	Well Name: 199-N-353
Location: 10' NNE of 199-N-256	Project: 100-NR-2 171 Wells
Prepared By: Troy Stevens Date: 1/13/10	Reviewed By: L. D. Walker Date: 3/17/10
Signature: D Walker for T. Stevens	Signature: D Walker

CONSTRUCTION DATA

Description	Diagram
8-in Flush Mount Well Head	
Portland Cement : 1.0 - 6.9 ft	
6-in I.D. PVC, Schedule 80 Permanent Casing: 0.0 - 17.74 ft	
Granular Bentonite Seal: 6.9 - 10.8 ft	
Bentonite Chips : 10.8 - 14.9 ft	
Static Water Level: 13.61 (1/11/10)	
Primary Filter pack 6-9 Mesh Colorado Silica Sand: 14.9 - 26.4 ft	
6-in I.D. PVC, 60 Slot Screen (.060-in): 17.74 - 24.74 ft	
6-in I.D. PVC Endcap: 24.74 - 25.15 ft	
All depths are in feet below ground surface.	
Borehole drilled with 10 3/4-in threaded casing: 0.0 - 26.4 ft	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0' - 2' Silty Sandy Gravel (msG)
		2' - 26.4' Sandy Gravel (sG)
5		
10		
15		
20		
25		26.4' Total Depth Drilled (1/11/2010)
30		
35		
40		

Figure 3-4. Typical Monitoring Well Construction

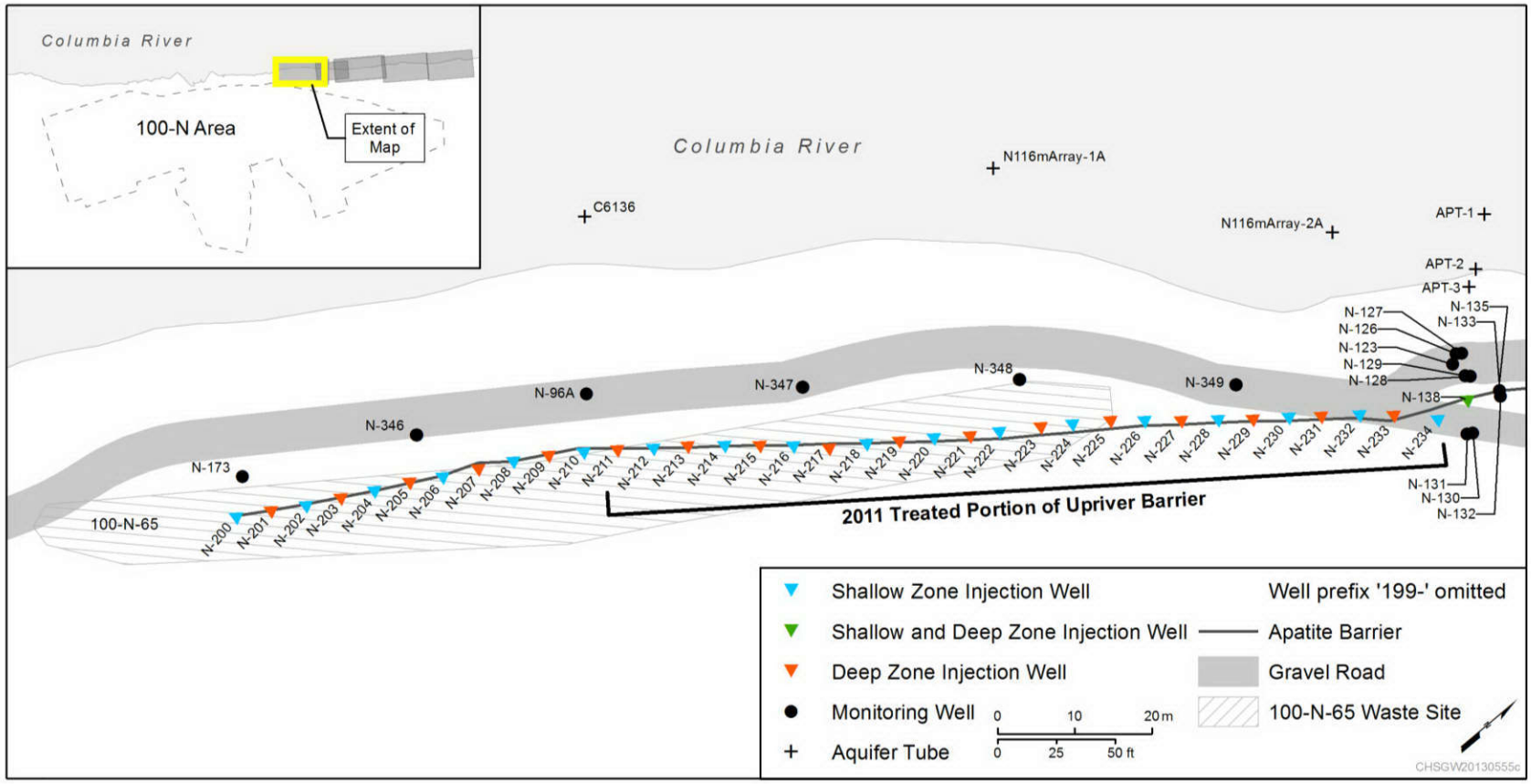

Figure 3-5. Upriver Extension Apatite Barrier Injection Wells, Monitoring Wells, and Aquifer Tubes along the Columbia River Shoreline

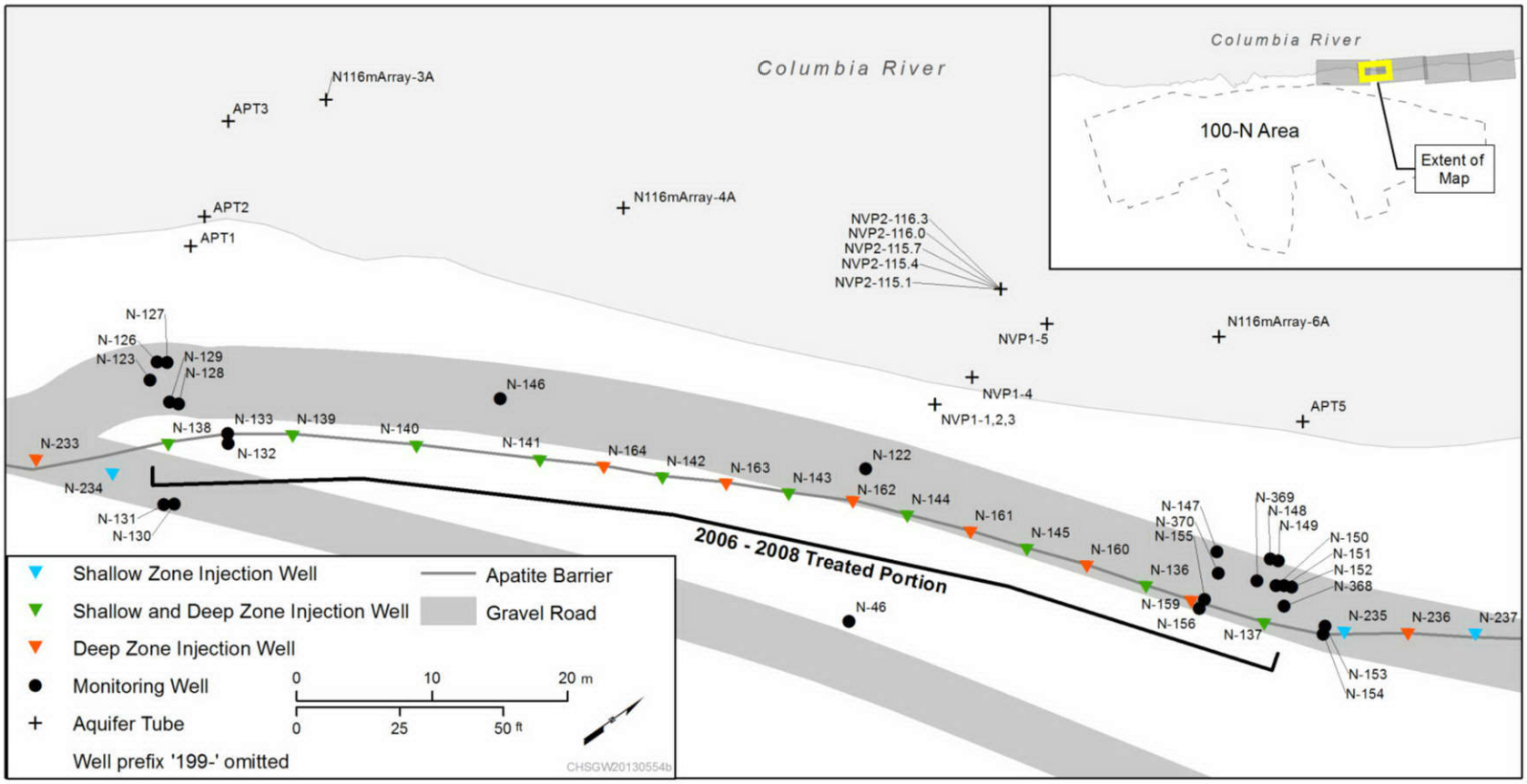

Figure 3-6. Apatite Barrier Location, 90 m (300 ft)

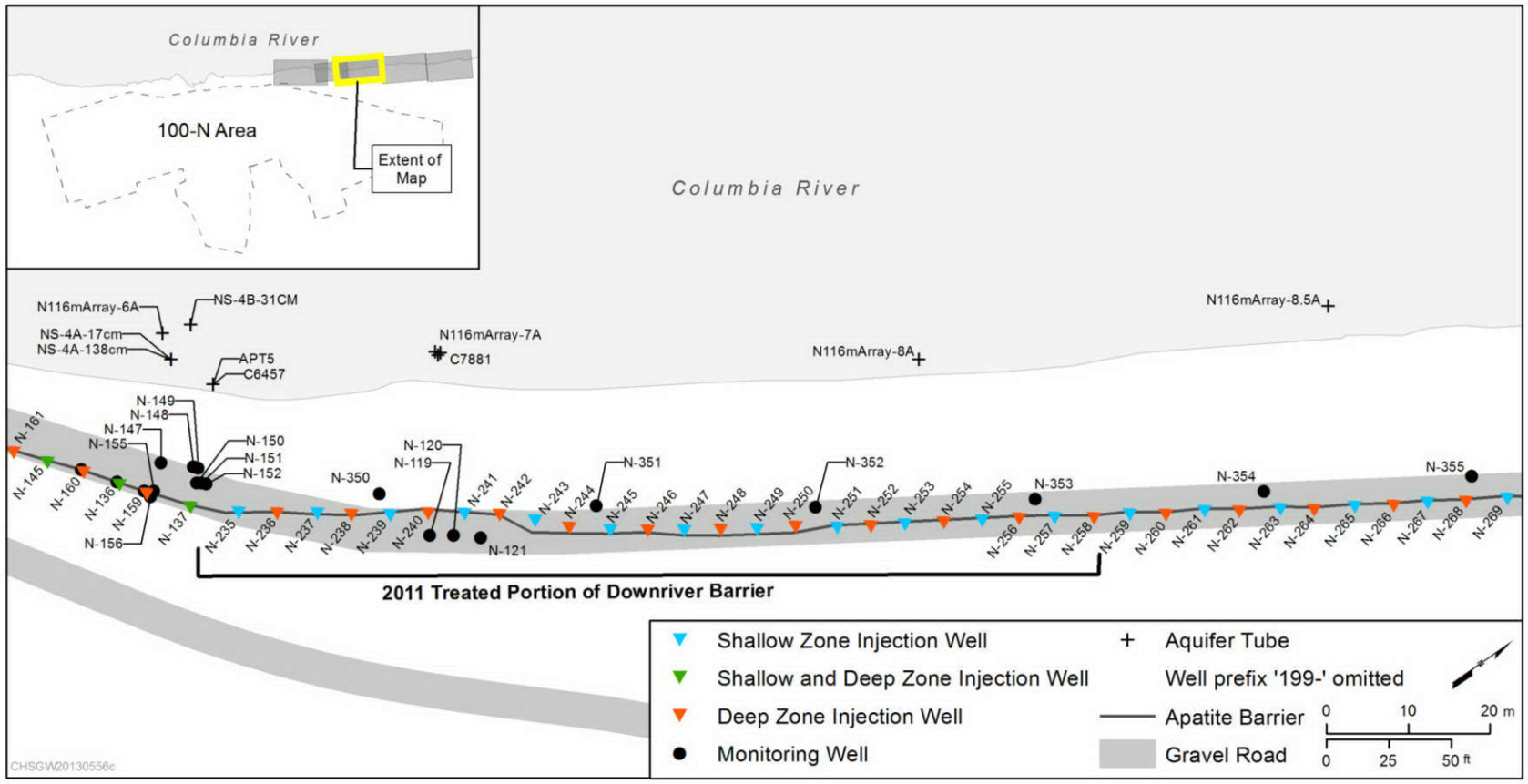

Figure 3-7. Downriver Extension Apatite Barrier Injection Wells, Monitoring Wells, and Aquifer Tubes along the Columbia River Shoreline

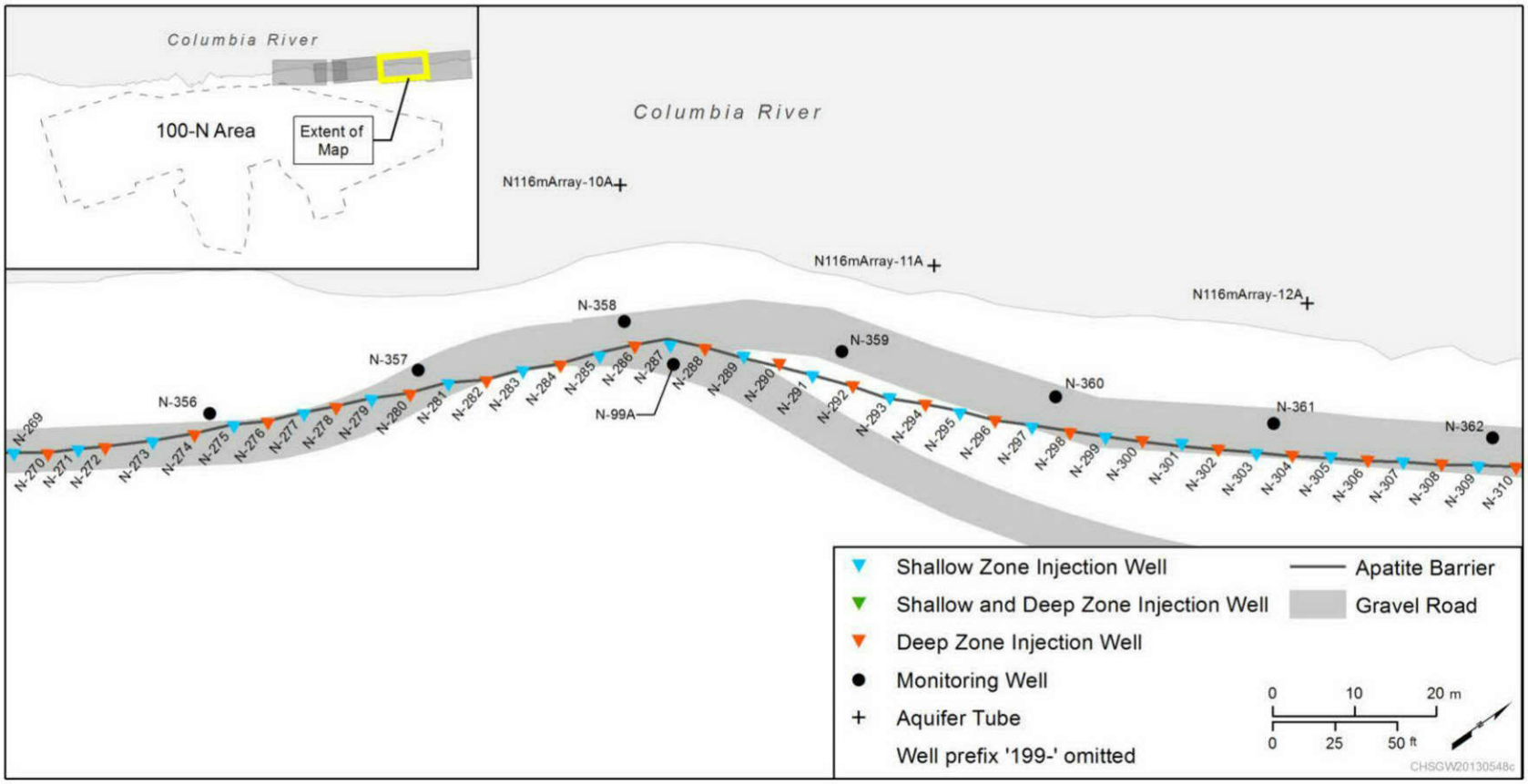

Figure 3-8. Downriver Apatite Barrier Injection Wells, Monitoring Wells, and Aquifer Tubes along the Columbia River Shoreline

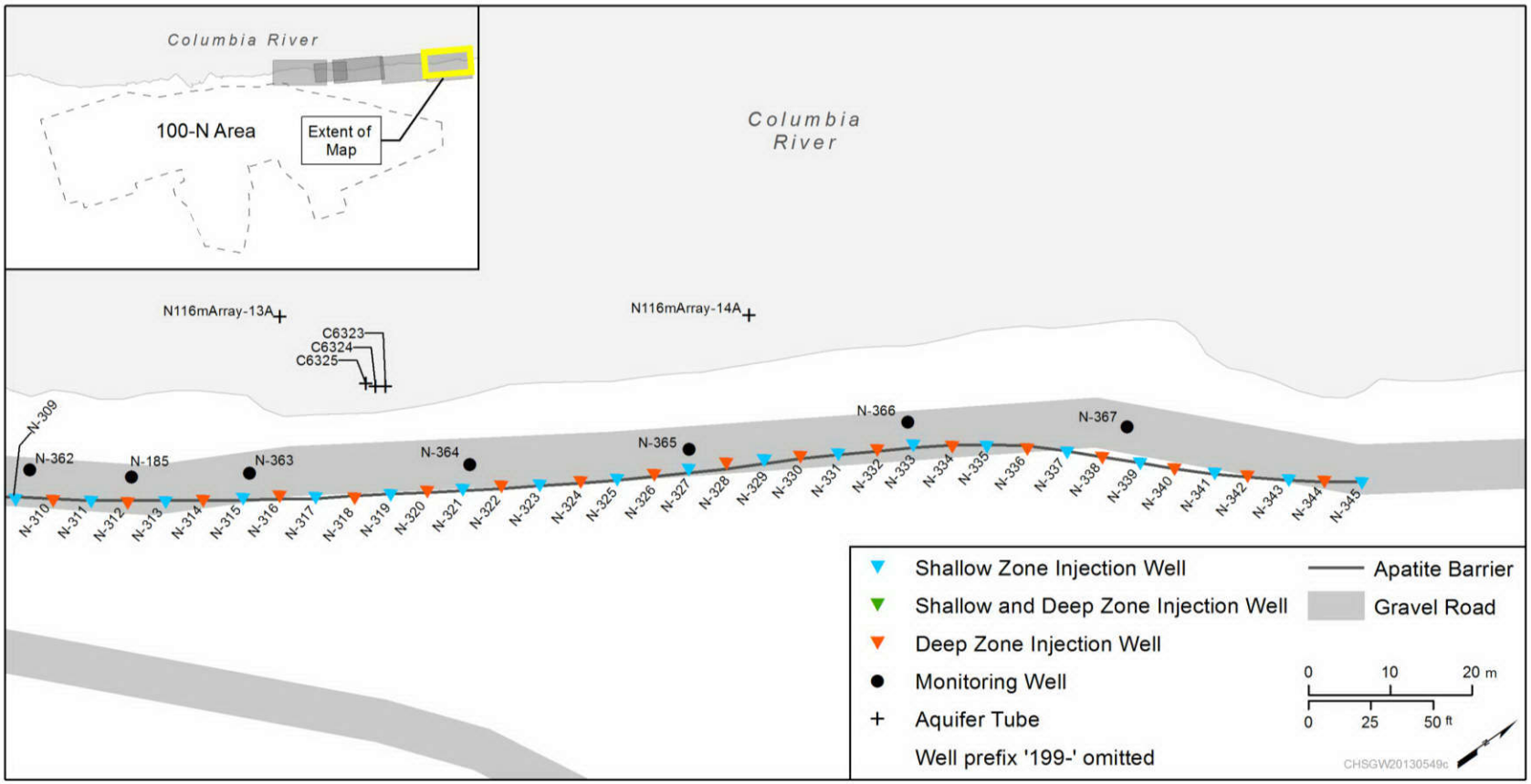

Figure 3-9. Downriver Apatite Barrier Injection Wells, Monitoring Wells, and Aquifer Tubes along the Columbia River Shoreline

3.1.1.2 Injection Design

The injection design is discussed in the following subsections, including the apatite mass, high-concentration formula, injection volume, and injection implementation.

Apatite Mass

A specific amount of apatite is needed to remove strontium and strontium-90 from groundwater over the next 300 years to protect the Columbia River (i.e., assuming an initial maximum strontium-90 concentration of 8,000 pCi/L, 10 half-lives of strontium-90 decay, and a half-life of 29.1 years). This calculation depends on the crystal substitution of strontium for calcium in apatite, average groundwater flow rate, and apatite PRB thickness. Assuming a 10 percent substitution (conservative estimate based on sediment core analyses), an average groundwater flow rate of 0.3 m/d (1 ft/d), and 10 m (32 ft) apatite PRB thickness, then 0.96 mg apatite/g sediment is sufficient to sequester strontium and strontium-90 from the estimated 3,300 pore volumes of water that will flow through the apatite-laden zone in 300 years (PNNL-23367, *Hanford Apatite Treatability Test Report Errata: Apatite Mass Loading Calculation*). The 0.96 mg apatite/g sediment would occupy less than 10 percent of the pore space. This small decrease in porosity from added apatite may result in a small decrease in permeability within the PRB.

The mass loading of apatite in the saturated zone PRB design is 1.7 mg apatite/g sediment, as referenced in PNNL-19572. The errata report (PNNL-23367) documents an error in the apatite-loading estimate reported in previous apatite treatability test reports and provides additional calculation details for estimating apatite loading and barrier longevity. The saturated zone PRB design is not modified based on the errata since the additional apatite that will be emplaced in the PRB will mitigate uncertainties in the assumptions used in estimating PRB apatite mass loading. The PRB design of 1.7 mg apatite/g sediment would occupy 13.6 percent of the pore space; therefore, some additional decrease in permeability would be expected, but not significant enough to impact performance.

High-Concentration Formula

Apatite treatment requires injecting sufficient phosphate to immobilize strontium-90 for 300 years while minimizing negative side effects. However, any solution injected into the aquifer that is of higher ionic strength than groundwater will cause some initial desorption of strontium-90^{2+} (and Sr^{2+}, Ca^{2+}, Mg^{2+}) from the sediment, as 99 percent of the strontium-90 mass in the aquifer is adsorbed by IX on sediment minerals (PNNL-17429). The ionic strength of the injecting solution, concentration of the monovalent and divalent ions in the solution, and total volume injected all affect the IX process.

The original concept for field-scale deployment of the apatite PRB technology involved injecting a low-concentration, apatite-forming solution, followed by higher concentration injections as required to emplace sufficient treatment capacity to meet remedial objectives. The low-concentration injections were designed to provide a small amount of treatment capacity, thus stabilizing the strontium-90 residing within the treatment zone while minimizing strontium-90 mobilization through the injection of high ionic-strength solutions. However, results from the low-concentration field testing and subsequent laboratory studies determined that modifying the solution to a calcium-poor formulation was a better approach for maximizing apatite formation while minimizing short-term increases in strontium-90 concentration. This modified formulation, which relies more heavily on calcium naturally present in the aquifer sediments as a source for apatite formation, was used during the high-concentration treatments conducted in 2008 (PNNL-19572).

The modified formulation consists of 3.6 mM calcium, 9 mM citrate, and 40 mM phosphate. This amendment solution was identified as the best formulation for meeting the following objectives: (1) minimize the number of injection operations, (2) minimize short-term increases in strontium-90

concentrations associated with injection of high ionic-strength solutions, and (3) keep amendment formulations well below solubility limits to reduce the potential for operational challenges associated with solution stability. The high-concentration Ca-citrate-PO_4 solution uses the existing calcium adsorbed to the arid Hanford sediments to meet the stoichiometric ratio of calcium to phosphate (5:3) reflected in the apatite structure and optimizes in situ precipitation (Figure 3-10) (PNNL-19572).

The high concentration Ca-citrate-PO_4 formulation was used in the 2011 PRB extensions and will be used for the final 488 m (1,600 ft) PRB buildout.

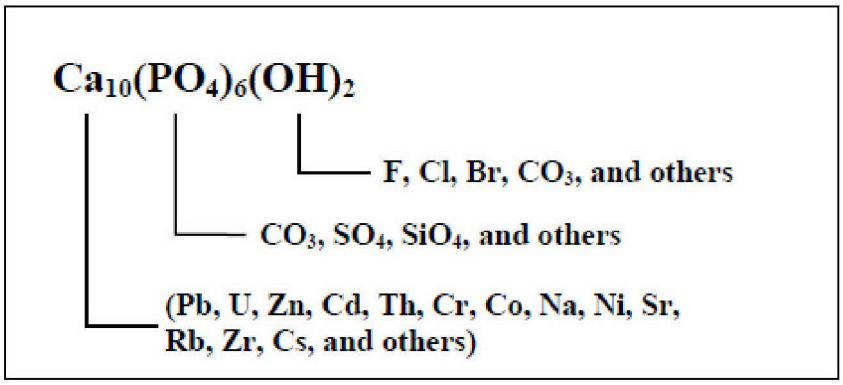

Figure 3-10. Cationic and Anionic Substitution in Apatite

Injection Volume

Sediment core samples collected from three boreholes in November 2009, approximately 1 year after the high-concentration treatments, were used to quantify the amount of apatite formation resulting from the low- and high-concentration treatments performed in the original 90 m (300 ft) PRB (PNNL-19572). Given the 10 mM phosphate (low-concentration) and 40 mM phosphate (high-concentration) injections, an average apatite loading of 1.9 mg apatite/g of sediment (or 0.608 mg phosphate/g) is expected.

Overall, the Hanford formation retained an average of 92 percent of the injected mass and the Ringold Formation retained an average of 44 percent, indicating that larger injection volumes may be needed for effective Ringold Formation treatment. The Ringold-only injection wells were screened within 1 to 2 m (3 to 6.5 ft) from the Hanford/Ringold interface. The reduced retention of injected mass in the Ringold Formation may have resulted from some of the injected amendment flowing vertically into the more permeable Hanford formation, as well as laterally within the Ringold Formation. However, as discussed in Section 1.3.3, detailed hydrogeologic cross sections of the 100-NR-2 OU PRB show that the Hanford/Ringold contact depths are much shallower upriver and downriver of the original 90 m (300 ft) barrier than have been observed along the original barrier. Along the expanded barrier network, the Hanford formation is very shallow, and most of the shallow and deep well screen pairs are actually contained in the Ringold Formation sediment and do not exist in the very shallow Hanford formation sediment. Because the injection wells for the expanded barrier network are predominately screened in the same formation (i.e., Ringold Formation), the conditions contributing to recommendations from PNNL-19752 to inject Ringold Formation during low river stage are not as prevalent for the remaining 488 m (1,600 ft) PRB buildout. The lateral distributions across the shallow and deeper screened wells are expected to be similar because injected mass will be in the same formation. Injections for the remaining PRB buildout will primarily be dependent upon the river stage being high enough so the groundwater elevation is above the screened interval of the injected wells. The remaining PRB buildout will target high-river periods to treat the full saturated thickness. However, if site conditions or other timing

constraints preclude injection during high-river periods, consideration will be given to injecting into wells where the screened intervals of wells are below the water table and lateral distribution can be achieved.

Based on the results from PNNL-19572 and the 2011 PRB extension (described in Section 1.3.2.5), minimum injection volumes for the remaining 488 m (1,600 ft) PRB should be approximately 227,125 L (60,000 gal) for both the Hanford formation and Ringold Formation wells. If the injections occur under less-than-ideal conditions, volumes may be increased. A single treatment with this high-concentration formulation is estimated to provide 270 years of treatment capacity (PNNL-19572).

Injection Implementation

Two injection skids were designed and constructed for injecting the high concentration Ca-citrate-PO_4 solution into the multipurpose wells (Figures 3-11 to 3-17). CH2M HILL Plateau Remediation Company (CHPRC) Soil and Groundwater Remediation Project (S&GRP) engineering (licensed professional engineers) designed the new injection systems in accordance with standard design procedures and criteria. These skids were used for the 274 m (900 ft) barrier expansion in 2011 and allowed for injecting chemicals into six wells simultaneously compared to the single injection in the 2006 version of the apatite delivery system.

Each treatment skid is capable of pumping chemicals from tanker trucks or tanks and river water to form an injection solution for distribution to wellheads. Flow meters and sample ports are provided on each injection skid to monitor and collect samples of pre-mixed chemical solution. Submersible pumps in the Columbia River will extract and transfer river water to the injection skid, where it will be filtered before being mixed with the chemical in a static inline mixing chamber. The injection skids will be used to mix concentrated calcium citrate and phosphate solutions with river water to dilute the chemicals to the high-concentration formulation values. Following mixing, a 10 cm (4 in.) pipe will convey the dilute chemical solution to a manifold for distribution to up to six individual wells. A sample port is provided ahead of the manifold for sample collection of the dilute chemical.

The volume of dilute chemical for injection will likely range from 944,607 to 4,540,000 L (25,000 to 120,000 gal) per well, with a targeted average volume of 227,000 L (60,000 gal) injected per well. The injection system is capable of injecting chemical solution at a flow rate from 37 to 189 L/min (10 to 50 gpm) per well, with a total capacity for each injection skid of up to 1,135 L/min (300 gpm). Based on an average injection rate of 114 L/min (30 gpm), it will take approximately 33 hours to inject 227,125 L (60,000 gal). Actual injection volumes delivered will be recorded for each well.

As the injection process begins, flow rates and system pressure will be monitored hourly, and the injection stream will be sampled. Operational sampling and injection monitoring will follow the protocols specified in the SAP (Appendix A, Insert A2).

Each injection skid and connected chemical and injection lines will be flushed with river water or raw water following completion of an injection cycle. Once the chemical lines and injection skid have been flushed with water, the residual water can be drained to the ground. The flushwater will be discarded to the ground within the apatite PRB footprint between the two wells, either on the gravel road or along the roadside away from the river. This water will infiltrate the ground surface and, because of the small volume, will not affect the apatite PRB. The injection systems will then be set up to inject the next six wells. Following completion of all injection cycles, the systems will be flushed, prepared for storage, and then transported to and stored in a protected area under cover.

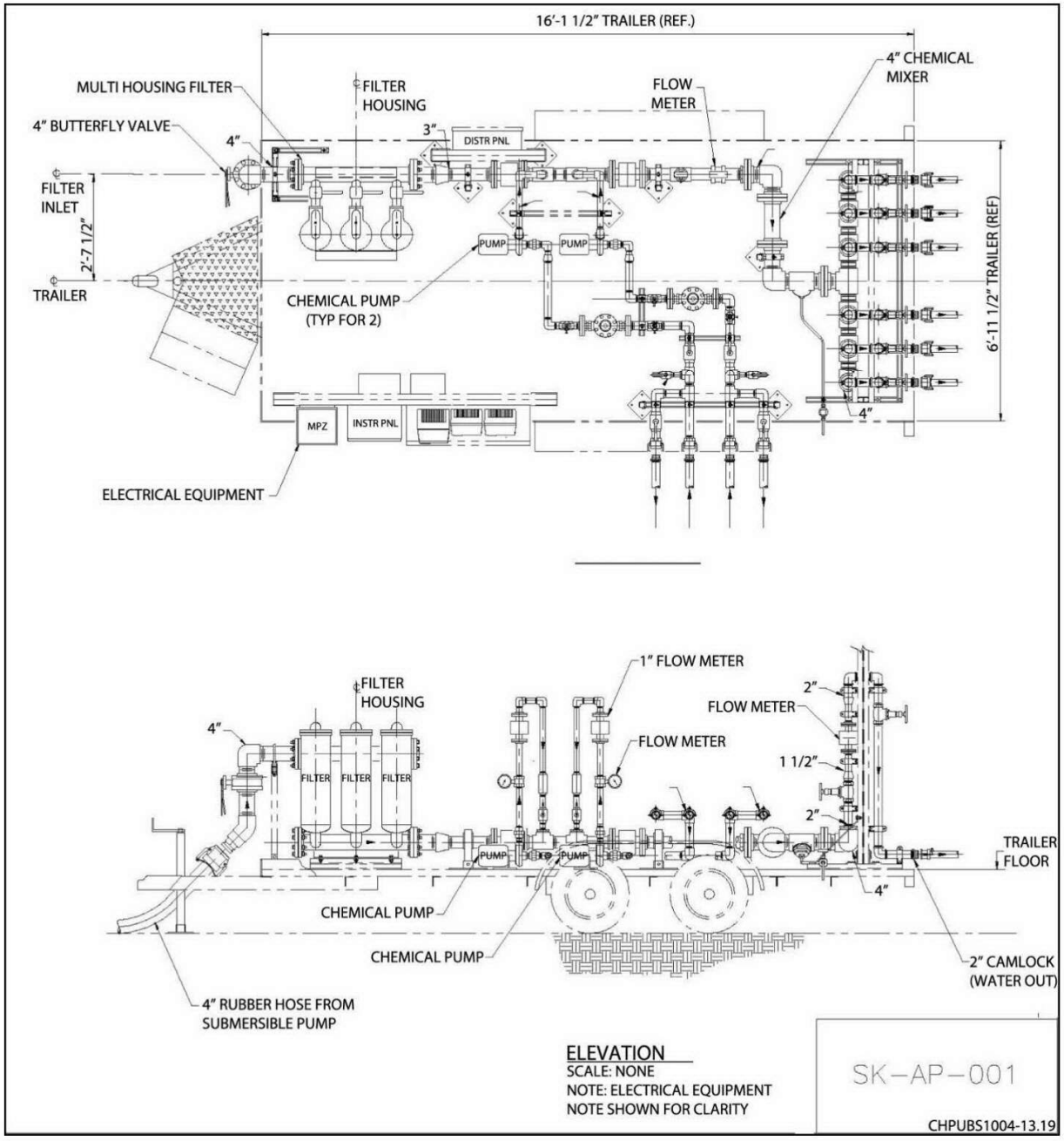

Figure 3-11. Generalized Schematic of Injection System

Field instructions have been prepared for the expansion of the PRB to be implemented in 2014 (SGW-57140, *Field Instruction for 100-NR-2 Operable Unit Saturated Zone Apatite Permeable Reactive Barrier Extension*). These instructions and detailed operational procedures guide injections and ensure that sufficient phosphate is injected and monitoring is performed to determine the arrival and distribution of apatite solution in the aquifer.

Figure 3-12. Chemical Tanks (with Lines to Skid Located below)

Figure 3-13. 100-NR-2 OU Injection Site

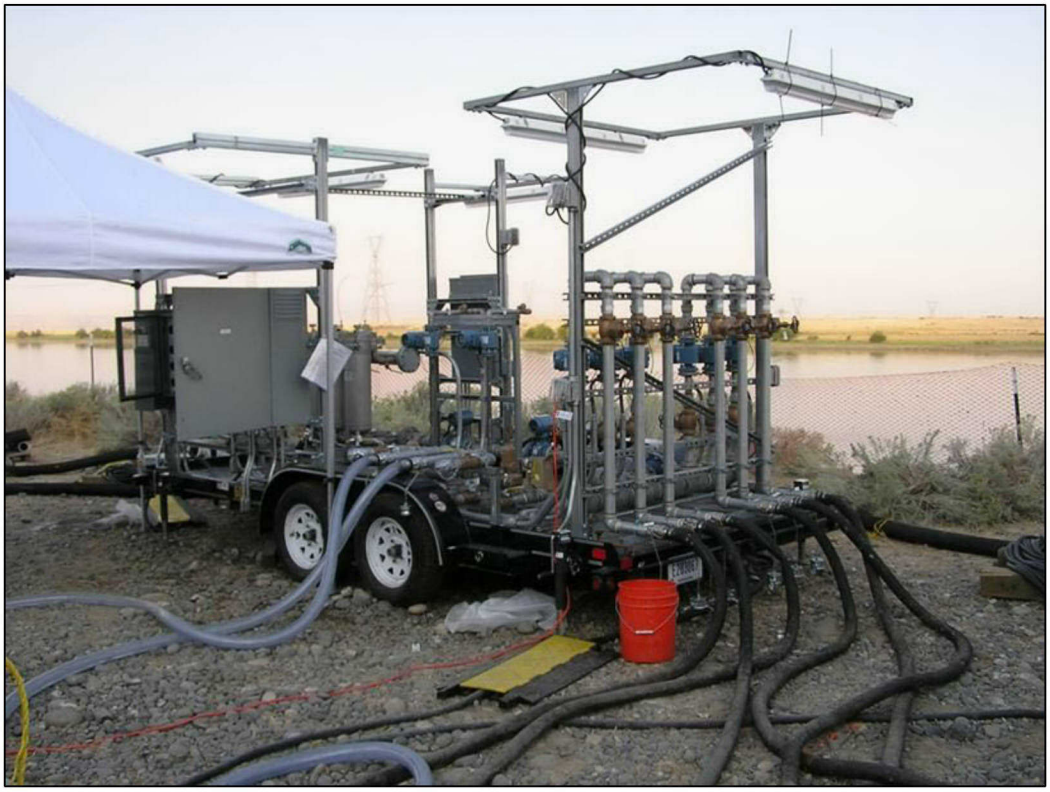

Figure 3-14. Injection Skid

Figure 3-15. Control Panel on Injection Skid

Figure 3-16. Lines Going to Wells

Figure 3-17. Injection at Well

Site utility requirements for deployment of the apatite PRB include a generator and water supply. Columbia River water will be used for blending and injection. DOE has water rights, and the National Marine Fisheries Service will be given courtesy notification. Two 1,135 L/min (300 gpm) pumps are mounted on a submersible skid and are fitted with fish screens for this purpose. A diesel generator will be used to operate the site facilities, injection and monitoring equipment, and ancillary equipment.

Waste will be managed in accordance with DOE/RL-2000-41, *Interim Action Waste Management Plan for the 100-NR-2 Operable Unit*, and 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.*

3.1.1.3 Operational Sampling and Performance Monitoring

Sampling and analysis requirements for the high-concentration Ca-citrate-PO_4 solution injections include chemical makeup sampling, injection flow rate and volume monitoring, and groundwater and aquifer tube sampling.

Operational sampling involves sampling injection solution immediately before injection starts and several times during the injection to ensure that the apatite precursors are being injected at the correct concentrations. During injection, flow rates and volumes will be monitored to test and optimize operation of the injection skid and to verify that the system is delivering the designed volume at multiple well locations. Field parameters will be measured in adjacent monitoring wells to monitor the rate of solution distribution in the aquifer.

Performance monitoring includes injection sampling, as well as the following items:

- Baseline sampling from targeted multipurpose and monitoring wells before injection to serve as the basis for judging barrier performance.
- Groundwater monitoring before, during, and after injections. Aqueous samples will be collected from specified monitoring wells and aquifer tubes identified in the SAP (Appendix A, Insert A2, Table A2-4) and analyzed for major anions and cations (particularly strontium-90, phosphate, and gross beta). Phosphate concentrations will be used to evaluate treatment distribution effectiveness, and strontium-90 and gross-beta concentrations will identify potential short-term strontium-90 flux changes toward the Columbia River.
- Groundwater monitoring at specified intervals to compare strontium-90 concentrations to baseline data to determine if the apatite emplacement is reducing strontium-90 at the compliance wells.

Operational sampling and performance monitoring for the saturated zone injections are discussed in further detail in the SAP (Appendix A).

3.1.1.4 Additional Injections

Based on previous monitoring data, the PRB is expected to achieve a 90 percent reduction in strontium-90 concentrations in the monitoring wells. Reinjections may be deemed necessary for sections of the groundwater PRB, based on the decision flow diagram presented in Figure 3-18. The decision flow diagram considers monitoring data collected for the following purposes:

- **Volume of high-concentration Ca-citrate-PO_4 solution injected into each multipurpose well:** Wells that received less than 80 percent of the target volume equivalent to 1.7 mg apatite/g sediment (227,125 L [60,000 gal]) will be considered for potential reinjection.

- **Strontium-90 concentrations in downgradient monitoring wells:** Four-event moving average concentrations will be determined individually for all monitoring wells for up to a 5-year period. Time-series charts will be prepared for individual wells, and moving average concentrations will be calculated annually.

- **Strontium-90 concentrations in injection wells:** Samples will also be collected at select injection (or multipurpose) wells for comparison to baseline strontium-90 concentrations. As with downgradient monitoring wells, four-event moving averages will be calculated.

Wells will be monitored for an initial 5-year period, beginning at the completion of first-round apatite injections, in accordance with the SAP (Appendix A, Section A3.2.1.1). Following 5 years of monitoring, the decision process for reinjection is as follows:

- Additional injections not needed if after 5 years of injection monitoring indicates the following:
  - Moving average strontium-90 concentrations in monitoring wells are below the cleanup level.
  - Moving average strontium-90 concentration in individual monitoring wells show 90 percent reduction from baseline concentrations.
- Additional injections will be considered where target reduction is not achieved and the following occur:
  - Moving average strontium-90 concentrations in monitoring wells show an upward trend.
  - Moving average strontium-90 concentrations in monitoring wells are stable, but operational criteria are not met during injections. Operational criteria include meeting target injection volumes and phosphate concentrations, and radial distribution of amendment.
  - Moving average strontium-90 concentrations in treated injection wells do not show target reduction.
  - If strontium-90 concentration target reduction is observed in treated injection wells, then monitoring will continue, and the need for additional injection will be re-evaluated annually for the first 5 years and every 5 years thereafter.

3.1.1.5 Compliance with Underground Injection Control Regulations

The intended use of the saturated zone apatite PRB injection wells (Underground Injection Control [UIC] well code 5X26) meets the requirements of the WAC 173-218-040(5)(a)(X), "Underground Injection Control Program," "UIC Well Classification Including Allowed and Prohibited Wells," definition of a Class V injection well: "Injection wells used for remediation wells receiving fluids intended to clean up, treat or prevent subsurface contamination."

In accordance with the requirements of WAC 173-218-060(5), "Requirements to Operate a UIC Well," the injection wells will be registered online at: http://www.ecy.wa.gov/programs/wq/grndwtr/uic/index.html.

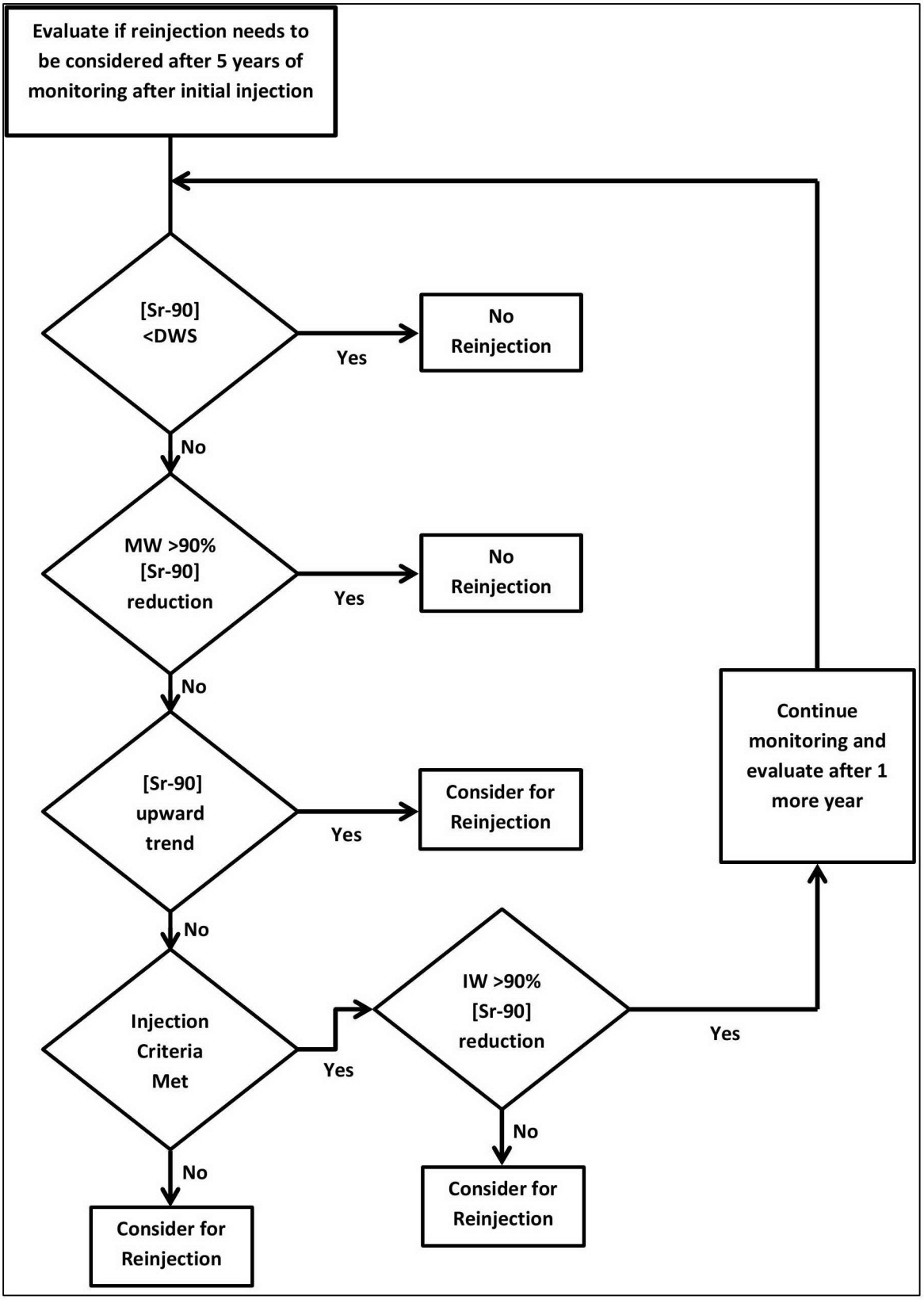

Figure 3-18. Reinjection Decision Flow Diagram

3.1.2 Vadose Zone Permeable Reactive Barrier (Jet Injections)

As described in DOE/RL-2011-25, *Calendar Year 2010 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations and 100-NR-2 Groundwater Remediation*, when the water table rises, strontium-90 from the vadose zone is mobilized and concentrations in groundwater increase. Concentration peaks in 2006, 2007, 2008, 2009, and 2010 were correlated with periods when the water table was high. Apatite jet injections will target areas of highest strontium-90 vadose zone contamination along the shoreline, for approximately 305 m (1,000 ft), and will emplace apatite from near the ground surface to approximately 7.6 m (25 ft) bgs, including the vadose zone and the PRZ, eliminating these potential hazards.

A vadose zone PRB will extend the existing 274 m (900 ft) long section of the saturated zone into the overlying vadose zone where a majority of the strontium-90 present along the river shoreline occurs. The vadose zone application will use a direct jet injection method to emplace pre-formed apatite to immobilize strontium-90 and will reduce or eliminate its transport from the vadose zone to groundwater and, ultimately, to the Columbia River. Based on the design optimization study (DOE/RL-2010-68), emplacement methods are described in the following subsections.

The vadose zone jet injections will occur above and within the existing 274 m (900 ft) long section of the saturated zone apatite PRB (Figure 3-1), and post-injection monitoring will reflect the combined performance of the vadose zone and saturated zone PRB. Elevated metals and strontium-90 concentrations resulting from jet injection in the vadose zone may be mitigated as the injected water subsequently flows through the existing apatite PRB in the saturated zone.

3.1.2.1 Injection Design

Based on favorable results observed during the 2009 jet injection pilot test (PNNL-19524; SGW-47062), approximately 400 borings will be drilled using a phosphate drilling fluid to a depth of 7.6 m (25 ft) and will then be jet injected with a phosphate solution containing pre-formed apatite slurry. In general, this methodology will achieve a semi-uniform distribution of pre-formed apatite and phosphate that will potentially precipitate with adsorbed calcium on sediment to form amorphous apatite (Section 2.1.1), creating a PRB that is 305 m (1,000 ft) long by 3 m (10 ft) wide.

The vadose zone apatite PRB will begin just upriver from the 2011 treated portion of the saturated zone apatite PRB at multipurpose Well 199-N-210 (C7317), and it will continue downstream, past the downstream (east) end of the saturated zone apatite PRB at Well 199-N-258 (C7351) (Figure 3-19). Additional details are shown in Figures 3-5 through 3-7. The PRB will be installed over the saturated zone apatite PRB on the downgradient (north) side of the existing PRB injection wells to provide greater certainty for overlap of the vadose zone and saturated zone apatite PRB treatment zones.

Drilling and injections will be conducted inside an excavated trench. In general, the trench will be approximately 3 m (10 ft) wide by 0.5 m (1.5 ft) deep, extending the length of the planned vadose zone apatite PRB (Figure 3-20). Actual dimensions will be adjusted in the field to allow for a 2 m (6 ft) buffer zone from the jet injection radius (nominal 1 m [3 ft]) and existing wells to avoid damage to the surface/annular seals of the existing wells. Excavated soil will be used to create a berm around the trench to contain drill cuttings and fluids that may rise to the surface during drilling and jet injection. Once the injections are completed within the trench, the boreholes and trench will be backfilled with excavated soil.

The jet injection design is not significantly influenced by river stage since the pre-formed apatite is directly emplaced in the soil sediments through the jet injection process. However, the preferred time period for conducting the jet injections is during low river stage to maximize contact of the phosphate solution carrier with the vadose zone soils.

Jet injection borings will be spaced in an offset pattern, similar to that shown on Figure 3-21, to provide overlap of pre-formed apatite injection radius. In areas where space is limited, the offset (and trench) may be adjusted, as long as the radius overlap between borings is maintained. Figure 3-22 provides an example

configuration for field adjustment of jet injection borehole locations within the road width and injection configuration to protect existing wells.

3.1.2.2 Injection Solutions

A 40 mM phosphate solution (DOE/RL-2010-68) will be used as the drilling fluid, prepared from 85 percent hydrogen phosphate (Na_2HPO_4) and 15 percent sodium hydrogen phosphate (NaH_2PO_4), with a total aqueous phosphate concentration not to exceed 100 mM. This mixture will be pre-blended from food-grade phosphoric acid and sodium hydroxide.

The jet injection solution will consist of pre-formed apatite and the phosphate solution. The volume of phosphate solution used for injection must be sufficient to saturate the treatment zone: 3 m (10 ft) wide by 305 m (1,000 ft) long, by 7.2 m (23.5 ft) deep (7.6 m [25 ft] minus 0.5 m [1.5 ft] trench), assuming an average soil porosity of 18 percent. Based on the design optimization study (DOE/RL-2010-68), it is estimated that approximately 7,571 L (2,000 gal) of phosphate solution and 115 kg of pre-formed apatite will be injected into each borehole.

Phosphate solutions will be made up in advance and stored onsite before blending with apatite and injecting. Because phosphate will precipitate with calcium, deionized water or another approved water source will be used for this solution. An auger will convey the apatite material into the mixing unit. The super-sack storage unit will be equipped with load cells that can accurately weigh and deliver the proper proportion of apatite product to the mixer for each batch.

The pre-formed apatite shall consist of crushed animal bone generally of the chemical form ($Ca_{10}(PO_4)_6(OH)_2$) with a total phosphate content of at least 30 percent, carbon content of 10 percent, and moisture content below 5 percent. The bone will be calcined, or thermally treated, to reduce organic biomass that could lead to biomass fouling in the treated sediments. Sufficient apatite will be injected into each borehole to achieve 3.4 mg apatite/g sediment (equivalent 1.1 mg phosphate/g sediment) throughout a 0.9 m (3 ft) radius soil column extending from 0.2 to 7.6 m (1.5 to 25 ft) bgs.

Injection pressures must be capable of mixing the solutions with the sediments to a minimum radial distance of 1 m (3 ft) from the injection nozzle. Previous injections conducted at this 100-N Area site were successful using approximately 400 bars (5,800 psi) injection systems (SGW-47062). Appropriate quality assurance (QA)/quality control (QC) protocols will be followed and documented throughout the injection process to ensure that the design objectives are met. Drilling and injection methods, borehole configuration, equipment cleaning, and daily logs will be recorded. A data recorder will be used to record drill depth, drill duration, rod rotation, lifting rate, jet injection pressure, solution flow rate, and solution injection quantity.

3.1.2.3 Injection Process

The temporary borings will be drilled using a hydraulic drill rig equipped with jet grout injection capabilities. The specific rig will be specified by the contractor. The borings will be advanced from the bottom of the trench to total depth (TD), using the phosphate solution as a drilling fluid (Figure 3-23). Trenches will serve as infiltration galleries, containing the excess phosphate solution and allowing it to seep into the ground to treat the shallow subsurface.

The actual TD of each boring will vary, depending on the geologic conditions encountered. The target TD is 7.6 m (25 ft) bgs, and successful injections to this depth will provide a 3 m (10 ft) wide barrier of pre-formed apatite that protects the vadose zone and reinforces the saturated zone PRB. Geologic conditions may result in refusal at shallower depths for some borings. A minimum depth of 4.6 m (15 ft) bgs is needed to ensure treatment of the vadose zone, and achieving this depth will be considered a priority.

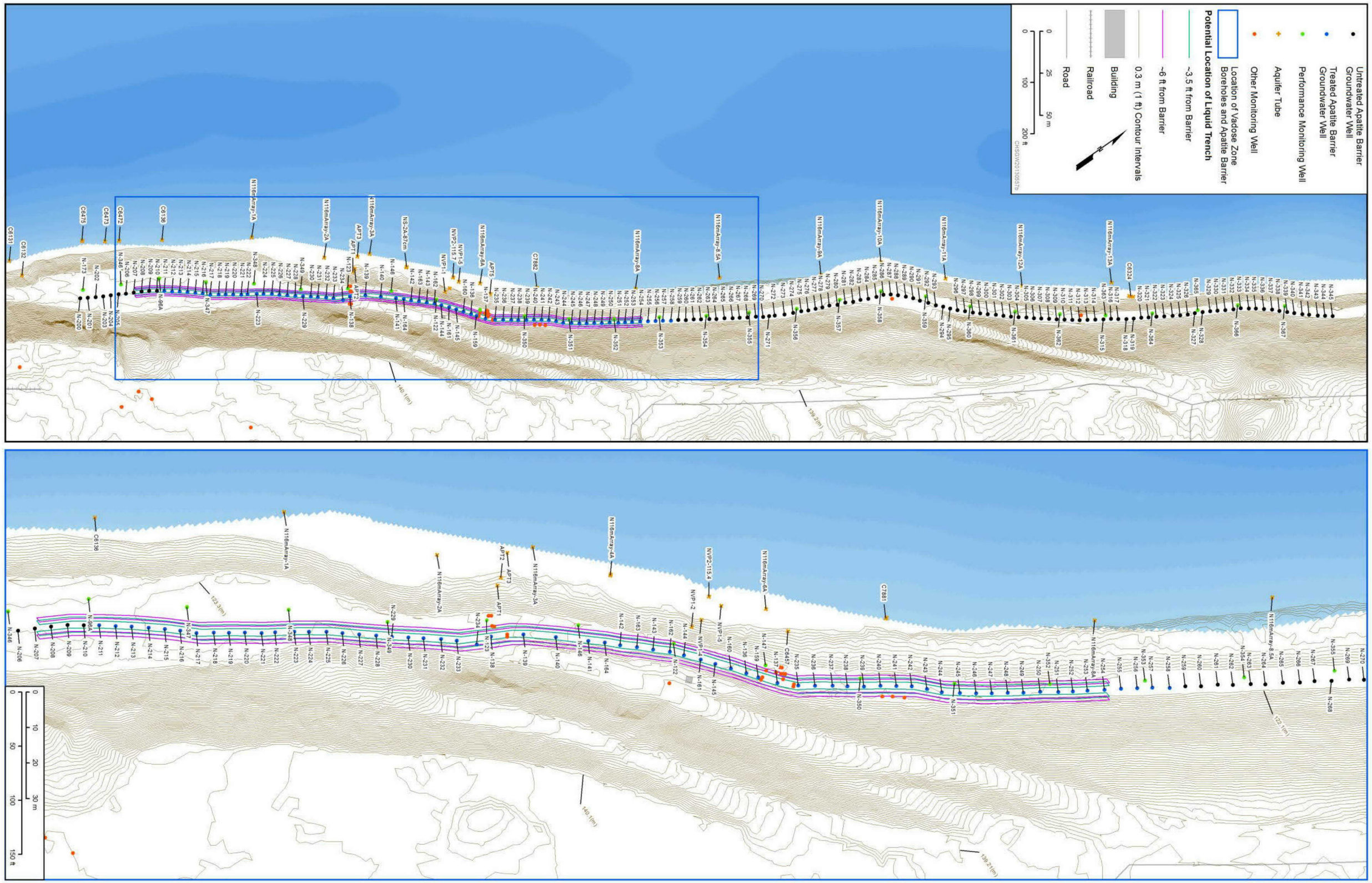

Figure 3-19. Location Map for Vadose Zone Jet injections

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Figure 3-20. Trench with Jet Injection

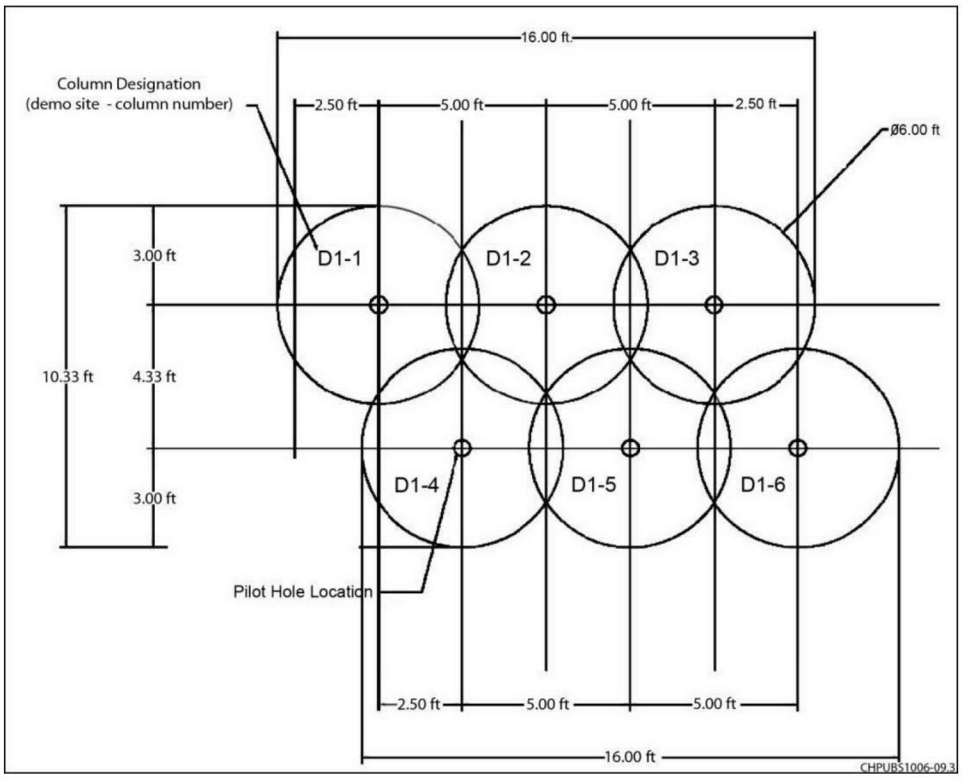


Figure 3-21. Example of Jet Injection Layout

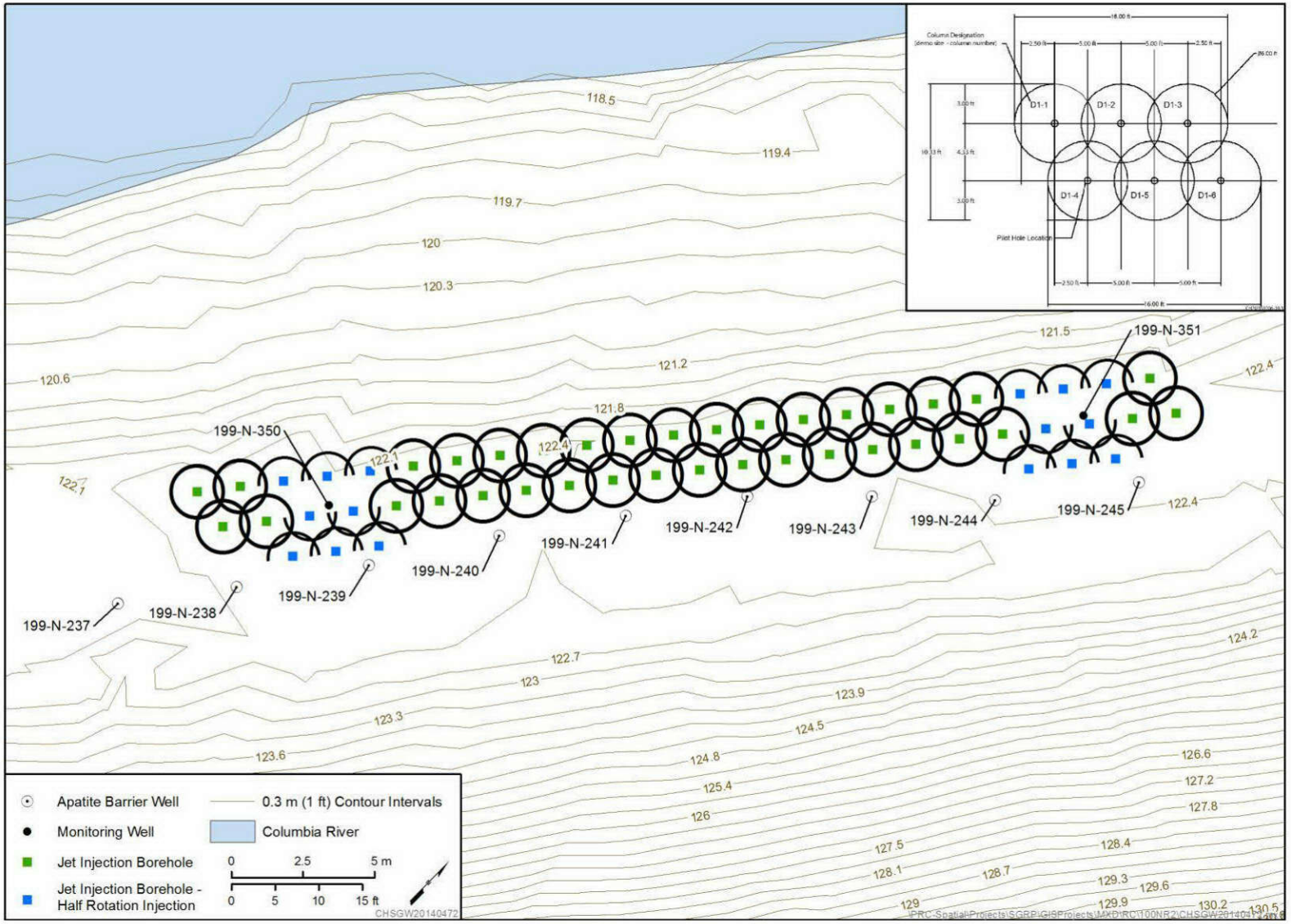


Figure 3-22. Apatite Treatment Zones for Saturated Zone PRB and Vadose Zone Jet Injections

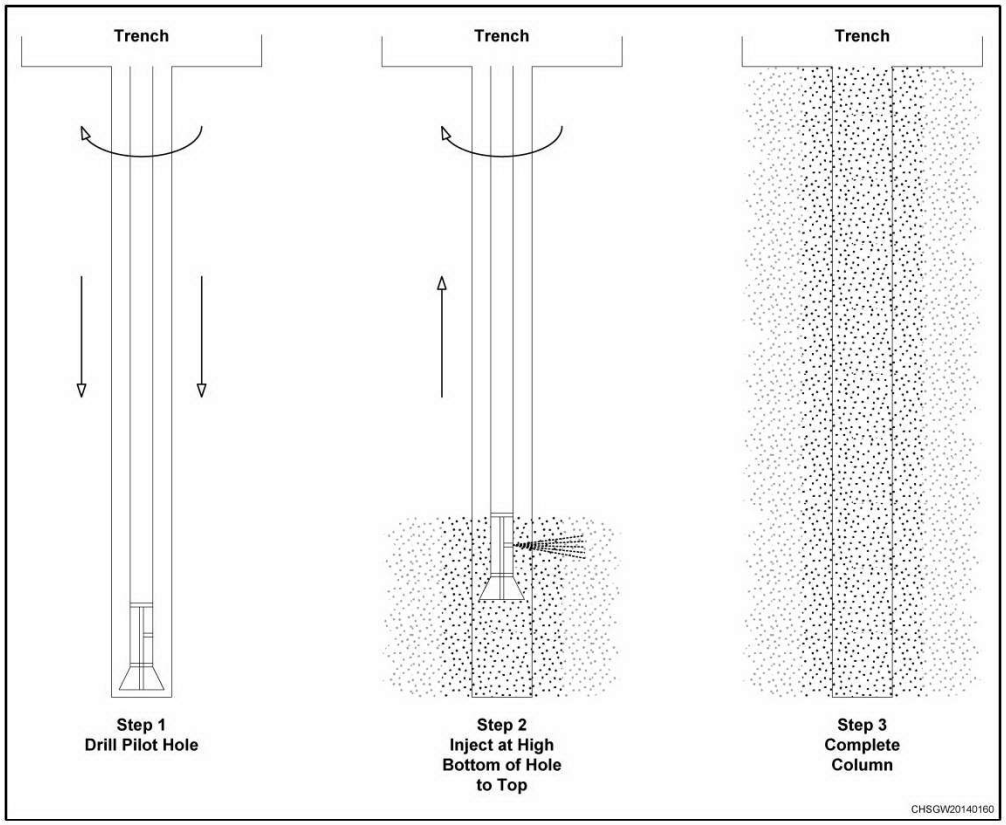


Figure 3-23. Typical Jet Injection Process

As shown in Figure 3-23, jet injection of pre-formed apatite begins near the bottom of the borehole and continues as the rod is retracted. High-pressure injection mixes or fluidizes the sediment with the apatite solution to a minimal radial distance of 1 m (3 ft) from the injection nozzle. Injections will terminate approximately 15 cm (6 in.) below the floor of the trench. The drill/injection rods are then removed from the borehole, which will be decommissioned in accordance with WAC 173-160. The process is summarized as follows:

- TD for each boring (column) will extend from 0.46 m (1.5 ft) to approximately 7.6 m (25 ft) bgs.
- Boreholes will be installed with a hydraulic drill rig with jet grout injection capabilities.
- The phosphate solution will be used as the drilling fluid as the boreholes are advanced.
- Jet injections will be performed using a system capable of injecting the solutions at pressures up to 400 bars (5,800 psi).
- Minimum radial distance of injection is 1 m (3 ft) from the injection nozzle.
- Injection materials are phosphate solution and apatite, sufficient volume to achieve 3.4 mg apatite/g sediment.
- The pre-formed solid apatite material will be blended with phosphate solution for injection.

Borehole decommissioning will meet the minimum standards required in WAC 173-160, as detailed in the decommissioning profile approved by Ecology on November 3, 2009. Excavated soils will be tested to verify that the soils are below radiological action levels. Trenches will then be backfilled with the excavated soil, and the trench areas will be graded to match surrounding topography and protect existing features, especially wells.

3.1.2.4 Drilling Fluid Variance and Compliance with Underground Injection Control Regulations

Monosodium and disodium phosphates are frequently used for water treatment at National Sanitation Foundation maximum-use levels up to 13 and 15 mg/L, respectively. However, the blended concentration planned for the jet injections (phosphate drilling fluid) exceeds these thresholds. Therefore, a request for variance from the maximum-use levels will be prepared in accordance with WAC 173-160-106, "How Do I Apply for a Variance on a Water Well?".

Although the jet injection borings are defined as wells in accordance with WAC 173-160-111(60), "What Are the Definitions of Specific Words as Used in This Chapter?" because they are uncased, they do not meet the definition of a resource protection water well per WAC 173-160-410(13), "What Are the Specific Definitions for Words in This Chapter?". Therefore, these borings may be exempt from the reporting, design and construction, and sealing specified in WAC 173-160-400, "What Are the Minimum Standards for Resource Protection Wells and Geotechnical Soil Borings?". Drilling, construction, and decommissioning of the jet injection borings will be completed in accordance with WAC 173-160 and will include any associated variances.

The intended use of the vadose zone apatite PRB injection wells (UIC well code 5X26) meets the WAC 173-218-040(5)(a)(X) definition of a Class V injection well: "Injection wells used for remediation wells receiving fluids intended to clean up, treat or prevent subsurface contamination." In accordance with the requirements of WAC 173-218-060(5), the vadose zone injection wells will be registered online at: http://www.ecy.wa.gov/programs/wq/grndwtr/uic/index.html.

3.1.2.5 Operational Sampling and Performance Monitoring

Operational testing procedures for the jet injections include chemical makeup sampling and injection flow rate and volume monitoring. During drilling and jet injections, flow rates will be monitored and adjusted, as necessary.

Injection sampling for the vadose zone includes the following:

- Before injection, baseline concentrations will be determined for each monitoring well and aquifer tube downgradient from the vadose zone PRB to serve as the basis to evaluate barrier performance. If applicable, data from previous sampling events will be used, and additional sampling will be conducted as needed.

- Groundwater monitoring will be conducted following injections at regular intervals. Aqueous samples will be collected from specified monitoring wells and aquifer tubes (see the SAP [Appendix A, Insert A2, Table A2-8]) and analyzed for major anions and cations (strontium-90, phosphate, and gross beta, in particular) to monitor the short-term impacts of apatite emplacement.

Specific sample location, frequency, and analytes for the first 6-month post-injection period are specified in the SAP (Appendix A, Insert A2). Monitoring will continue in order to assess the effectiveness of the jet injections in reducing strontium-90 concentrations in groundwater relative to baseline concentrations. Because vadose zone jet injections will take place above and within the existing saturated zone PRB, long-term monitoring will reflect the combined effects from the vadose zone and saturated zone PRB.

Sediment cores will be collected at least 3 months, but not more than one year, after the jet injections. Continuous core samples at four locations within the vadose zone treated PRB will be collected where higher strontium-90 concentrations are observed. Two continuous core samples will be collected at each of the four locations (for a total of eight core samples) in alignment from saturated zone injection wells and existing downgradient monitoring wells. These cores samples will be used for comparison to the samples taken during the jet injection pilot study and will serve as an additional basis for judging barrier performance. Additional details are found in the SAP (Appendix A, Insert A2, Section A2.6.4).

3.1.3 Decommissioning Existing Pump and Treat System

A P&T system was installed in August 1995 as an ERA to meet TPA (Ecology et al., 1989a) Milestone M-16-12D and to address the N-Springs release of strontium-90-contaminated groundwater to the Columbia River. The P&T system captured water along the entire length of the 1301-N Trench. At the optimized pumping rate of 227 L/min (60 gpm), the system removed approximately 0.2 Ci/yr of strontium-90, which was about 10 times less than the amount removed by natural radioactive decay of the strontium-90 stored in the aquifer (DOE/RL-2004-21).

From September 1996 through March 2006, the P&T system in the 100-N Area treated more than 1.1 billion L (305 million gal) of groundwater and removed approximately 1.8 Ci of strontium-90 from the aquifer in the 100-NR-2 OU (DOE/RL-2008-66, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*). Despite the hydraulic containment provided by the P&T system, elevated strontium-90 concentrations near the shoreline have persisted since the beginning of P&T operations, and the system was placed in a standby mode in March 2006 by TPA (Ecology et al., 1989a) Change Request M-16-06-01, as approved by the Tri-Parties.

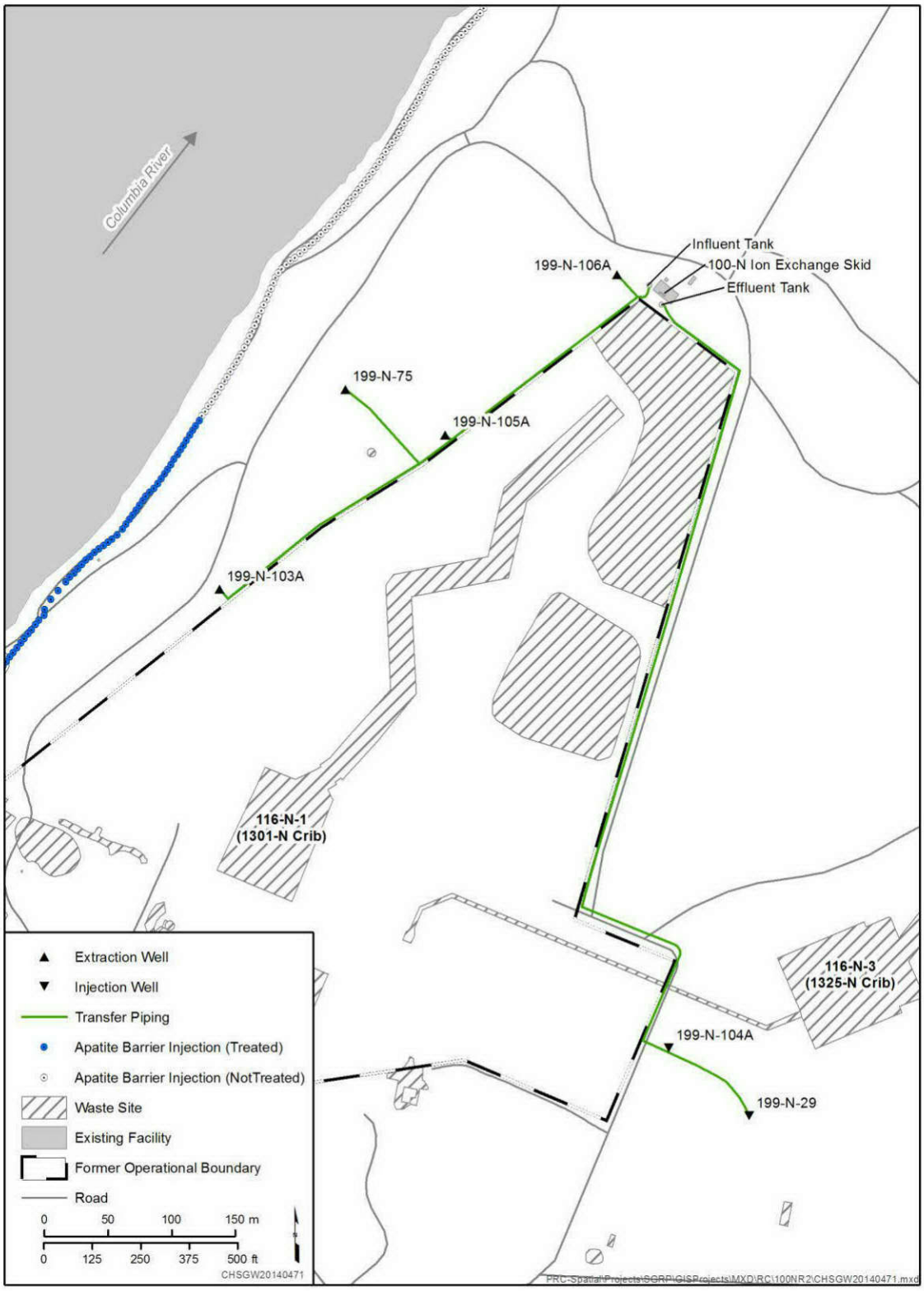
3.1.3.1 Pump and Treat System Design

The N-Springs P&T facility consisted of four extraction wells, two injection wells, a treatment module, and plant equipment (e.g., piping, electrical equipment, instrumentation, and tanks). Figure 3-24 shows the general layout of the facility and well field. The treatment system was based on an IX process and used clinoptilolite as the IX media. Figure 3-25 shows the simplified process flow diagram of the treatment facility and wells. The main components of the treatment system were the tanks, IX vessel, piping, and instrumentation (DOE/RL-95-110).

Two 49,210 L (13,000 gal) storage tanks (influent and effluent) were used for the system. The extraction system consisted of four wells (199-N-75, 199-N-103A, 199-N-105A, and 199-N-106A), collectively capable of providing 189.3 L/min (50 gpm) of groundwater through the IX system. Extracted water was stored in the influent storage tank before being pumped to the IX vessels.

The IX consisted of four vessels connected with piping and valves that allowed a combination of any three vessels to be in service at one time. Each vessel was filled with approximately 1.47 m^3 (52 ft^3) of clinoptilolite as the IX medium. Originally designed to have a minimum combined extraction pumping rate of 190 L/min (50 gpm) with a 10-year operational life, the system was upgraded to operate at 227 L/min (60 gpm) beginning in December 1996 (DOE/RL-95-110; DOE/RL-97-34).

Processed water was pumped from the effluent tank to one of two injection wells (199-N-29 and 199-N-104A); both were capable of receiving more than 227 L/min (60 gpm). Flow meters in the system provided monitoring, control, and protection (i.e., shutdown) functions. A programmable logic controller used information such as water levels, flow rates, and other process monitoring data to control the system. The operators could adjust the system control set points through the operator interface panel.



Note: Figure recreated from DOE/RL-95-110, *N-Springs Expedited Response Action Performance Evaluation Report*.

Figure 3-24. Layout of the N-Springs P&T System

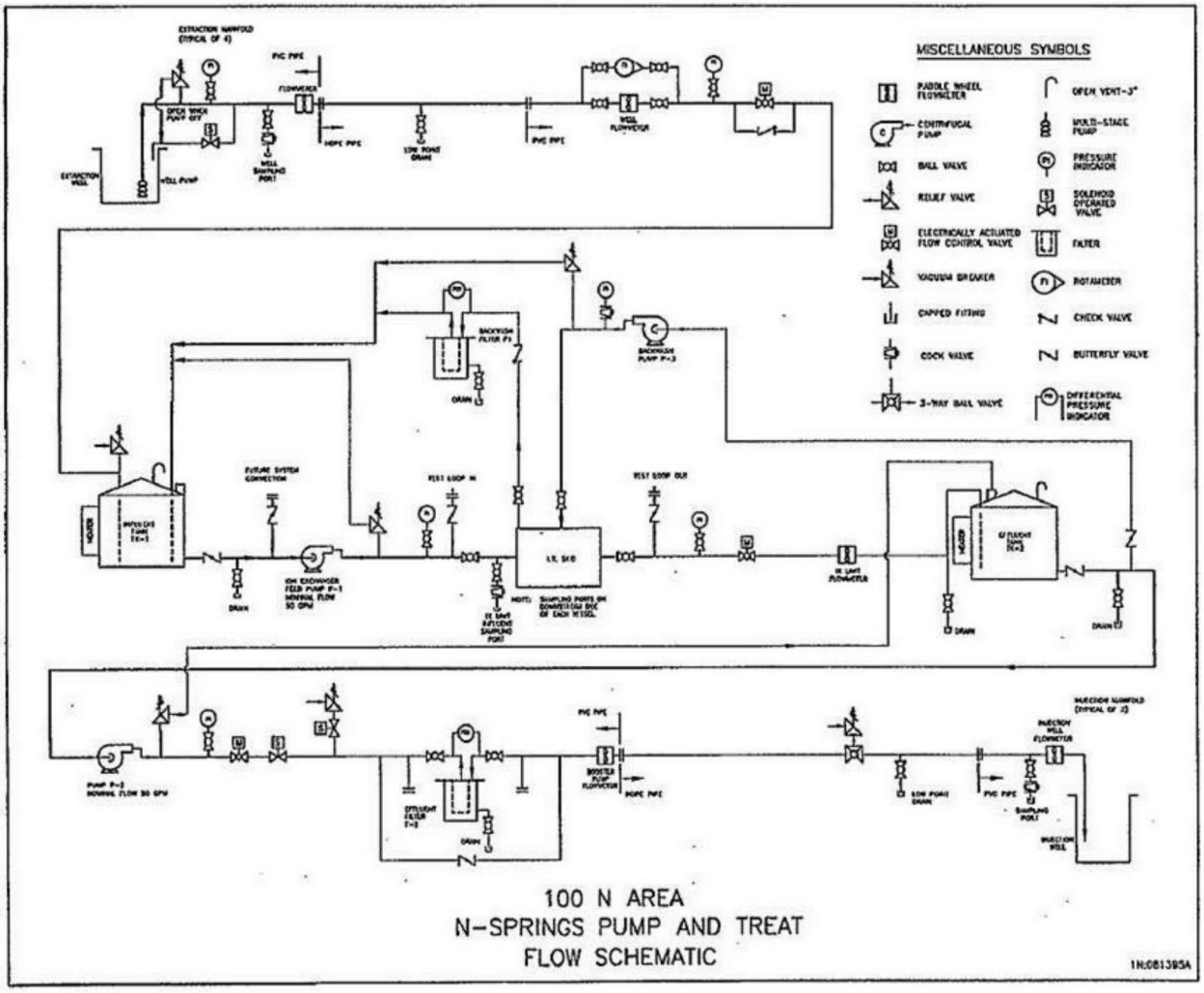


Figure 3-25. P&T Facility Flow Diagram

3.1.3.2 Shutdown Plan

The 100-NR-2 OU P&T system was placed in cold-standby status on March 9, 2006, in support of TPA (Ecology et al., 1989a) Milestone M-16-06-01, "Complete a Permeable Reactive Barrier at 100-N." Treatability testing for an apatite PRB began in April 2006. The system shutdown was required to allow equilibration before placement of the PRB.

The P&T system is scheduled to be permanently shut down, which will include the following:

- Residual IX media will be removed and disposed at ERDF. The IX vessels will be triple-rinsed and disposed at ERDF. All rinse/flushwater will be supplied by a portable tank or purgewater truck. The flushwater will be sent to the Purgewater Storage and Treatment Facility or the Effluent Treatment Facility, as appropriate, in accordance with DOE/RL-2000-41. All noncontact treatment system hardware will be dismantled and reused or salvaged. The shed also will be dismantled and reused or salvaged.

- Aboveground extraction piping will be triple-flushed with clean water, disconnected at the wellhead tees, and disposed at ERDF.

- Manifolds and influent storage vessels that contacted untreated groundwater containing COCs will be triple-flushed with clean water, disconnected, and disposed at ERDF.

- The down-well equipment in the extraction wells (e.g., pump, piping, and level transducer) will be disconnected where attached to the wellhead. The wellhead will be blanked and secured to meet Washington State regulations. The down-well equipment will be disposed in accordance with DOE/RL-2000-41.

- Pipe downstream from the IX skid has only been contacted by treated water and does not need to be flushed. The lines will be drained or blown out with air and then isolated by closing the valves.

- Extraction wells 199-N-75, 199-N-103A, 199-N-105A, and 199-N-106A will be maintained as monitoring wells in the 100-N Area groundwater monitoring network. The well completions (including surface seal, cap, and protective casing or monument) will be altered, if required, to comply with Washington State regulations for monitoring well construction.

- Injection well 199-N-104A will be maintained for use as a monitoring well in the 100-N Area groundwater monitoring network. Injection well 199-N-29 and backup injection well 199-N-31 will be maintained as potential monitoring wells. The well completions (including surface seal, cap, and protective casing or monument) will be altered, if required, to comply with Washington State regulations for monitoring well construction. Any well rack equipment located at the injection wells will be disconnected and disposed in accordance with DOE/RL-2000-41.

3.1.4 Petroleum Hydrocarbon Contamination

The Interim Action ROD, as amended (EPA, 2010), requires any free-floating product observed in any 100-N Area wells to be remediated. Petroleum hydrocarbon contamination as free product has occasionally been observed at wells 199-N-17 and 199-N-18. Well 199-N-17 went dry and was taken out of service and decommissioned. A passive removal method (Smart Sponge) was initiated in 2003 to remove the small amount of free product in Well 199-N-18. This approach was taken because the layer of floating petroleum was too thin for removal by active methods. The average mass removal rate in 2004 was 0.4 kg per month. Any additional wells with observed free product will be subject to this remediation approach.

The apatite barrier is located downgradient of the TPH-D source area and cuts across a relatively dilute, dissolved-phase plume that spreads from the TPH source area to the Columbia River (Figure 1-7). TPH-D was detected in samples from a number of wells in the upriver section of the PRB that were installed during implementation of the shoreline SAP and as reported in the borehole summary report (SGW-47791) (see Section 1.3.1 and Table 1-2). The apatite barrier injections have the potential to displace and dilute the dissolved-phase TPH mass located downgradient of the apatite barrier injection wells. Any TPH contaminant mass potentially mobilized upgradient (i.e., away from the river) will be spread into the surrounding aerobic zones where it is susceptible to aerobic biodegradation.

Along the shoreline, groundwater samples collected annually from the following monitoring wells and the aquifer tubes will continue to be analyzed for TPH-D: 199-N-173, 199-N-346, 199-N-96A, 199-N-347, 199-N-348, 199-N-349, 199-N-123, N116mArray-0A, and N116mArray-2A.

If additional groundwater monitoring or remediation is required for the petroleum release sites, the change control procedures specified in Chapter 4 will be used to amend this document.

3.1.5 Groundwater Monitoring

The SAP (Appendix A) addresses groundwater monitoring to be conducted during saturated zone and vadose zone jet injections to determine the nature and duration of the release of strontium-90 and other metals after injections, as well as to determine the short-term effectiveness of the apatite injections in reducing the flux of strontium-90 downgradient of the barrier.

Long-term groundwater monitoring activities associated with monitoring the upland strontium-90 plume, the TPH plume, and other contaminants (including nitrate, Cr(VI), and manganese) will be performed in accordance with the monitoring plans identified in Section 2.1.3.

3.1.6 Institutional Controls

ICs are required to prevent human exposure to contaminated groundwater that is present in the 100-NR-2 OU. With respect to the 100-NR-2 OU remedial action, all relevant ICs are included in DOE/RL-2001-41. Specific ICs for the 100 Areas are identified in Appendix A1.0 of DOE/RL-2001-41. Continued reliance on these ICs will meet the requirements of the Interim Action ROD, as amended (EPA, 2010). Existing ICs include access controls, water use and land-use restrictions, and signage.

Access control is achieved through Hanford Site badging requirements and the use of signs posted along the Columbia River shoreline for restricted uses. Restrictions on certain land uses (e.g., restricting drilling or excavation) are administered through the onsite excavation permit process. DOE is responsible for establishing and maintaining land-use and access restrictions until the 100-NR-2 OU interim action RAOs are achieved, or until a final remedy is selected and implemented.

DOE will prohibit activities that would interfere with the interim action remedial activities. In addition, necessary measures will be taken to ensure the continuation of these restrictions if there is any transfer or lease of the property. DOE will provide Ecology and EPA with written verification that these restrictions have been put in place.

Additional control measures for the 100-NR-2 OU are included in DOE/RL-2001-41 (Tables A1-6, A1-8, and A1-10) pursuant to the Interim Action ROD (EPA/ROD/R10-99/112); EPA/ROD/R10-00/120; and EPA/ESD/R10-03/605, *Explanation of Significant Differences for the 100-NR-1 Operable Unit Treatment, Storage, and Disposal Interim Action Record of Decision and 100-NR-1/100-NR-2 Operable Units Interim Action Record of Decision, Hanford Site, Benton County, Washington.* These measures include the following:

- DOE will notify Ecology upon the discovery of any trespassing incident and will report the incident to the Benton County Sheriff's Office.
- Until final remedy selection, DOE will not delete or terminate any ICs requirement established in the Interim Action ROD unless Ecology has provided written concurrence and appropriate documentation has been placed in the Administrative Record.
- DOE will evaluate the implementation and effectiveness of ICs for the 100-NR-2 OU annually and will report the result to the EPA and Ecology.
- Additional control measures are included in Table A1-9 of DOE/RL-2001-41 for the 100 Areas pursuant to EPA et al., 2000, *Declaration of the Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington.*

3.1.7 Riprap Cover

The boulder cover at the shoreline will be inspected every 5 years. Maintenance, which could include moving or adding riprap, will be conducted if needed to prevent erosion of the river shoreline.

3.1.8 Lower Road Surface

The lower road will be inspected annually after winter storms, until the entire apatite barrier (including vadose zone jet injections) has been completed, and for 5 years annually thereafter. If damage is not observed during that 5-year period, then the inspection interval will be lengthened to every 5 years.

3.2 Supplemental Design Tasks

No supplemental design-related or treatability testing tasks beyond those described in this RD/RAWP are anticipated at this time. The injection system and multipurpose well network for the saturated zone PRB was designed and constructed as summarized in Section 3.1.1 and as described in DOE/RL-2010-29. Emplacement of apatite in the vadose zone will be performed using commercially available, pre-fitted equipment operated by a CHPRC subcontractor. Therefore, no additional design-related activities are necessary.

3.3 Remedial Design Report

Implementation of the saturated zone PRB expansion work (described in DOE/RL-2010-29) was completed, and a final report following 3 years of monitoring has been prepared to document the test results (SGW-56970).

Interim reports for the interim action remedy will be prepared following completion of the saturated zone PRB and the vadose zone PRB, and final reports will be prepared following 3 years of performance monitoring. Groundwater monitoring results will continue to be documented in annual Hanford Site groundwater monitoring reports. The information provided in future reports for the apatite PRBs will be consistent with that provided in previous annual reports. Progress will be communicated at the unit managers' meetings (including, for example, sample and analyses results, operations, and general project status/timelines).

3.4 Operations and Maintenance Plan

An O&M plan was developed for the 100-NR-2 OU P&T system (Appendix A of DOE/RL-2001-27, Rev. 0). With the implementation of the Interim Action ROD, as amended (EPA, 2010), the O&M plan for the P&T system is no longer applicable, and a separate O&M plan for buildout of the apatite PRB is not planned. The apatite PRB injections are not routine and are anticipated to be one-time events, with possible infrequent need for reinjections (as described in Section 3.1.1.4). O&M activities will primarily be associated with well maintenance and performance monitoring. These activities are addressed in the SAP (Appendix A).

The SAP (Appendix A) specifies the activities required to protect the integrity of the selected remedy and also describes how verification of the selected remedy will be performed. The SAP (Appendix A) includes groundwater monitoring and routine reporting. ICs for the Hanford Site are already in place, as described in DOE/RL-2001-41; therefore, inspection and annual reporting on ICs for the 100-NR-2 OU will be performed in accordance with DOE/RL-2001-41.

4 Remedial Action Management and Approach

This chapter describes the work elements and the management approach associated with implementing the selected remedy. The technical approach and management practices that will be used to meet the RAOs in the Interim Action ROD, as amended (EPA, 2010), are also outlined in this chapter.

4.1 Project Team

The project team includes all of the individuals working to accomplish the interim remedial action. Key project team members include RL (the lead agency), Ecology (the lead regulatory agency), and the CHPRC 100-N Area lead.

4.1.1 Regulatory Agencies

Ecology is the lead regulatory agency for CERCLA remediation activities in the 100-N Area, as described in the TPA (Ecology et al., 1989a). The lead regulatory agency is responsible for overseeing activities to verify that applicable regulatory requirements are met. Lead regulatory agency approval is required on all TPA primary documents (e.g., this RD/RAWP and the SAP [provided as Appendix A], if deemed necessary). Ecology is also responsible for the approval of any changes to the primary documents, field modifications of the SAP, or modifications regarding remedial action design and implementation.

4.1.2 U.S. Department of Energy, Richland Operations Office

RL is the government agency responsible for remedial action throughout the Hanford Site and, as such, has assigned remedial project managers to each main area and task involved with remediation activities. A remedial project manager is responsible for managing the assigned activities, which include scope, budget, schedule, quality, personnel, communication, risk/safety, contracts, and regulatory interface.

4.1.3 CH2M HILL Plateau Remediation Company

The CHPRC 100-N Area lead provides oversight for all activities in the 100-N Area and coordinates with RL, Ecology, Washington Closure Hanford, and subcontractor representatives in support of remediation activities. The CHPRC 100-N Area lead provides technical support to other project team managers to ensure that all work is performed safely and cost effectively.

4.2 Change Management

The following three types of changes to the 100-NR-2 OU selected remedy could affect compliance with the requirements of the Interim Action ROD, as amended (EPA, 2010):

- **Fundamental change:** A change that does not meet the requirements set forth in the Interim Action ROD, as amended, or that incorporates remedial activities not defined in the scope of the ROD. Any fundamental change would be performed under a ROD amendment.
- **Significant change:** Generally involves a change to a component of a remedy that does not fundamentally alter the overall cleanup approach. All significant changes will be addressed in an explanation of significant differences.
- **Minor change:** A change that will not have a significant impact on the scope, performance, or cost of the remedy. Minor changes will be documented in the appropriate post-decision project file (e.g., through interoffice memoranda or logbooks). Because these changes are not significant, they will not affect the requirements of the ROD or functional requirements.

Determining the significance of the change is the responsibility of RL and Ecology. The CHPRC 100-N Area lead is responsible for tracking all changes and obtaining appropriate reviews and will discuss the change with RL. RL will then discuss the type of change that is necessary with Ecology, up to and including changes described in Section 9.3 and Section 12.0 of the TPA Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*). Appropriate documentation will follow in accordance with the requirements for that type of change. Changes will not be implemented until RL and Ecology concur on the change and the Interim Action ROD is amended or an explanation of significant differences is issued, as appropriate. Minor changes, including updates to this RD/RAWP, can be made following the guidance provided in Section 9.3 of the TPA Action Plan (Ecology et al., 1989b), which includes the use of change notices.

5 Environmental Management and Controls

This chapter summarizes the environmental management controls associated with waste management, health and safety, emergency response, and the QA program.

5.1 Air Emissions

Radiological and nonradiological air emissions associated with deployment of the apatite PRB are not anticipated under the selected remedy. A diesel generator will temporarily be required during installation of the apatite barrier. Depending on the size of the engine powering the generator, an evaluation will be conducted to determine reporting requirements, if any.

5.2 Reporting Requirements for Nonroutine Releases

In accordance with 40 CFR 302, "Designation, Reportable Quantities, and Notification," immediate notification to the National Response Center is required upon discovery of a release of a hazardous substance into the environment in excess of a reportable quantity in a 24-hour period. Any UPR of the apatite-forming chemical sodium phosphate exceeding the reportable quantity of 2,270 kg will be reported. There is no reportable quantity for calcium citrate.

40 CFR 355, "Emergency Planning and Notification," requires immediate notification to the community emergency coordinator for the local emergency planning committee and to the State Emergency Response Commission for a release of a reportable quantity of an extremely hazardous substance or a CERCLA hazardous substance in a 24-hour period, except for releases exempted from reporting under 40 CFR 355.31, "What Types of Releases are Exempt from the Emergency Release Notification Requirements of this Subpart?". There are no extremely hazardous substances associated with emplacement of apatite-forming chemicals.

A diesel generator will be used to operate the site facilities, injection/monitoring equipment, and ancillary equipment. In the unlikely event of a diesel fuel spill, established procedures will be implemented, including notification of regulatory agencies when required. The provisions of this procedure are intended to facilitate spill response and cleanup in a manner that is protective of HHE and that meets applicable federal, state, and local environmental regulations; environmental permits; and compliance agreements and orders.

Notwithstanding, any incident that involves a spill, release, fire, explosion, or environmental permit exceedance will be reported to the CHPRC environmental event single point of contact, as required by DOE/RL-94-02, *Hanford Emergency Management Plan*, to determine the applicability of requirements and to perform appropriate environmental notifications.

5.3 Waste Management

All regulated waste generated during the implementation activities described in this RD/RAWP (including apatite injection, groundwater monitoring, petroleum removal, and decommissioning of the P&T system) will be managed in accordance with DOE/RL-2000-41. Disposition of purgewater and miscellaneous solid waste will be conducted in accordance with DOE/RL-2000-41.

Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the laboratory contract and agreements for return of the waste to the project site. Pursuant to the NCP (40 CFR 300.440, "Procedures for Planning and Implementing Off-Site Response Actions"), RL project manager approval is required before returning unused samples or waste from offsite laboratories, as applicable.

Table 5-1 summarizes the projected waste streams expected during well drilling, well development, and apatite PRB deployment.

Table 5-1. General Waste Stream Description

General Waste Stream Description	Hazard Classification Anticipated	Container Options	Estimated Annual Volumes	Disposal Pathway Options	Hazard Source
Drill cuttings (dry soils and saturated slurries; sample returns)	Low-level, mixed, hazardous, dangerous, nonregulated	Roll-off boxes, drums	300 to 400 tons	ERDF	CERCLA
Liquids, but not limited to the following: decontamination liquids; purgewater generated during well installation, development, testing, and sampling; decant from drilling slurries; pore water generated from sampling of aquifer tubes; and unused and unmixed injection chemicals	Low-level, mixed, hazardous, dangerous, nonregulated	Purge water trucks, temporary transfer drums	1,000,000 gal	Effluent Treatment Facility	CERCLA
Miscellaneous solid waste, but not limited to the following: personal protective equipment, cloth, plastic, wipes, wood, equipment, tools, pumps, wire, metal casing, plastic piping, sample returns, etc.	Low-level, mixed, hazardous, dangerous, nonregulated	Burial box	2 tons	ERDF	CERCLA
Excess premixed chemicals/reagents	Nonregulated	Unused reagent chemicals that have been pre-mixed will be infiltrated within the apatite PRB footprint to promote additional vadose zone treatment			Nonregulated
Decontamination and demolition debris (from pump and treat decommissioning) such as, but not limited to, the following: concrete, wood, rebar, metal/plastic pipes and screens, wire, bentonite, sand, gravel, equipment, pumps, and tanks	Low-level, mixed, hazardous, dangerous, nonregulated	Burial boxes	10 tons	ERDF	CERCLA, nonregulated

CERCLA = *Comprehensive Environmental Response Compensation and Liability Act of 1980*
ERDF = Environmental Restoration Disposal Facility
PRB = permeable reactive barrier

5.4 Cultural/Ecological Resources

National Environmental Policy Act of 1969 (NEPA) values are incorporated into DOE CERCLA documentation (DOE O 451.1B, Chg 2, *National Environmental Policy Act Compliance Program*). NEPA values include, but are not limited to, consideration of the cumulative, ecological, cultural, historical, and socioeconomic impacts of the proposed remedial alternative. NEPA values were incorporated into the 100-N Area RI/FS (Chapter 8 of DOE/RL-2012-15, Draft A), and the conclusions will be included in the CERCLA ROD. For the remedies described in this document, environmental impacts include temporary short-term disturbances (e.g., increased traffic, noise levels, and fugitive dust) within limited areas. DOE expects minimal, if any, long-term impacts to air quality, natural resources, historical resources, transportation, socioeconomic values, or environmental justice.

Because the area associated with the apatite barrier installation has been previously disturbed, this project is not expected to affect historical properties (36 CFR 800, Subpart B, "The Section 106 Process"), and no further actions should be required. This assumption will be evaluated and confirmed as part of the DOE Hanford Cultural Resource Program cultural release process before initiating field activities. Additionally, as a precaution, all workers will be directed to be aware of potential cultural materials (e.g., bones and artifacts) during all work activities. If any cultural materials are encountered, work in the vicinity of the discovery must stop until a DOE Hanford Cultural Resource Program archaeologist has been notified, has assessed the significance of the find, and has arranged for mitigation of the impacts to the find, if necessary.

5.5 Health and Safety Program

All field operations will be performed in accordance with CHPRC health and safety requirements, as outlined in the latest revision of the S&GRP health and safety plan (SGW-41472, *Soil and Groundwater Remediation Project Site Specific Health and Safety Plan (HASP)*). Radiological contamination is probable during performance of injection boring drilling and sampling activities. The sampling processes and associated activities will take into consideration exposure reduction and contamination control techniques (e.g., as low as reasonably achievable, and Integrated Safety Management System) that will minimize chemical exposure to the sampling team. Health and Safety personnel will use data collected during the activities addressed in DOE/RL-2010-29 and DOE/RL-2010-68 as input to determine exposure levels to workers, and to conduct health and safety assessments during all field activities.

All hazard controls associated with the apatite injection will be controlled by the job hazard analysis process, as implemented through DOE-approved programs and contractor-approved internal work requirements and processes.

The Health and Safety officer is responsible for coordinating industrial safety and health support for the project, and for other pertinent safety documents required by federal regulation or by internal primary contractor work requirements. In addition, the CHPRC Health and Safety program assists project personnel in complying with applicable health and safety standards and requirements, and coordinating with radiological engineering to determine personal protective clothing requirements, as necessary.

5.6 Quality Assurance Program

The QA engineer is responsible for QA issues on the project. Responsibilities include (as appropriate) overseeing implementation of the project QA requirements; reviewing project documents, including data needs summary reports, field sampling plans, and the quality assurance project plan; and participating in QA assessments for sample collection and analysis activities. The QA point of contact must be independent of the unit generating the data.

QA and QC procedures for the saturated zone and vadose zone 100-NR-2 OU apatite PRB buildout are specified in the SAP (Appendix A). The operations test results to confirm the injection chemical concentrations and flow rates will be recorded on data sheets, including flow rates and volumes, pressure changes, monitoring data, and any adjustments needed. The data will be reported in the remedy performance reports.

6 Remedial Action Completion

This chapter describes how the effectiveness of the apatite PRB interim remedial action component will be evaluated, and the contingency actions that may be implemented if the PRB does not achieve the expected decline in strontium-90 concentrations. The long-term compliance monitoring strategy that will be used to show ultimate attainment of the final cleanup values in the hyporheic zone will be presented in the RD/RAWP for the final remedy.

6.1 Remedial Action Exit Strategy

The apatite PRB will likely be an important component of the final remedy for the 100-N Area, which will be implemented following the issuance of a final ROD. At this time, this interim remedial action has no exit strategy other than to include it as a component of the final remedy, if supported by the CERCLA evaluation to be presented in the final RI/FS report.

Achieving the goal of declining strontium-90 concentrations will be determined by comparing strontium-90 concentrations in groundwater samples collected downgradient of the apatite PRB over time. Four-event moving average concentrations will be determined for individual monitoring wells for up to a 5-year period. If specific wells do not show declining concentrations and remain above cleanup levels, the PRB sections upgradient from the wells will be considered for reinjection. Wells where cleanup levels have been achieved will not need to be evaluated for reinjection. Time-series charts will be prepared for all PRB monitoring wells (Table 6-1), and average concentrations will be calculated annually. Section 3.1.1.4 provides additional discussion on this process.

Table 6-1. Apatite PRB Monitoring Wells

199-N-173	199-N-146	199-N-354	199-N-360	199-N-366
199-N-346	199-N-122	199-N-355	199-N-361	199-N-367
199-N-96A	199-N-147	199-N-356	199-N-362	199-N-92A
199-N-347	199-N-350	199-N-357	199-N-185	
199-N-348	199-N-351	199-N-358	199-N-363	
199-N-349	199-N-352	199-N-99A	199-N-364	
199-N-123	199-N-353	199-N-359	199-N-365	

6.2 Interim Remedial Action Completion Report

The documents and milestones that will precede the completion report, and several other subsequent pertinent reports or reviews, are listed in Table 6-2.

DOE and the regulatory agency project managers will determine the need for a final inspection based on the results of the pre-final inspection and the content of the pre-final inspection report. A final inspection will verify the closure of open items from the pre-final inspections, and it will confirm and document that satisfactory progress is being made toward achieving the flux reduction goal. The final inspection, conducted by the Tri-Parties' project managers, will confirm the resolution of outstanding items identified in the pre-final inspection and will verify that the remediation has been completed in accordance with the requirements of the Interim Action ROD, as amended (EPA, 2010). The results of the final inspection

will be incorporated in the Hanford Site completion report. Information collected as part of the final inspection and the final inspection report will be no less than that collected during a pre-final inspection and pre-final inspection report. The final inspection report should contain the following elements:

- Results of the final inspection
- Evaluation of the effectiveness in meeting treatment system performance requirements based on the results of the shakedown period

Following full buildout of the apatite PRB, DOE will prepare an interim remedial action completion report. The report for a given OU is used only for remedial actions that include groundwater or surface water restoration remedies, including MNA. Interim reports are used because of the long delay between the construction of the remedy and the achievement of cleanup goals.

Table 6-2. Preliminary Documents and Milestones

Activity/Report	FY Complete
Annual groundwater monitoring reports	Completed annually
183 m (600 ft) PRB 2011 expansion report	2015
Interim remedial design/remedial action work plan (Rev. 2)	2015
Pre-final inspection report	Same FY following completion of saturated zone and vadose zone injections
Saturated zone apatite PRB final buildout report	Same FY following completion of saturated zone and vadose zone injections
Vadose zone jet injection final buildout report	Same FY following completion of saturated zone and vadose zone injections
Interim remedial action completion report	Same FY following completion of saturated zone and vadose zone injections
Interim milestone report	Same FY following completion of saturated zone and vadose zone injections
Hanford Site CERCLA 5-year review	2017
Major milestone report	2024

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
FY = fiscal year
PRB = permeable reactive barrier

7 Cost and Schedule

This chapter provides the project schedule, which is divided into major phases or components. The schedule will reflect completed milestones to date and will provide sufficient detail to allow development of future milestones. Document review protocol and requirements will be incorporated into the schedule. If developed, schedules for performing activities will be provided subsequent to or in coordination with this project.

7.1 Cost Summary

A cost estimate and schedule for the 100-NR-2 OU interim actions for the time frame of fiscal year (FY) 2014 to FY 2018 are provided in Tables 7-1 and 7-2, respectively. The schedule shown in Table 7-2 includes the buildout and footage to be added each year. The cost estimate includes costs for the following:

- **Project support:** Includes project management and coordination-related activities and technical consultation, as required, during the course of the design, construction, and operation.
- **PRB performance monitoring:** Includes groundwater sampling and sample analysis of PRB monitoring wells and aquifer tubes.
- **Groundwater monitoring and reporting:** Includes groundwater sampling, sample analysis, and reporting for long-term monitoring for identified COCs and COPCs for the 100-NR-2 OU.
- **O&M:** Represents supplies, labor, and craft supervision costs associated with well maintenance and maintaining ICs.
- **Saturated zone injections:** Includes materials and labor for planning, designing, conducting injections, and reporting. Also includes subcontractor fees for materials and equipment.
- **Vadose zone injections:** Includes materials and labor for planning, designing, conducting injections, and reporting. Also includes subcontractor fees for materials and equipment, drilling, injecting, and decommissioning boreholes.
- **TPH removal:** Represents supplies, labor, and craft supervision costs associated with TPH free-product removal.
- **P&T demolition:** Includes costs for demolition of the 100-NR-2 OU P&T system.

The cost estimate presented in this section is based on the best available information regarding the scope of the interim actions. The cost estimate represents an order of magnitude estimate, with an expected accuracy of +50 to -30 percent. Changes in the scope of the apatite PRB design and its construction may arise as a result of new information obtained through the implementation of the work described in DOE/RL-2010-29 and DOE/RL-2010-68. These changes will likely result in a final project cost that differs from the estimate presented in this RD/RAWP.

7.2 Schedule

Table 7-2 provides a projected activity schedule through the full buildout of the apatite PRB. This schedule reflects projected dates prior to a boundary revision to an existing traditional cultural property. The revised traditional cultural property boundary, effective in January 2014, now encompasses the project area. A cultural review of the project activities addressing the requirements of the NHPA Section 106 process (specifically 36 CFR 800.3, "Initiation of the Section 106 Process," through 800.5,

"Assessment of Adverse Effects") have deemed the project to have an "adverse effect" on the traditional cultural property, as defined in 36 CFR 800.5(b). As such, the work involved in completion of the barrier and the facility decommissioning and demolition is dependent upon completion of the NHPA Section 106 reviews and is subject to schedule delays pending establishment of a memorandum of understanding to conduct the project activities deemed to have an adverse effect on the traditional cultural property.

Table 7-1. 100-NR-2 OU Interim Action Cost Estimate (2014 through 2018)

Activity	Estimated Cost ($)
Project support	2,739,460
PRB performance monitoring	2,138,564
Groundwater monitoring and reporting	6,371,949
Operations and maintenance	2,429,371
Saturated zone injections	5,363,769
Vadose zone injections	7,494,890
TPH removal	175,385
Pump and treat decommissioning and demolition	1,601,124
Saturated zone injections (reinjections)	1,610,791
Total estimated cost	**$27,882,422**

Table 7-2. Interim RD/RAWP Schedule

Activity	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Initiate and complete work to expand groundwater PRB to 579 m (1,900 ft)	X[a]			X[b]	X[b]
Initiate and complete work to expand groundwater PRB to 762 m (2,500 ft)	X[a]			X[b]	X[b]
Initiate and complete work for vadose zone jet injection 305 m (1,000 ft)	X[a]			X[b]	X[b]
Pump and treat facility decommissioning planning	X				
Pump and treat decommissioning and demolition			X	X	
PRB monitoring	X	X	X	X	X
PRB reinjections, as needed				X[b]	X[b]

a. Activity initiated but then suspended to complete cultural resources reviews associated with revision of traditional cultural property boundary.

b. Anticipated period of performance following completion of *National Historic Preservation Act of 1966* Section 106 reviews and confirmation of PRB placement based on finalization of analysis in the 100-N Area RI/FS (DOE/RL-2012-15, Rev 0 pending).

FY = fiscal year

PRB = permeable reactive barrier

A second set of PRB injections will occur within 5 years of the first injections, if necessary (as described in Section 3.1.1.4). Monitoring will be conducted until the preliminary remediation goal has been achieved along the length of the PRB at the river boundary, which, according to the groundwater modeling presented in the 100-N Area RI/FS (DOE/RL-2012-15, Draft A), is approximately the

year 2125. The time frame for cleanup is being further evaluated and will be updated with the 100-N Area RI/FS (DOE/RL-2012-15, Rev. 0 pending).

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8 References

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=1b3f661bad4b1ca290b1e76814091b3d&node=pt10.2.61&rgn=div5.

36 CFR 65, "National Historic Landmarks Program," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=1b3f661bad4b1ca290b1e76814091b3d&node=pt36.1.65&rgn=div5.

36 CFR 800, "Protection of Historic Properties," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=1b3f661bad4b1ca290b1e76814091b3d&node=pt36.3.800&rgn=div5.

36 CFR 800.3, "Initiation of the Section 106 Process."

36 CFR 800.4, "Identification of Historic Properties."

36 CFR 800.5, "Assessment of Adverse Effects."

Subpart B, "The Section 106 Process."

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=1b3f661bad4b1ca290b1e76814091b3d&node=pt40.9.61&rgn=div5.

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Appendix A

Sampling and Analysis Plan for the 100-NR-2 Groundwater Operable Unit

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Signature Page

Title: *Sampling and Analysis Plan for the 100-NR-2 Groundwater Operable Unit*

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A2 Saturated Zone Aquifer and Vadose Zone Jet Injection Projects ..... Insert A2, Page i
A3 Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit ..... Insert A3, Page i

Terms

ALARA	as low as reasonably achievable
AEA	*Atomic Energy Act of 1954*
ASTM	American Society for Testing and Materials
BTR	buyer's technical representative
BTEX	benzene, toluene, ethylbenzene, and xylene
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DOT	U.S. Department of Transportation
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
EB	equipment blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEAD	format for electronic analytical data
FS	feasibility study
FSO	Field Sampling Operations
FTB	full trip blank
FXR	field transfer blank
FWS	field work supervisor
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
HEIS	Hanford Environmental Information System

IATA	International Air Transport Association
IC	ion chromatography
ICP	inductively coupled plasma
ICP/AES	inductively coupled plasma/atomic emission spectroscopy
ICP/MS	inductively coupled plasma/mass spectrometry
LCS	laboratory control sample
LRA	lead regulatory agency
MB	method blank
MDA	minimum detectable activity
MDL	method detection limit
MNA	monitored natural attenuation
MS	matrix spike
MSD	matrix spike duplicate
MTCA	"Model Toxics Control Act—Cleanup" (WAC 173-340)
N/A	not applicable
NAPL	nonaqueous-phase liquid
NCO	nuclear chemical operator
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PNNL	Pacific Northwest National Laboratory
PPE	personal protective equipment
PRB	permeable reactive barrier
PSQ	principal study question
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
RD/RAWP	remedial design/remedial action work plan

RI	remedial investigation
ROD	record of decision
RPD	relative percent difference
RUM	Ringold upper mud (unit)
SAF	sample authorization form
SAP	sampling and analysis plan
SMILE	Sample Management Integrated Lifecycle Environment
SMR	Sample Management and Reporting
SPLIT	split
SUR	surrogate
TPH	total petroleum hydrocarbons
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
Tri-Parties	U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy
TSD	treatment, storage, and disposal
WTPH	Washington total petroleum hydrocarbons
VOA	volatile organics analysis
VOC	volatile organic compound
WIDS	Waste Information Data System

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A1 Introduction

This sampling and analysis plan (SAP) presents the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) groundwater monitoring program for the 100-NR-2 Groundwater Operable Unit (OU). The 100-NR-2 Groundwater OU is located adjacent to the Columbia River on the U.S. Department of Energy (DOE) Hanford Site in southeast Washington State (Figure A-1). This OU comprises the groundwater contaminated by releases from the 100-NR-1 source OU facilities and waste sites associated with past operation of the 105-N Reactor. The 105-N Reactor (operational from 1963 to 1987) and activities associated with reactor operations (e.g., liquid waste disposal practices) have impacted the soil, groundwater, and the Columbia River.

The 100-NR-1 source OU includes waste sites contaminated because of intentional/unintentional releases to the soil column. Most of these waste sites have been cleaned up according to EPA/ROD/R10-99/112, *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (100-NR-1 and 100-NR-2 OUs ROD). Strontium-90 (Sr-90), tritium, nitrate, total petroleum hydrocarbons (TPH), and metals are the main contaminants of potential concern (COPCs) and risk drivers in the 100-NR-1 and 100-NR-2 OUs.

The 100-NR-2 OU groundwater monitoring program addresses both long-term and performance monitoring under CERCLA. The long-term program (i.e., routine monitoring) is being performed for continued evaluation of the nature and extent of Sr-90, tritium, nitrate, TPH, chromium, and hexavalent chromium contamination. Performance monitoring is being conducted to assess groundwater conditions associated with remedial actions for Sr-90 and TPH contamination.

Performance monitoring is being conducted along an apatite[1] permeable reactive barrier (PRB) to evaluate the effectiveness of this interim remedy to limit Sr-90 groundwater contaminant migration into the Columbia River. The selected interim remedy from EPA, 2010, *U.S. Department of Energy, 100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*, combines apatite sequestration, monitored natural attenuation (MNA), and institutional controls to reduce Sr-90 flux to the Columbia River. The mass of apatite to be emplaced within the PRB footprint is designed to sequester Sr-90 entering the PRB via groundwater flow over the next 300 years. These activities are intended to ensure protection of public health and the environment by achieving the remedial action objectives (RAOs) until a final remedy is selected for the 100-NR-2 OU. RAOs are identified in the remedial design/remedial action work plan (RD/RAWP) (DOE/RL-2001-27, *Remedial Design/Remedial Action Work Plan for 100-NR-2 Operable*, Chapter 2).

The 100-NR-1 and 100-NR-2 OUs ROD (EPA/ROD/R10-99/112) identifies in situ bioremediation (using, bacteria, nutrients, and supplied oxygen) as the selected remedy for the cleanup of petroleum in the vadose zone greater than 4.6 m (15 ft) below the surrounding grade. To implement the remedy, bioventing is being performed for in situ bioremediation of deep vadose zone petroleum contamination at the UPR-100-N-17, 166-N Diesel Oil Supply Line Leak waste site. Although cleanup and monitoring of the vadose zone are not within the scope of this SAP, an important element of the in situ bioremediation remedy is the monitoring of groundwater within and surrounding the bioremediation treatment area to evaluate impacts to the aquifer. The implementation of bioventing is described in Appendix H of DOE/RL-2005-93, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*. DOE/RL-2005-93 describes performance monitoring requirements for the deep vadose zone and the underlying aquifer. Groundwater monitoring requirements defined in DOE/RL-2005-93 are incorporated into this SAP to ensure a complete understanding of the data being collected associated with groundwater.

[1] Apatite is a phosphate mineral with the chemical formula $Ca_{10}(PO_4)_6(OH)_2$.

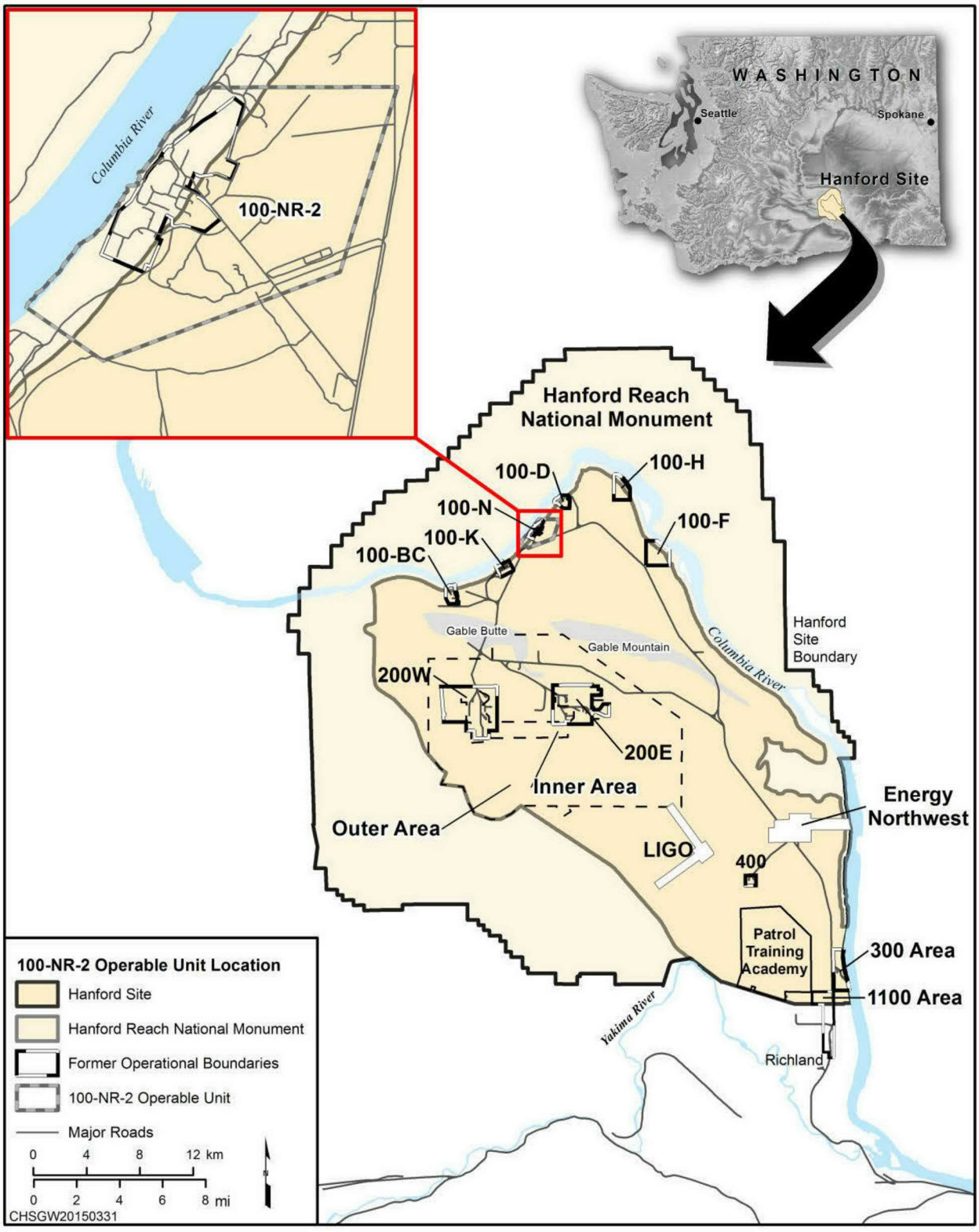


Figure A-1. 100-NR-2 OU Location Map

Atomic Energy Act of 1954 (AEA) and *Resource Conservation and Recovery Act of 1976* (RCRA) groundwater monitoring are also conducted within the 100-NR-2 Groundwater OU. Groundwater monitoring is performed at four RCRA (i.e., WAC 173-303, "Dangerous Waste Regulations") treatment, storage, and disposal (TSD) sites 1324-N/NA (120-N-1, 120-N-2), 1301-N (116-N-1), and 1325-N (116-N-3). RCRA monitoring is conducted according to WHC-SD-EN-AP-038, *Groundwater Monitoring Plan for 1301-N, 1324-N, 1324-NA, and 1325-N Sites*, and supplemented by PNNL-13914, *Groundwater Monitoring Plan for the 1301-N, 1324-N/NA, and 1325-N RCRA Facilities*. For information purposes, the RCRA groundwater monitoring requirements for the four RCRA sites are included with the CERCLA groundwater monitoring requirements identified in this SAP. To clarify sampling requirements applicable to the AEA, a groundwater monitoring plan is currently being developed.

This SAP was prepared based on the 100-NR-2 OU groundwater data quality objective (DQO) process in Insert A1 and information from the following documents/databases:

- DOE/RL-2012-15, *Remedial Investigation/Feasibility Study for the 100-NR-1 and 100-NR-2 Operable Units* (Draft A)
- DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*
- DOE/RL-2001-27, *Remedial Design/Remedial Action Work Plan for the 100-NR-2 Operable Unit*, Rev. 1, Appendix A, "100-NR-2 Groundwater Operable Unit Sampling and Analysis Plan for Interim Actions Associated with Saturated and Vadose Injection Projects, Long-Term/Routine Monitoring, and Barrier Performance Monitoring"
- DOE/RL-2005-93, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, Rev. 1, Appendix H, "Phase II Testing Performance Monitoring Plan for the UPR-100-N-17 Bioremediation," October 2013
- EPA/ROD/R10-99/112, *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site Benton County, Washington*
- EPA 2010, *100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*
- Hanford Environmental Information System (HEIS)

This SAP consists of five chapters with the remainder of this section addressing the project scope and objectives, background, DQOs, contaminants, and the project schedule. Chapter 2 discusses the quality assurance (QA) requirements. Chapter 3 provides the field sampling plan. Chapters 4 and 5 address waste management and health and safety requirements. Insert A1 contains the "Data Quality Objectives Summary Report for 100-NR-2 OU Groundwater Monitoring." Insert A2 provides additional information on the PRB and characterization requirements applicable to its installation and extension. Insert A3 provides information on the hydrogeologic unit monitored.

A1.1 Project Scope and Objectives

The scope of this SAP includes CERCLA 100-NR-2 OU long-term groundwater monitoring, apatite PRB performance monitoring, and groundwater monitoring associated with in situ bioremediation/bioventing performance monitoring. The objectives of this SAP are to collect the required data to:

- Determine the effectiveness of the PRB to reduce Sr-90 concentrations in groundwater down-gradient of the barrier. This evaluation includes remedy performance monitoring for the combined saturated zone and vadose zone PRB.
- In conjunction with the bioremediation of petroleum, monitor the groundwater underlying the area of TPH contamination to support an evaluation of the bioventing system for achieving compliance with the cleanup standards.
- Better define the nature (type and concentration) and extent (distribution) of Sr-90, tritium, nitrate, TPH, chromium, and hexavalent chromium contamination. These contaminants exceed one or more of the following: drinking water standard, ambient water quality criteria, or WAC 173-340, "Model Toxics Control Act—Cleanup" (MTCA) Method B groundwater cleanup standard.
- Determine the concentrations of chromium and hexavalent chromium in the confined aquifer in Well 199-N-80.
- Determine if antimony, cadmium, and cobalt contamination are present above action/cleanup levels. The occurrence of antimony, cadmium, and cobalt in groundwater is uncertain because these analytes historically have been detected in groundwater at concentrations above their respective action level; however, their presence was not associated with a specific location or a trend and the analytical methods used were not sufficient for risk characterization purposes.

Insert A2 in this SAP also describes activities and tasks outlined in DOE/RL-2001-27, Rev. 1, to address the following:

- Extension of the existing apatite PRB in the saturated zone from 90 m (300 ft) to approximately 760 m (2,500 ft).
- Implementation of a 305 m (1,000 ft) apatite barrier to enhance the attenuation of Sr-90 in the vadose zone, emplaced via jet injection above and within the groundwater PRB along the shoreline.
- First year of remedy performance monitoring for the combined saturated zone and vadose zone PRB following injections. Performance monitoring after the first year will be conducted in accordance with this SAP.

Contaminants of concern (COCs), COPCs for long-term groundwater monitoring, apatite PRB performance monitoring, and in situ bioremediation/bioventing performance monitoring are listed in Table A-1. An evaluation of COC/COPCs retained is presented in the remedial investigation (RI)/feasibility study (FS) (DOE/RL-2012-15, Draft A) and summarized in the 100-NR-2 DQO summary report (Insert A1).

Table A-1. Summary of COCs, COPCs, Background, and Water Quality Criteria

COCs and COPCs	DOE/RL-96-61 Background Values (µg/L)	Drinking Water Standards (µg/L unless noted otherwise)	Ambient Water Quality Standards (µg/L unless noted otherwise)
Interim Action Record of Decision			
Sr-90	1.03 pCi/L	8 pCi/L	278 pCi/L[a]
Tritium	119 pCi/L	20,000 pCi/L	No value

Table A-1. Summary of COCs, COPCs, Background, and Water Quality Criteria

COCs and COPCs	DOE/RL-96-61 Background Values (µg/L)	Drinking Water Standards (µg/L unless noted otherwise)	Ambient Water Quality Standards (µg/L unless noted otherwise)
Total Chromium (filtered)	2.4	100	65
Hexavalent chromium	No value	48	10
Manganese (filtered)	38.5	50	No value
Nitrate	26,871	10,000[b]	No value
Sulfate	47,014	250,000 (secondary)	No value
Total TPH	No value	500	No value
Apatite Barrier Performance Monitoring			
Sr-90	1.03 pCi/L	8.0 pCi/L	278 pCi/L[a]
Anions[c]	Analyte-specific	Analyte-specific	Analyte-specific
Chloride	15,630	250,000 (secondary)	230,000
Nitrate	26,871	10,000[b]	No value
Sulfate	47,014	250,000 (secondary)	No value
Alpha (gross)	0	15 pCi/L	No value
Beta (gross)	3.1 pCi/L	4.0 mrem/yr	No value
Cadmium	0.916	5	0.25
Calcium	52,644	No value	No value
Total chromium	2.4	100	65
Magnesium	24,816	No value	No value
Manganese	38.5	50 (secondary)	No value
Sodium	26,998	No value	No value
TPH-Diesel	No value	500	No value
Bioventing Performance Monitoring			
TPH-Diesel	No value	500	No value
TPH-Gasoline	No value	1,000	No value
TPH-Motor oil	No value	No value	No value
Oil and grease	No value	No value	No value
VOC (BTEX)	No value	Analyte-specific	Analyte-specific
PAH	No value	Analyte-specific	Analyte-specific
Arsenic	7.85	0.058	150
Barium	105	2,000	No value
Cadmium	0.916	5	0.25
Total Chromium	2.4	100	65

Table A-1. Summary of COCs, COPCs, Background, and Water Quality Criteria

COCs and COPCs	DOE/RL-96-61 Background Values (µg/L)	Drinking Water Standards (µg/L unless noted otherwise)	Ambient Water Quality Standards (µg/L unless noted otherwise)
Iron	570	300	1,000
Lead	0.917	15	2.1
Magnesium	24,816	No value	No value
Manganese	38.5	50 (secondary)	No value
Selenium	10.5	50	5
Silver	5.28	80	2.6
Sodium	26,998	No value	No value
Nitrite	No value	3,300	No value
Nitrate	26,871	10,000[b]	No value
Phosphate	162	No value	No value
Alkalinity	147,127	No value	No value
Contaminants Retained in DOE/RL-2012-15, Draft A			
Sr-90 (COC)	1.03 pCi/L	8.0 pCi/L	278 pCi/L[b]
Ethylbenzene (COC)	No value	4	No value
Nitrate (COC)	26,871	10,000[b]	No value
TPH-Diesel (COC)	No value	500	No value
Tritium (COPC)	119 pCi/L	20,000 pCi/L	No value
Antimony (uncertain COPC)	55.1	6	No value
Cadmium (COPC)	0.916	5	0.25
Total chromium (COPC)	2.4	100	65
Hexavalent chromium (COPC)	No value	48	10
Cobalt (uncertain COPC)	0.916	4.8	No value
TPH-Gasoline (COPC)	No value	1,000	No value

DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*.

a. Benchmark (not criteria).

b. Nitrate may be expressed as total nitrate (NO3) or as total nitrogen (N). The MCL for nitrate as NO3 is 45,000 µg/L, and the same concentration expressed as N is 10,000 µg/L. (EPA's drinking water regulations are published as 10,000 µg/L.)

c. Anions include, but are not limited, to chloride, nitrate, and sulfate.

COC = contaminant of concern
COPC = contaminant of potential concern
PAH = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons
VOC = volatile organic compound

As part of the DQO process described in the 100-NR-2 OU DQO summary report (Insert A1), historical sampling locations and the analytical results generated from the 100-NR-2 Groundwater OU monitoring

network from the period from January 2009 through December 2014 were reviewed in the development of this SAP. The locations of monitoring wells and aquifer tubes with respect to the year 2013 plume configurations were analyzed with the objective of optimizing the current well network and sampling requirements. The analysis was directed at defining those wells and aquifer tubes needed for contaminant monitoring and determination of an appropriate sampling frequency. Throughout the remainder of this document, when discussing "wells," aquifer tubes are also included.

The monitoring networks identified in this SAP are designed to collect groundwater data sufficient to achieve project objectives defined in Section A1.1. This monitoring will be conducted until a final 100-NR-2 ROD is issued. In the interim, data collection requirements may require modification based on the data collected, operational changes in the performance monitoring networks, and refinement of contaminant distribution models. Changes to this SAP will be approved by DOE, the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA).

Long-term and performance groundwater monitoring data will be reported in the annual Hanford Site groundwater report. The data gathered under this plan help satisfy the requirements of CERCLA (40 CFR 300.430(b), "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy"). Table A-2 identifies the existing documents that have sampling requirements associated with the 100-NR-2 OU and identifies which existing document is completely or partially superseded by this SAP.

CERCLA groundwater monitoring requirements in the 100-NR-2 OU are addressed by this new plan. Programmatic requirements for RCRA groundwater monitoring associated with the 1301-N Radioactive Liquid Waste Disposal Trench, 1324-N Surface Impoundment/1324-NA Percolation Pond, and 1325-N Liquid Effluent Disposal Facility are found in a separate plan. A groundwater monitoring plan is currently being developed to clarify sampling requirements applicable to the AEA. The data collected for RCRA and AEA groundwater monitoring are considered as supplementary groundwater quality information to the CERCLA OU process.

DOE/RL-2012-59, *Surveillance Groundwater Monitoring on the Hanford Site*, issued in October 2013, includes monitoring specifications of the upper basalt confined aquifer and the Ringold confined aquifer. Groundwater within the upper basalt confined aquifer is monitored because it is a potential pathway for contaminants to move offsite. The confined to semi-confined aquifer within the Ringold Unit A is present beneath most of the Hanford Site. Confined aquifer sampling will continue according to DOE/RL-2012-59 and is not within the scope of this SAP.

Hexavalent chromium is present in the groundwater in the 100-NR-2 OU above the ambient water quality criteria of 10 µg/L. The source of the contamination is attributed to the adjacent, upgradient 100-K Area and 100-N Area reactor operations. Because there are two source areas, responsibility for the monitoring of hexavalent chromium is shared by the 100-KR-4 and 100-NR-2 Groundwater OU projects. Hexavalent chromium within the 100-NR-2 OU boundary that is considered to have a source in the adjacent 100-K Area is addressed in the 100-KR-4 OU SAP. Hexavalent chromium within the 100-NR-2 OU boundary that is considered to have a 100-N Area source is addressed within this SAP.

Groundwater monitoring wells on the Hanford Site provide essential access to the subsurface for environmental data collection. When the effective life of a well is reached, wells should be decommissioned and replaced, if applicable. Decommissioning is commonly required when wells are improperly constructed, improperly abandoned, unprotected, and neglected. These conditions may create preferential pathways to the aquifer and vadose zone and cause mixing of aquifers and compromise the collection of representative environmental data.

Table A-2. Controlling Documents for 100-NR-2 Groundwater Operable Unit Monitoring

Controlling Document Document Title	Modifying Documents	Date	Notes
N Springs Expedited Response Action Performance Monitoring Plan (BHI-00164, Rev. 1)	Original	23-Aug-1995	Performance monitoring plan for 100-N Springs pump and treat system. Monitoring requirements identified in this new SAP supersede requirements identified in BHI-00164.
	N Springs Expedited Response Action Performance Monitoring Plan: Update (BHI-001165, Rev. 0)	15-Apr-1998	Updates the requirements in BHI-00164. Monitoring requirements identified in this new SAP supersede requirements identified in BHI-001165.
100-NR-2 Streamlined Groundwater Sampling and Analysis Plan (BHI-00165, Rev. 0)	Original	26-Jan-1995	Streamlined CERCLA groundwater monitoring program. Monitoring requirements identified in this new SAP supersede requirements identified in BHI-00165.
Sampling and Analysis Plan for Aquifer Sampling Tubes (DOE/RL-2000-59, Rev. 1)	Original	12-Mar-2009	Monitor contamination in and adjacent to the Columbia River. Monitoring requirements identified in this new SAP only supersede the 100-NR-2 portion of DOE/RL-2000-59.
	TPA-CN-353	09-Jun-2010	Sampling of two new aquifer tube clusters to support remedial investigation. Monitoring requirements identified in TPA-CN-353 have been completed.
Remedial Design Report/Remedial Action Work Plan for the 100-NR-2 Operable Unit, (DOE/RL-2001-27, Rev. 1, Appendix A, Apatite Barrier Performance Monitoring SAP)	Original	29-Sep-2014	Monitoring requirements identified in this new SAP will supersede requirements identified in DOE/RL-2001-27, Rev 1.

Table A-2. Controlling Documents for 100-NR-2 Groundwater Operable Unit Monitoring

Controlling Document Document Title	Modifying Documents	Date	Notes
Remedial Design Report/Remedial Action Work Plan for the 100-N Area (DOE/RL-2005-93, Rev. 1, Appendix H, Phase II Testing Performance Monitoring Plan for the UPR-100-N-17 Bioremediation)	Original	25-Nov-2013	Groundwater monitoring requirements for petroleum hydrocarbons at UPR-100-N-17, 166-N Diesel Oil Supply Line Leak petroleum waste site. Monitoring requirements identified in this new SAP reiterates the groundwater monitoring requirements in DOE/RL-2005-93.
Strontium-90 Treatability Test Plan for 100-NR-2 Groundwater Operable Unit (DOE/RL-2005-96, Rev. 0)	Original	23-Mar-2006	This document describes the treatability test plan for the construction of the PRB. Monitoring requirements identified in DOE/RL-2005-96 have been completed.
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)	Original	03-Jan-2011	100-NR-2 Operable Unit Remedial Investigation/Feasibility Study sampling. Monitoring requirements identified in DOE/RL-2009-42 have been completed".
Integrated 100 Area Remedial Investigation Feasibility Study Work Plan, Addendum 5: 100-NR-1 and 100-NR-2 Operable Units (DOE/RL-2008-46-ADD5, Rev. 0)	Original	10-Mar-2011	Established framework for 100-N Area Remedial Investigation and Feasibility Study. Monitoring requirements identified in DOE/RL-2008-46-ADD5 have been completed.
Design Optimization Study for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit (DOE/RL-2010-29, Rev. 0)	Original	23-Sep-2010	Sampling for design optimization study for further expansion of the existing saturated zone PRB. Monitoring requirements identified in DOE/RL-2010-29 have been completed
Jet Injection Design Optimization Study for 100-NR-2 Groundwater Operable Unit (DOE/RL-2010-68, Rev. 0)	Original	04-Jan-2011	Sampling for jet injection to place apatite precursors in the vadose zone. Monitoring requirements identified in DOE/RL-2010-68 have been completed

Table A-2. Controlling Documents for 100-NR-2 Groundwater Operable Unit Monitoring

Controlling Document Document Title	Modifying Documents	Date	Notes
100-KR-4 Groundwater Operable Unit Monitoring Program Sampling and Analysis Plan (DOE/RL-2013-29, Draft A)	Original	15-Dec-2015	100-KR-4 OU Groundwater Monitoring. Monitoring requirements for hexavalent chromium are identified in DOE/RL-2013-29 and this SAP.

OU = operable unit
PNNL = Pacific Northwest National Laboratory
PRB = permeable reactive barrier
SAP = sampling and analysis plan
TPA = Tri-Party Agreement (*Hanford Federal Facility Agreement and Consent Order*)
TPH = total petroleum hydrocarbons

1

Well decommissioning methods typically include the following:

- Grouting/backfilling with bentonite in place
- Perforating the casing followed by grouting in place
- Grouting/backfilling with bentonite in place followed by casing pulling
- Overdrilling and grouting with or without a temporary casing

In a complex situation, one or more decommissioning procedures may be used for different intervals of the same well.

Wells on the Hanford Site are decommissioned according to DOE/RL-2005-70, *Hanford Site Well Decommissioning Plan*. The plan describes the basis, decision logic, and implementation process for the decommissioning of Hanford Site wells. Priority is placed on those wells judged to have the greatest relative risk of contaminating groundwater. DOE/RL-2005-70 identifies seven wells (199-N-37, 199-N-58, 199-N-60, 199-N-61, 199-N-63, 199-N-124, and 199-N-125) in the 100-NR-2 OU Area that are potential candidates for decommissioning. These wells are not in the 100-NR-2 OU groundwater monitoring network.

A1.2 Background

This section describes the 100-NR-2 OU site geology, hydrogeology, sources of groundwater contamination, and contaminant plumes.

A1.2.1 Site Geology

The geology of the 100-N Area consists of the Miocene-age Columbia River Basalt Group and late Miocene- to Pleistocene-age sediments that overlie the basalts. The overlying sediments are approximately 125 m (400 ft) thick and are divided into two main units: the Ringold Formation of late Miocene to Pliocene age and the Hanford formation of Pleistocene age. Holocene deposits of silt, sand, and gravel form a relatively thin veneer at the surface. Figure A-2 provides a generalized geologic stratigraphic section of the 100-N Area.

The Hanford formation consists of mostly gravel and sand deposited during catastrophic paleoflooding that occurred during the Pleistocene time. The upper portion of the Hanford formation is composed of unconsolidated basaltic cobble and boulder-sized clasts. Cobbles as large as 15 cm (6 in.) and boulders up to 0.9 m (3 ft) are present at the 100-N Area. Below the cobble-boulder unit, clast size decreases to pebbles and cobbles with local dominant sand. The gravel and sand are predominantly basaltic in composition. Significant sand layers are sometimes intercepted during drilling, as was the case for the bioventing borehole wells drilled at the UPR-100-N-17 waste site (WCH-370, *Bioremediation Well Borehole Soil Sampling and Data Analysis Summary Report for the 100-N Bioremediation Project (UPR-100-N-17)*).

For most of the 100-N Area, the Hanford formation extends from ground surface to just above the water table, 5.8 to 24.5 m (19 to 77 ft) in thickness. However, in some areas, deeper channels eroded into the Ringold Formation may be filled with Hanford gravels that extend below the water table. At the UPR-100-N-17 location, the Hanford formation is approximately 13.7 m (45 ft) thick.

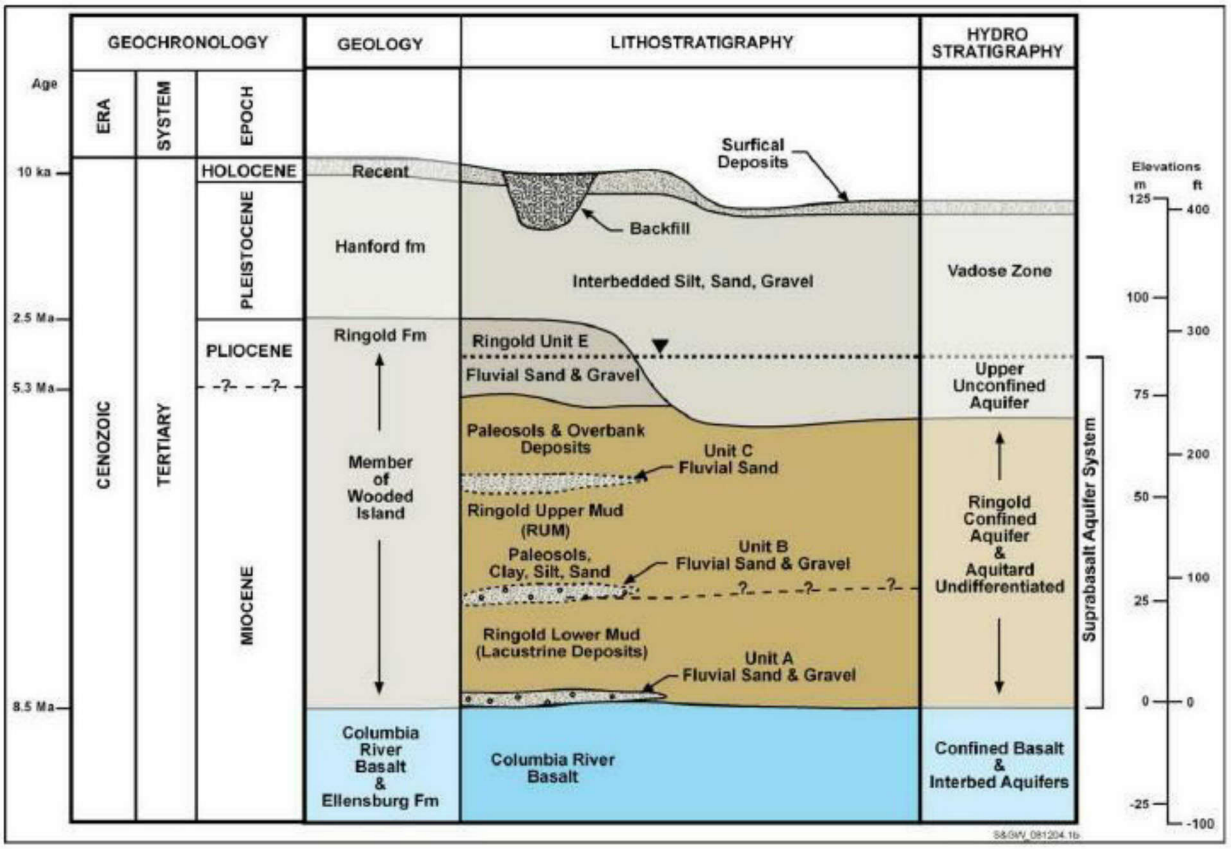


Figure A-2. Generalized Geologic Stratigraphic Section of the 100-N Area (from DOE/RL 2008-46-ADD5)

In the 100-N Area, the underlying Ringold Formation consists of a mix of fluvial gravels, fluvial sands, underlain with a thick sequence of overbank deposits, paleosols, and lake deposits. The Ringold Formation unconformably overlies the Saddle Mountain Basalt. The Ringold Formation units identified in the 100-N Area, from oldest to youngest, include unit A, the lower mud unit; the Ringold upper mud (RUM) containing relatively thin, less continuous coarse-grained units B (oldest) and C (youngest); and unit E, a fluvial silty sandy gravel. Within the 100-N Area, the top of the Ringold Formation ranges from 6 m (19 ft) to approximately 23 m (77 ft) below ground surface. At the UPR-100-N-17 location, the top of the Ringold Formation is encountered at approximately 13.7 m (45 ft) to 15.2 m (50 ft) below ground surface. The uppermost Ringold Formation unit at the 100-N Area is unit E, consisting of variably cemented pebble-to-cobble gravel with a fine- to coarse-grained sand matrix with interbedded layers of sand and silty-sandy gravel. Unit E exhibits a more felsic (feldspar/quartz) composition than the overlying Hanford formation and is differentiated based on the composition of the sand and gravel. Ringold Formation unit E has a greater percentage of tan sands derived from primarily granitics and metamorphic rocks, while the Hanford formation is composed predominantly of black gravel and sands derived from basalt. In addition, the Ringold Formation unit E is more compacted than the Hanford formation. The contact between the Hanford formation and the Ringold Formation is sometimes difficult to determine because a transition zone of reworked Ringold Formation sand and gravel mixed with Hanford formation sand and gravel. However, beneath the UPR-100-N-17 waste site, the Hanford formation and Ringold Formation contact is relatively sharp.

The Hanford formation/Ringold Formation contact divides gravelly deposits with varying hydraulic properties that have caused significant lateral spreading of effluent and contamination along the contact and deeper within the relatively lower permeability Ringold Formation sediment.

A1.2.2 Hydrogeology and Groundwater Flow

The uppermost aquifer beneath the 100-N Area is unconfined and primarily located within the Ringold Formation. During high river stage, the water table can rise temporarily into the very lower portion of the Hanford formation in a very limited area near the river. Under current (natural background) conditions, the unconfined aquifer ranges in thickness between approximately 6.5 and 14 m (21 to 46 ft) thick. The unconfined aquifer surface is relatively flat beneath the 100-N Area with an average gradient of 0.001 m/m (0.003 ft/ft) toward the northwest where it enters the Columbia River.

The current water table elevation in the 100-NR-2 OU is dominated by the Columbia River water level stages. The use of the Priest Rapids Dam as a water management facility for power generation, irrigation, and in support of fish migration causes the Columbia River's water level to fluctuate as much as 2.6 m (8.5 ft) in a single day. These fluctuations in river stage have been observed to influence water levels, particularly in wells located close to the Columbia River. During high river stage, the river level may be higher than the groundwater levels in wells, initiating a temporary reversal of hydraulic gradient and the flow of river water into near-shore portions of the unconfined aquifer.

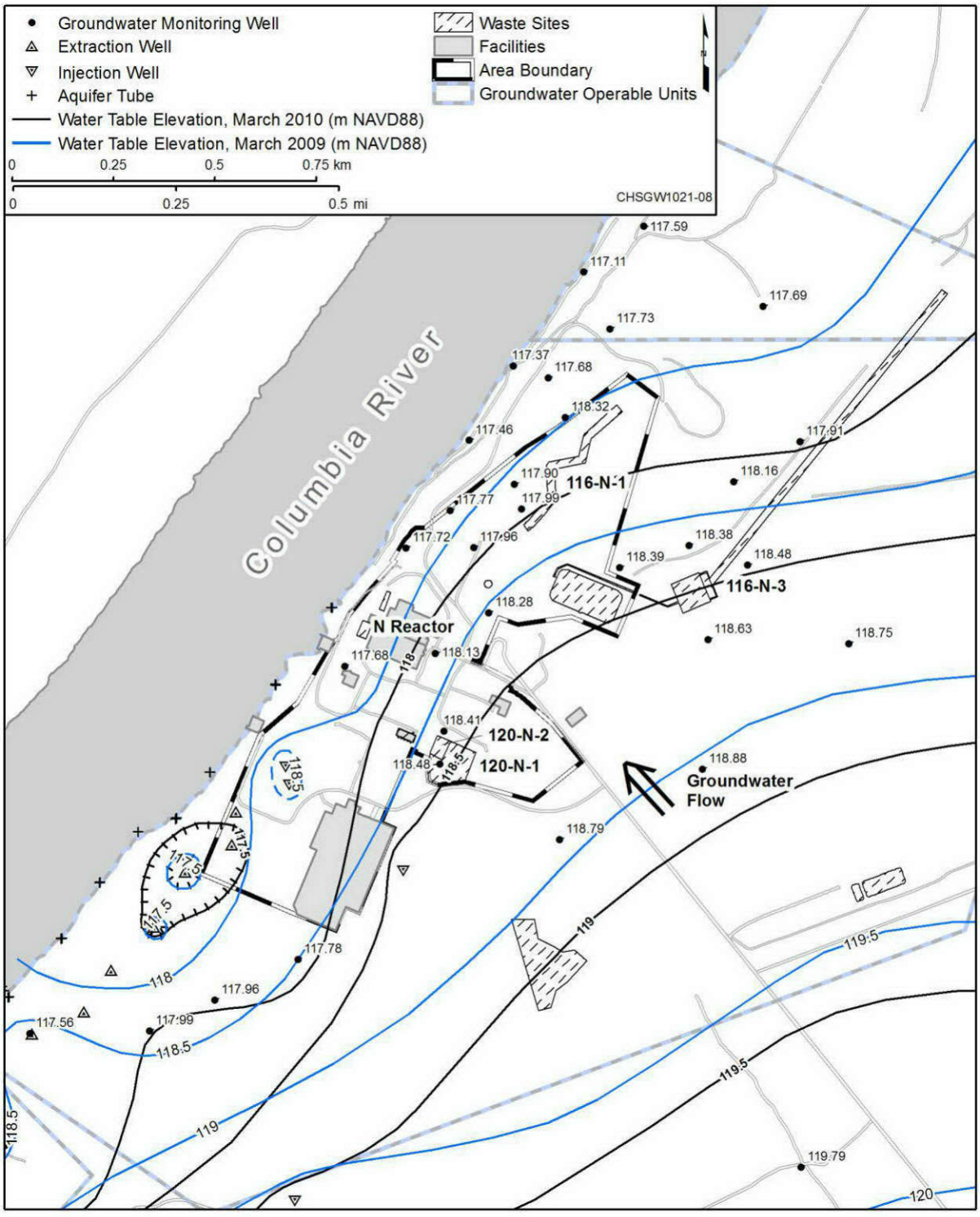
The base of the aquifer is defined as the contact between the Ringold Formation unit E and the underlying, much less transmissive RUM and Ringold lower mud unit, which are approximately 60 m (197 ft) thick. Most of the groundwater monitoring wells in the 100-N Area are completed within the Ringold Formation unit E.

Groundwater within the 100-NR-2 OU is also influenced by the 100-KR-4 OU pump and treat system. Figure A-3 shows the water table for 2009 and 2010 starting to flatten and return to natural flow patterns following the shutdown of the pump and treat system at the 100-N Area. However, in the later part of 2010, expansion of the 100-KR-4 OU pump and treat systems began to influence the groundwater flow patterns in the southwestern portion of 100-N. Injection wells located in the southern portion of 100-N injecting treated water to the aquifer provide a water table divide or flow barrier so contamination from the 100-K Area does not migrate into the 100-N Area downgradient. The 2011 water table presented in Figure A-4 shows the influence the 100-KR-4 OU pump and treat systems has had on groundwater flow direction and water table elevations at 100-N. The hydraulic impacts from the 100-KR-4 OU pump and treat systems continue to influence the water table and flow direction at 100-N as shown in the water table map for 2014 (Figure A-5).

A1.2.3 Sources of Groundwater Contamination

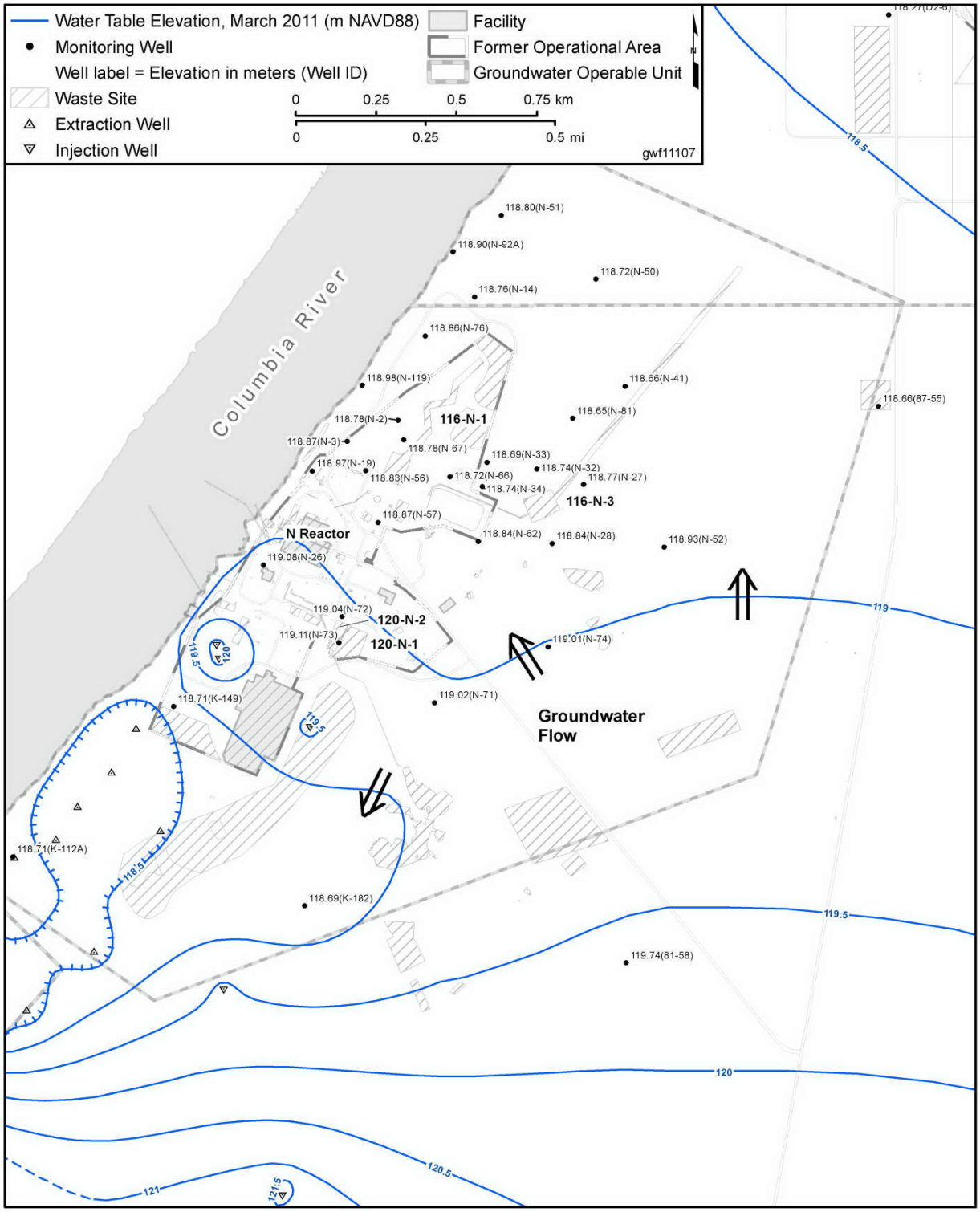
The 100-NR-2 Groundwater OU comprises groundwater contaminated by releases from facilities and waste sites associated with past operation of the 105-N Reactor. Waste sites and source contamination associated with the reactor and reactor operations are assigned to the 100-NR-1 source OU.

The 105-N Reactor was operational between 1963 and 1987. The 105-N Reactor was a closed-loop dual-purpose reactor that produced plutonium for defense purposes and steam for commercial electrical power generation. Although the reactor had a closed-loop cooling system, it actually operated as a bleed-and-feed system where a portion of the cooling water was constantly bled off. The effluent removed from the loop eventually made its way to the 116-N-1 and 116-N-3 Cribs and Trenches. Both the reactor and generating plant operated continuously, except during periods of shutdown for maintenance and repair. The reactor was placed in cold stand-by mode in February 1988 and defueled in 1989. Orders to permanently shut down the reactor were received in October 1991.



Sources: DOE/RL-2012-02, *Calendar Year 2011 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*; NAVD88, *North American Vertical Datum of 1988*.

Figure A-3. 100 N Area Water Table Map, Calendar Years 2009 and 2010



Sources: DOE/RL-2012-02, *Calendar Year 2011 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*; NAVD88, *North American Vertical Datum of 1988*.

Figure A-4. 100 N Area Water Table Map, March 2011

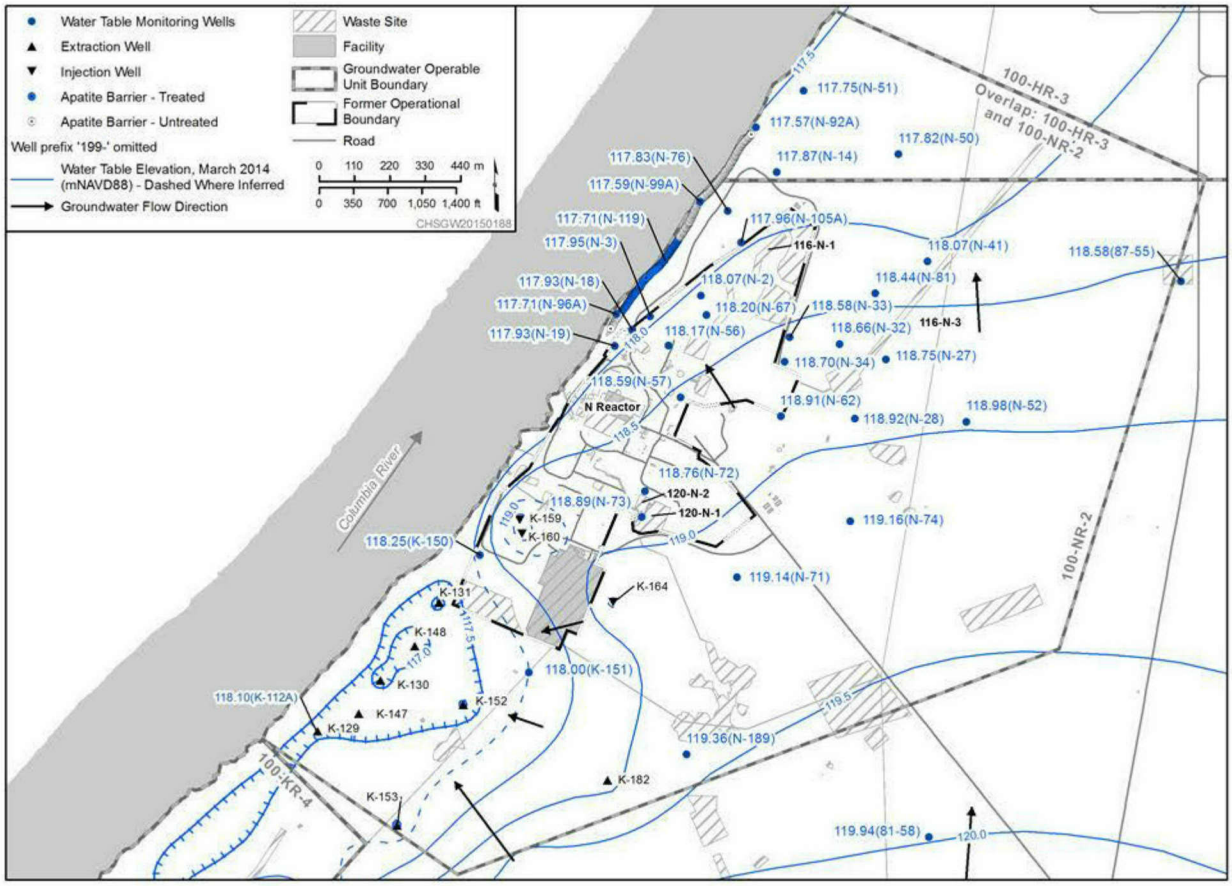


Figure A-5. March 2014 Water Table Map for the 100-NR-2 OU

The 100-NR-1 source OU includes sites contaminated because of intentional/unintentional discharges of contaminated liquid effluents to waste sites (i.e., cribs, basins, french drains) and unplanned releases or leaks from piping systems and storage tanks. Liquid wastes were disposed in the study area to the soil column and the Columbia River. Disposal of radioactive solid waste was limited to the temporary storage of irradiated spacers in three large silos. When the silos became full, the spacers were removed, packaged, and disposed in the radioactive burial grounds outside the study area. Other solid waste disposed was limited to nonradioactive construction debris. Often construction disposal sites were used as burning pits for combustible wastes. According to the 100-NR-1 and 100-NR-2 OUs ROD (EPA/ROD/R10-99/112), radionuclides, metals, and petroleum hydrocarbons are the main COCs in the groundwater beneath the 100-N Area.

More than 200 Waste Information Data System (WIDS) sites are recorded in the source area. Many of these sites required interim remedial action according to the 100-NR-1 and 100-NR-2 OUs ROD (EPA/ROD/R10-99/112) and have been cleaned up according to the selected remedy (i.e., remove/treat/dispose and bioremediation of petroleum). By March 2015, fewer than 15 waste sites still required remedial action. An additional evaluation of the source waste sites and groundwater is presented in the RI/FS for the 100-NR-1 and 100-NR-2 OUs (DOE/RL-2012-15, Draft A). DOE/RL-2012-15 will be used to support preparation of a proposed plan and final ROD for the 100-NR-1 source and 100-NR-2 Groundwater OUs.

A1.2.4 Contaminant Plumes

Five groundwater plumes are within the unconfined aquifer in the 100-NR-2 Groundwater OU: Sr-90, tritium, petroleum hydrocarbon, nitrate, and hexavalent chromium. Hexavalent chromium and chromium also exceed cleanup standards in a relatively confined interval located within the upper portion of the RUM in a single well (199-N-80), but has not been detected in nearby wells or boreholes in the unconfined aquifer. The contaminant plumes in the unconfined aquifer are shown in Figures A-6, A-7, A-8, A-9, and A-10.

A1.2.4.1 Strontium-90 Plume

During operation of the 105-N Reactor, very high volumes of Sr-90-contaminated effluent were disposed to the 116-N-1 and 116-N-3 Cribs and Trenches. These volumes overwhelmed the existing sedimentary pore structure within the subsurface, rapidly built up the water table, and moved contaminated effluent laterally and vertically away from the sources. This rapid, high-volume intrusion of effluent overwhelmed the sediment cation exchange capacity beneath the cribs and trenches and provided the mechanism that carried and spread the Sr-90 where it was sorbed into the sediments away from the source. After cessation of the effluent disposal operations, residual Sr-90 remains sorbed on the sediments because of the strong sorptive properties (very high K_d) of Sr-90. Those affected areas that contain residual Sr-90 today include the Hanford formation portion of the shallow vadose zone immediately beneath the remediated 116-N-1 and 116-N-3 waste sites, extending down to the approximate elevation of the contact with the Ringold Formation unit E and the more laterally extensive contaminated lower vadose zone (within the Ringold Formation unit E) that was previously saturated during operations. The main concentrations of Sr-90 in groundwater currently reside in the upper portion of the unconfined aquifer and the periodically rewetted zone. Based on the depth-discrete data obtained during the RI, in conjunction with the previous data, the residual contaminant remains relatively immobile in the vadose zone and within the sediment of the upper portion of the unconfined aquifer. Sr-90 concentrations are relatively low to undetectable at the base of the unconfined aquifer. The highest Sr-90 concentrations in groundwater (Figure A-6) remain at the water table and directly beneath the 116-N-1 and 116-N-3 Cribs and Trenches footprints where most of the Sr-90 was initially disposed of and ultimately sorbed.

Groundwater elevation fluctuations into the contaminated lower vadose zone cause temporary saturation and absorption of some residual Sr-90 into the unconfined aquifer by ion exchange with cations in the groundwater with Sr-90 on the vadose zone sediments. Well 199-N-67 downgradient of the 116-N-1 Crib had the highest concentration within the plume in 2014 at 13,250 pCi/L. However, the highly sorptive properties of Sr-90 released into the groundwater will result in minimal movement before the Sr-90 resorbs to sediment downgradient. This process is reflected by monitoring data showing Sr-90 concentrations increase quickly and decrease quickly with sudden elevation increases in the water table related to recent river stage changes. Very little migration of the Sr-90 in the vadose zone or groundwater plume is occurring under these conditions. The net contaminant migration effect of the water table oscillations is very slow movement in the sediment and groundwater toward the Columbia River. This is reflected in the general area and extent of the Sr-90 plume (Figure A-6) in the unconfined aquifer which has not changed appreciably since cessation of effluent discharges to the soil column in 1987.

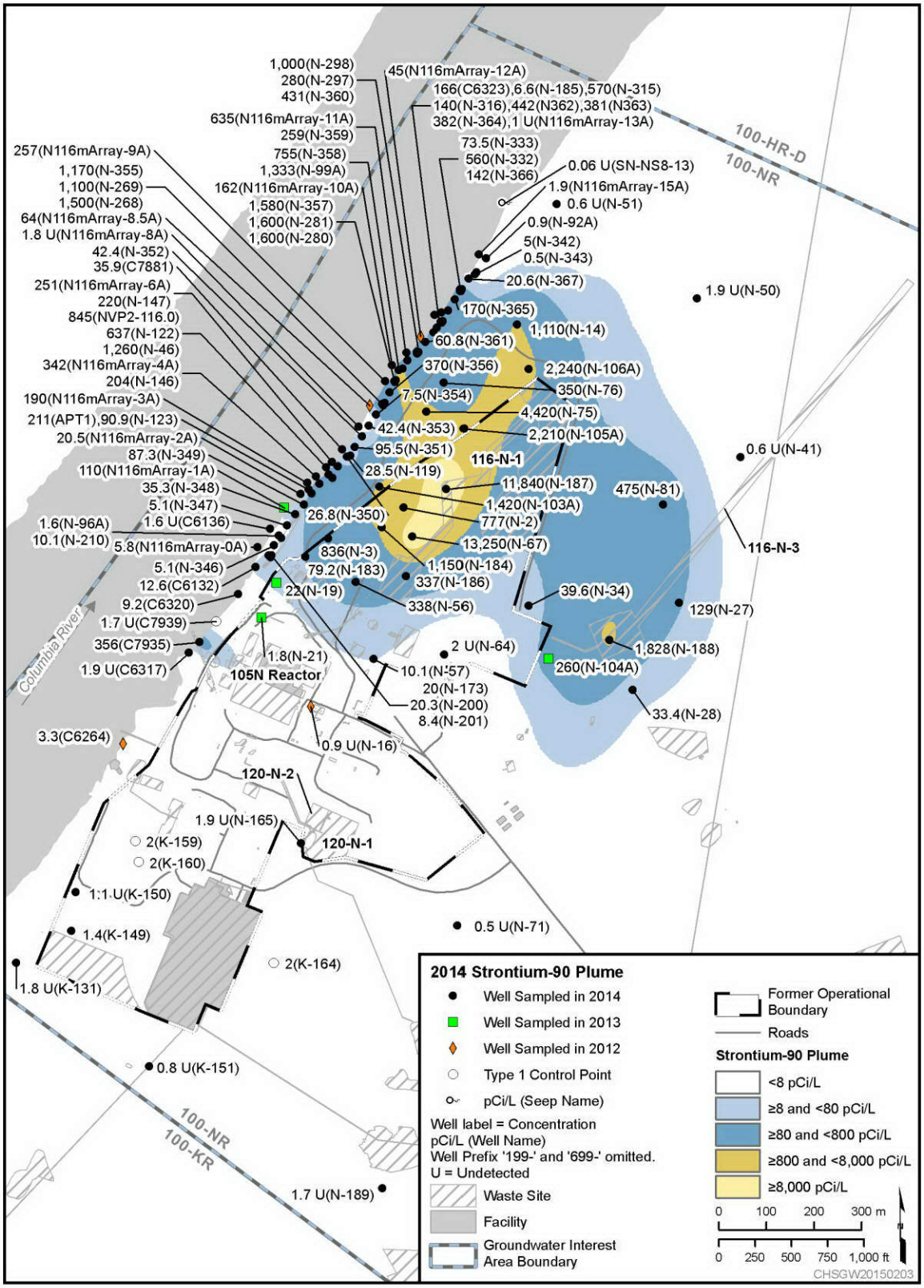


Figure A-6. 100-NR-2 OU 2014 Sr-90 Plume

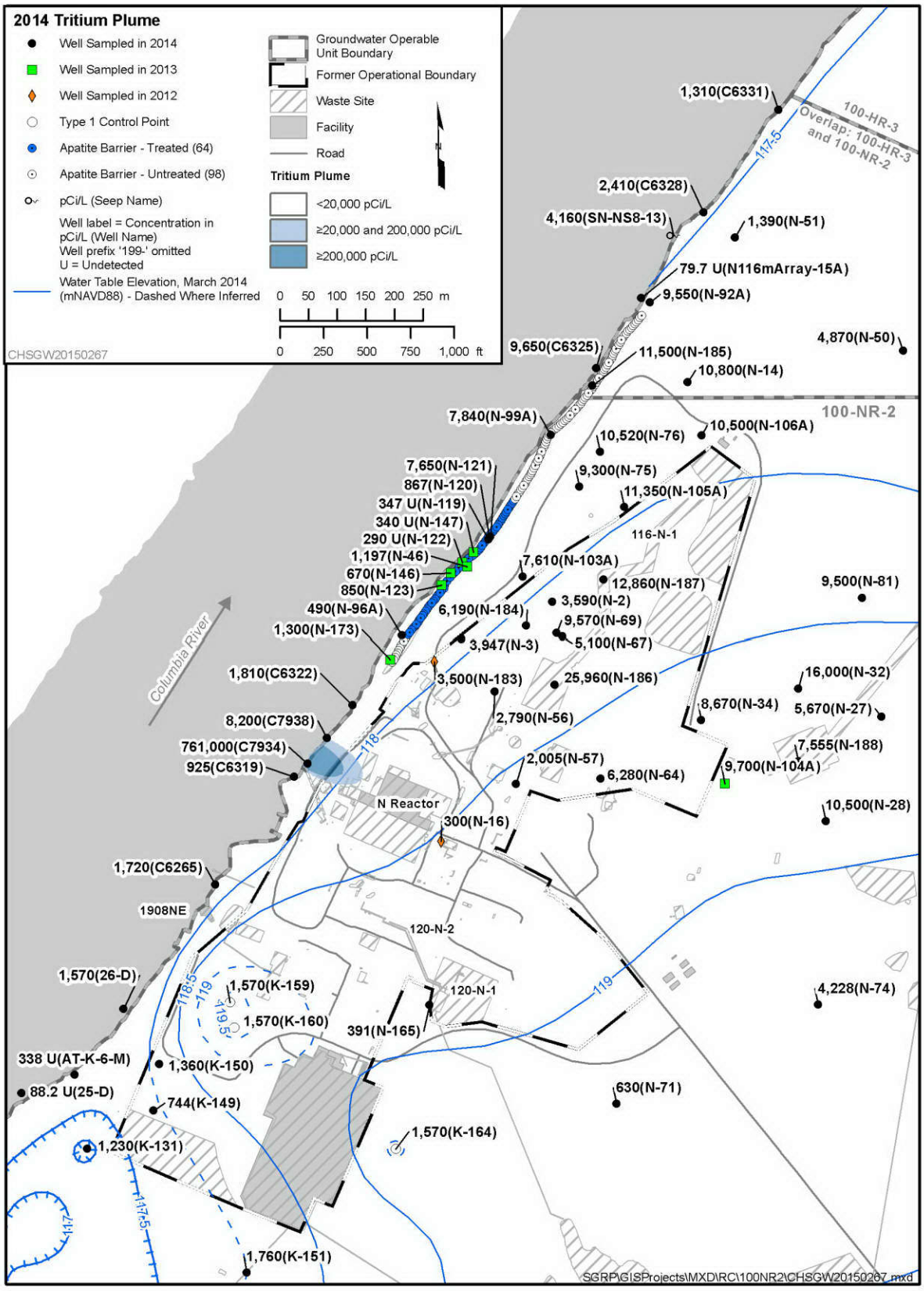


Figure A-7. 100-NR-2 OU 2014 Tritium Plume

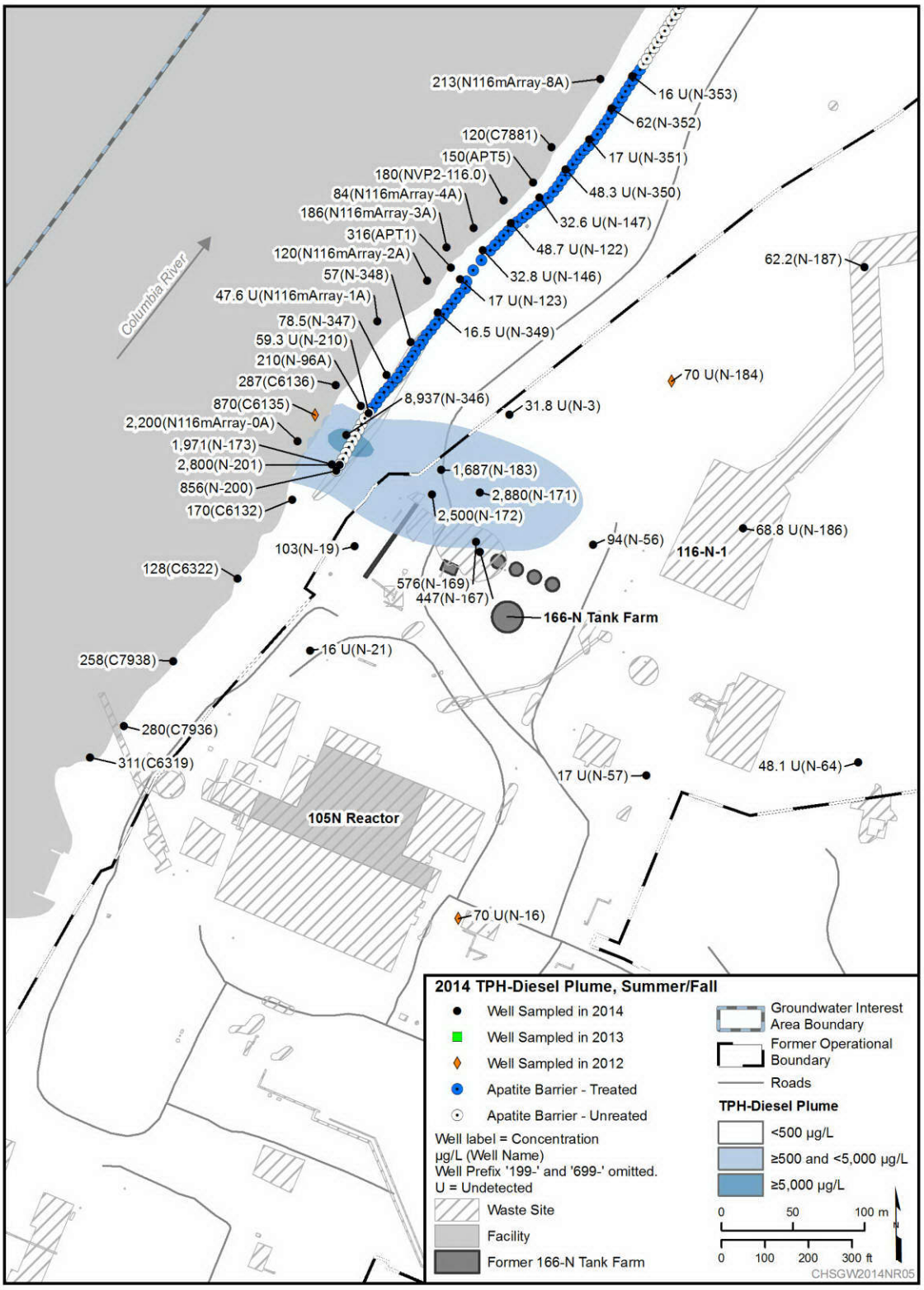


Figure A-8. 100-NR-2 OU 2014 TPH-Diesel Plume

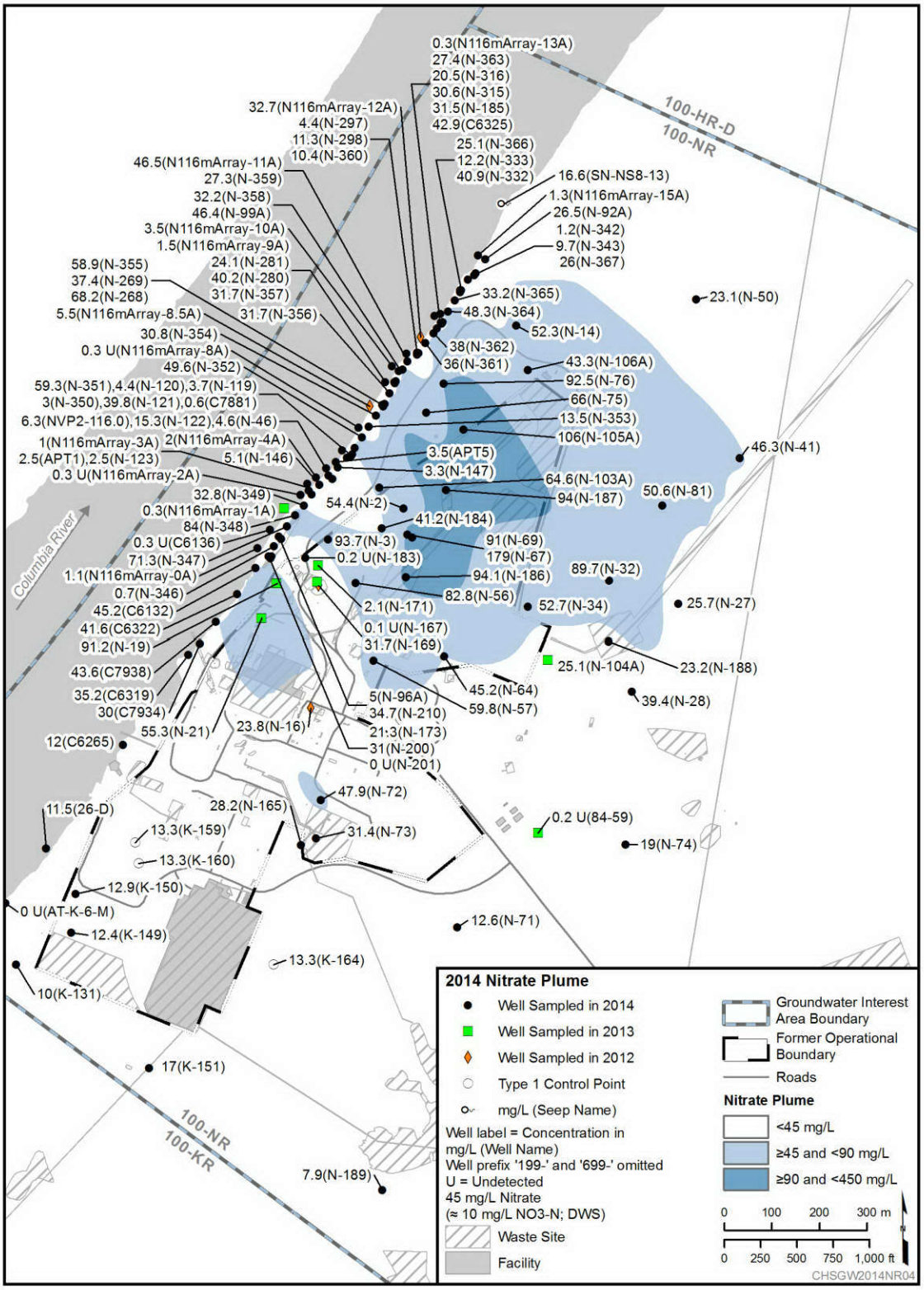


Figure A-9. 100-NR-2 OU 2014 Nitrate Plume

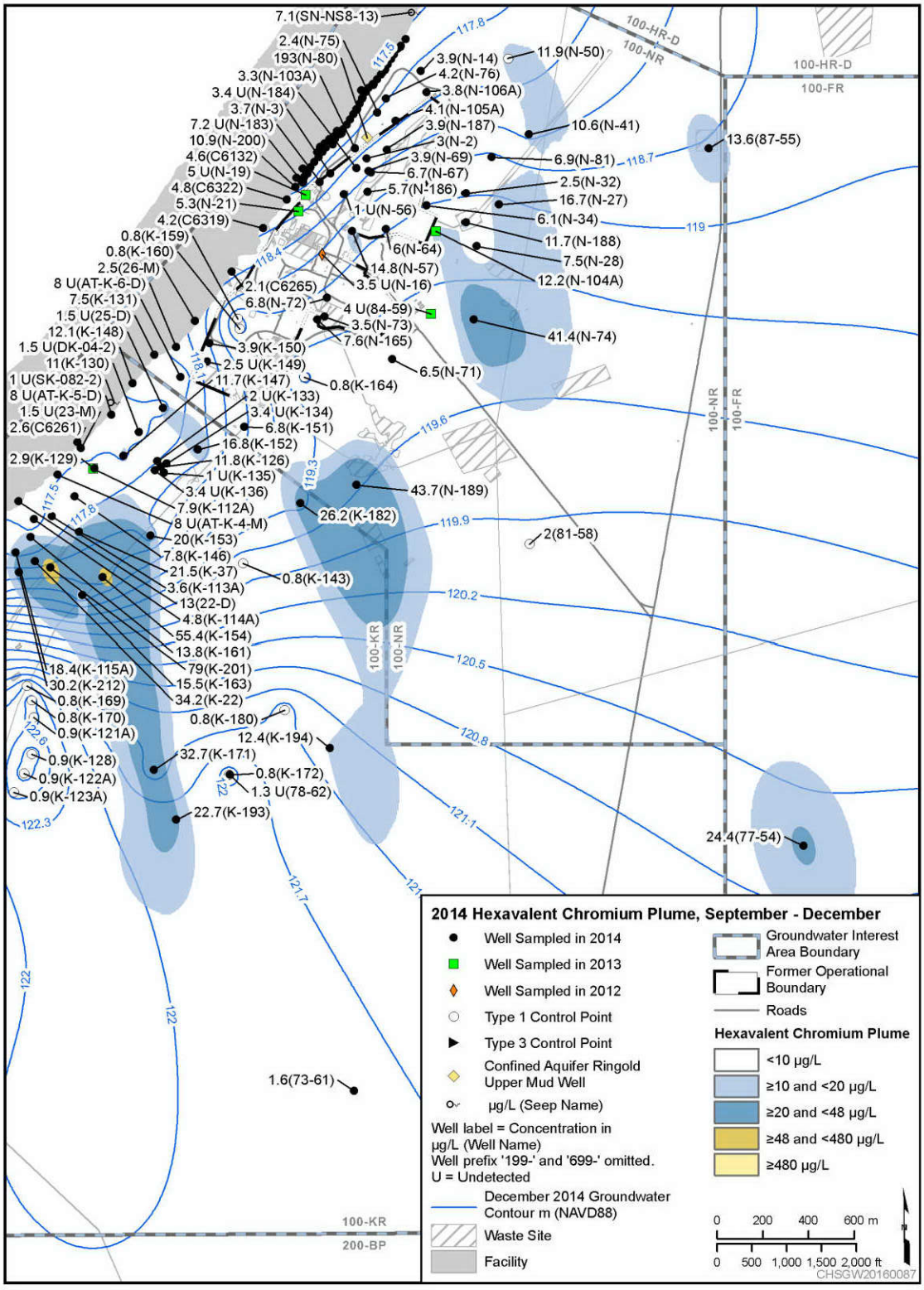


Figure A-10. Hexavalent Chromium Plume

Adjacent to the Columbia River and upriver, less than 190 m (624 ft) southwest of the PRB (Figure A-6), two isolated smaller areas of Sr-90 contamination are present. In these areas, 310 pCi/L of Sr-90 was detected associated with an aquifer tube cluster (C7934, C7935, and C7936). Additionally, concentrations in aquifer tube C6320 (closest to the main Sr-90 plumes) were less than two times (14 pCi/L) the drinking water standard.

Three documented unplanned releases (UPR-100-N-3, UPR-100-N-7 and UPR-100-N-12) may be the sources of the Sr-90 contamination at aquifer tube cluster C7934, C7935, and C7936, as well as the tritium plume discussed in Section A1.2.4.2. Collectively, over 4.22 million liters (1.11 million gallons) of radioactive liquid effluent was released to the soil between the reactor and river.

Waste site UPR-100-N-7 is the largest of the radioactive liquid effluent spills. The spill occurred in April 1985 from a radioactive drain return pipe between the 109-N Bldg. and 1909-N valve pit. Approximately 420,000 L (504,000 gal) of effluent water were released from a rupture in the 25.4-cm (10-in.), radioactive drain-return line containing mixed fission products (DOE/RL-95-111, *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units*).

Waste site UPR-100-N-3 is the unplanned release of radioactively contaminated fuel storage basin water discovered north of the fuel storage basin in March 1978 (DOE/RL-95-111). The leak reported as UPR-100-N-12 occurred in February 1979 at the same location. The source of both leaks was a 7.6-cm (3-in.) reinforced plastic pipe extending from the 100-N Fuel Storage Basin to the Dummy Disposal Silos. The transfer line was 3.3 m (11 ft) below grade at the leakage point. An estimated 1,363,000 L (360,000 gal) and 946,000 L (250,000 gal) of storage-basin water were released to the soil during 1978 and 1979, respectively. The estimated Sr-90 inventory released from UPR-100-N-3 was 0.8 Ci (DOE/RL-95-111). Based on the estimated release volume and inventory, the release concentration would calculate to be 5.86E+5 pCi/L. No inventory estimate was documented for UPR-100-N-12, however, Sr-90 concentration in a sample of fuel storage basin water in 1997 (sample number B0L5M1) was 7.97E+6 pCi/L.

The conceptual site model for the Sr-90 hot spot detected in the aquifer tubes downgradient from the 105-N Reactor is that the concentration and volume of the unplanned releases exceeded the ion exchange capacity of the sediments and strontium-90 contamination was flushed to groundwater and to the River. The volume of the combined radioactive effluent releases saturated the vadose zone beneath localized areas west of the 105-N Reactor down to the unconfined aquifer. The releases occurred in 1978 through 1985 and the strontium-90 that adsorbed to the sediments remained in place and was already present when the aquifer tube cluster (C7934, C7935, and C7936) was installed and initially sampled in 2010.

Concentrations of Sr-90 in wells 199-N-23 and 199-N-24 (decommissioned in early 2000) downgradient of the reactor and fuel storage basin did not show increased Sr-90 concentrations corresponding to release concentrations or to the concentrations observed at the aquifer tubes. The release may have run between the two wells in a narrow path from the unplanned release sites to the River at the aquifer tube locations. Additional characterization from soil and groundwater samples collected during drilling of three new wells behind the reactor (identified in Section A1.8.3.9 of Insert A1) is expected to help clarify the conceptual model in this area.

Due to the concurrent large-volume effluent disposal at the 116-N-1 and 116-N-3 Cribs, the regional water table was elevated up to 2 m (6.6 ft) above natural aquifer levels west of the 105-N Reactor. Therefore, the leaked reactor effluent would have had a shorter vertical flow path through the vadose zone to the aquifer, subsequently flowing downgradient the short distance to the Columbia River. The aquifer tubes are also located close to the engineered fill around the 1908-N Outfall waste site, which is a likely preferential pathway to the river. Sr-90 contamination in the leaked effluent sorbed to the aquifer sediments, however, the volume released in this localized area likely overwhelmed the cation exchange capacity of the sediments and resulted in Sr-90 contamination being carried to the Columbia River where it was sorbed into the sediments along the flow path.

Drainage through the vadose zone slowed as the facility was shut down and effluent no longer leaked into the subsurface, and some of the effluent became trapped in secondary pore spaces within the deep vadose zone (Ringold Formation sediment) and laterally within the periodically rewetted zone. Also, with the cessation of 105-N Reactor operations, the water table began to decline. This conceptual site model suggests that the Sr-90 detected at the aquifer tube cluster downgradient from these sources migrated to the river during operations and in the process sorbed to the aquifer sediments. Under current groundwater conditions, Sr-90 contamination in the groundwater is coming from sorbed Sr-90 already in the vicinity. This contamination is more or less at a steady state between concentrations in the PRZ and the top of the saturated zone. The strontium-90 in the aquifer is expected to continue the current concentration trends, fluctuating slightly higher and then lower with changes in the water table elevation that exposes some groundwater to areas of higher or lower residual Sr-90 sorbed within the PRZ. This is essentially the same process that has occurred beneath the 116-N-1 and 116-N-3 Cribs and Trenches. The residual Sr-90 contamination will slowly decay to below the DWS, with minimal net migration within the aquifer.

A1.2.4.2 Tritium Plume

In the 100-NR-2 OU, there are two small areas of tritium contamination that exceed the drinking water standard of 20,000 pCi/L. The maximum concentration of tritium (761,000 pCi/L) was detected along the river in 2014 at aquifer tube cluster C7934, C7935, and C7936 (Figure A-7). The conceptual site model assumes that the unplanned radioactive effluent releases that are the source of Sr-90 contamination detected at the aquifer tubes as described in Section A1.2.4.1 are also the source for the tritium plume since the radioactive effluent was also contaminated with tritium. The volume of the combined radioactive effluent releases saturated the vadose zone beneath localized areas west of the 105-N Reactor down to the unconfined aquifer.

The mobile tritium migrated to the aquifer and subsequently flowed downgradient the short distance to the Columbia River. However, vadose moisture drainage slowed when the facility was shut down, and no additional leakage occurred. As the aquifer elevation declined, and effluent drained through the PRZ and deep vadose zone, residual tritium was retained in pore water with some becoming trapped in secondary pore spaces within the deep vadose zone (Ringold Formation sediment).

The residual vadose moisture, which also contained tritium, was eventually flushed from the vadose zone sediment during recent facility decommissioning and waste site remediation/excavation activities initiated in 2012 near the unplanned release sources (UPR-100-N-3, UPR-100-N-7, and UPR-100-N-12). The tritium was remobilized and rapidly flushed to groundwater by the application of dust-suppression water in the open excavations approximately 10 m (33 ft) above the unconfined aquifer. Data show that there is no large-scale tritium plume upgradient of the 105-N Reactor and that this hot spot is highly localized. The recent appearance and quick increase in tritium concentration downgradient of these remediated waste sites is related to a limited residual contaminant volume that was most likely flushed from beneath the waste sites and into the aquifer, creating a short-duration slug of contaminated groundwater.

A relatively fast tritium groundwater travel time estimate of 4 months was calculated for the distance between the back of the N Reactor and the Columbia River based on estimated flow rates in DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*. This short tritium travel time is consistent and within the timespan of waste site remedial activities conducted between the N Reactor and the river between 2009 and 2014. The short distance between the west side of the N Reactor and the river, and the relatively close location of the contaminated aquifer tube cluster and surrounding monitoring wells, define a relatively localized and narrow contaminant plume path (Figure A-7); none of the surrounding monitoring wells indicate a significant presence of tritium at those locations. Due to the high mobility of tritium under saturated conditions and relatively short half-lfe of tritium it is anticipated that this small contaminant plume will continue to decrease rapidly.

The estimated tritium inventory released from UPR-100-N-3 was 1 Ci (DOE/RL-95-111). Based on the estimated release volume and inventory, the release concentration would calculate to be 7.33E+5 pCi/L. No inventory estimate was documented for UPR-100-N-12, however, a sample of fuel storage basin water in 1997 (sample number B0L5M1) had concentrations of tritium of 3.36E+7 pCi/L, respectively. Residual tritium in the vadose zone at these concentrations would account for the tritium spike observed at the C7934, C7935, and C7936 aquifer tube cluster theorized to have been flushed by excavation activities of waste sites behind the reactor. The lag time between start of excavation and dust suppression water application and time when increased tritium concentrations were observed at the aquifer tubes correspond with the groundwater flow travel time to the river. Additionally a magnesium chloride based fixative was also used during remedial excavation activities and chloride concentration trends at the aquifer tubes were compared to tritium trends for correlation. Increase in chloride concentrations observed at the aquifer tubes correspond to tritium increases and subsequent slow decline which supports the conceptual model that dust suppression water flushed residual tritium contamination in the vadose zone.

Concentrations of tritium in wells 199-N-23 and 199-N-24 (decommissioned in early 2000) downgradient of the reactor and fuel storage basin did not show significantly increased tritium concentrations corresponding to release concentrations or to the concentrations observed at the aquifer tubes. The release may have run between the two wells in a narrow path from the unplanned release sites to the River at the aquifer tube locations. Additional characterization from soil and groundwater samples collected during drilling of three new wells behind the reactor (identified in Section A1.8.3.9 of Insert A1) is expected to help clarify the conceptual model in this area.

Tritium concentrations (41,000 pCi/L) also exceed the drinking water standard in recently installed RI Well 199-N-186 in 2013. Tritium concentrations at this well was 35,100 pCi/L in 2014. This well was installed through the 116-N-1 Crib, which is the likely source of the tritium. With the exception of this relatively small, localized high tritium concentration directly beneath the 116-N-1 Crib (this is the source identified in the 100-NR-2 OU ROD), tritium concentrations were below the drinking water standard in all other 100-NR-2 OU groundwater monitoring wells in 2014. The size and concentration range of the tritium plume have declined faster than the other mobile contaminant plumes primarily because of a relatively short radioisotope half-life.

A1.2.4.3 Total Petroleum Hydrocarbon Plume

Petroleum hydrocarbon concentrations in the 100-NR-2 OU exceed the drinking water standard of 500 µg/L. The petroleum hydrocarbon plume (Figure A-8) is from a 1966 diesel spill at the 166-N Tank Farm. In WIDS, the waste site is identified as UPR-100-N-17. The majority of the diesel spill resulted from a leak in an underground pipe; the diesel migrated vertically through the subsurface soil (Hanford formation). Lateral spreading of the diesel as nonaqueous-phase liquid (NAPL) or free product and possibly some dissolved fraction occurred when it encountered either the Ringold Formation or the water table (which was greatly elevated during 100-N Area operations by effluent discharges). Diesel is

less dense than water and the NAPL stayed near the surface of the water table, slowly dissolving into the aquifer. The less dense diesel remained near the artificially elevated water table during the 100-N Area operational period and moved along the groundwater flow path toward the Columbia River. As the artificially induced water table subsided following the cessation of 100-N Area operations, some residual NAPL and dissolved petroleum products remained in the previously saturated portion of the Ringold Formation unit E, geochemically bound to and/or physically trapped within sediment grain structures (secondary porosity), and dissolved in the residual sediment pore water.

The residual petroleum within the rewetted vadose interval above the water table will continue to be a source to the groundwater plume during high river stage events, and any remaining groundwater NAPL will continue to introduce contamination into the vadose zone during high water table conditions. The magnitude of the petroleum contribution to the groundwater plume is expected to decrease over time as the periodically rewetted zone residual source is depleted.

A1.2.4.4 Nitrate Plume

Nitrate exceeds 45 mg/L (derived from the drinking water standard of 10 mg/L for nitrate as nitrogen) in groundwater beneath the 116-N-1 and 116-N-3 Cribs and Trenches and the 100-N Reactor area to the southwest (Figure A-9). The highest concentration detected in 2014 was 186 mg/L in Well 199-N-67 downgradient of the 116-N-1 Crib.

The extent of the northern portion of the nitrate plume is similar to the Sr-90 plume indicating that effluent disposed to the 116-N-1 and 116-N-3 Cribs and Trenches is most likely the primary source of nitrate in this portion of the plume. Nitrate has not been documented as a significant direct waste source disposed to the 116-N-1 and 116-N-3 Cribs and Trenches during their operation, but compounds that could break down into nitrates that were used during operations were discharged with the effluent; specifically ammonium hydroxide, hydrazine, morpholine and Separan (formed from the polymerization of polyacrylamide) used for water treatment.Ammonium hydroxide would be the most likely source for nitrate through nitrification of ammonia. Annual consumption of ammonium hydroxide during 105-N Reactor operations ranged from 189,000 to 265,000 liters (50,000 to 70,000 gallons). The large quantity of ammonium hydroxide in the effluent discharged to the 116-N-1 and 116-N-3 Cribs and Trenches would have provided a nitrate source within the saturated sediments in the vadose zone and upper unconfined aquifer as the ammonia converted to nitrate. This potential residual vadose source of nitrate may continue to supply the aquifer contributing to the persistent plume beneath the 116-N-1 and 116-N-3 Cribs and Trenches. Additional discussion of nitrate sources is presented in Insert A1.

The nitrate plume extends south beneath the decommissioned 120-N-1 and 120-N-2 waste sites and 105-N Reactor. Lateral spread of the effluents discharged to the 116-N-1 and 116-N-3 Cribs and Trenches may have contributed to the plume in this area, but sanitary septic systems, waste sites 100-N-1 and 130-N-1, and spills and leaks from ammonium hydroxide and hydrazine storage tanks, transfer pumps, and piing are considered the primary sources of nitrate in the southern-southwestern portion of the 100-N Area.

Ammonium hydroxide was stored near the 109-N Building in a 113,562 L (30,000 gal) storage tank, while dilute hydrazine was stored in a tank inside the 184-N Building east of 109-N. Accidental spills of these chemicals were collected in a series of floor drains, sumps, and catch basins and discharged to the river. However, chemicals may have also leaked or spilled to the ground at storage tanks, transfer pumps, and connections along the system.

The 130-N-1 Pond received filter backwash from the 163-N/183-N Building after the filter backwash was rerouted in 1983 from the 120-N-1 Percolation Pond and settling pond system. Sample data from this

liquid waste stream indicate that average nitrate concentrations were 0.596 mg/L. This low concentration suggests that the effluent from backwash was not a significant source of nitrate. Maximum concentrations (170 mg/kg) of nitrate detected during soil remediation at 120-N-1/120-N-2 suggest that little nitrate was available to impact groundwater at these sites. However, a maximum concentration of 1,420 mg/kg was detected at 130-N-1, which indicates a significant source as concentrations greater than 1,000 mg/kg in soil are not considered protective of groundwater.

A1.2.4.5 Hexavalent Chromium Plume/Chromium

Sodium dichromate (hexavalent chromium) was used during 105-N Reactor operations from 1964 to 1972, but in significantly less amounts than in the other 100 Area reactors because of the design of the 105-N Reactor cooling system and the use of corrosion-resistant metals (such as zircaloy) in the fuel and facility. Only one well (199-N-80) in the 100-NR-2 OU had hexavalent chromium and chromium concentrations above groundwater cleanup levels in 2013. The hexavalent chromium concentration in Well 199-N-80, which was completed in a thin, confined water-bearing zone in the upper portion of the RUM unit, was 177 µg/L. This concentration is consistent with previous results and remains relatively unchanged since monitoring began in 1993. There is also hexavalent chromium (19.2 µg/L) in the area of Well 199-N-96A that is above the ambient water quality criteria of 10 µg/L. Only the hexavalent chromium/chromium in confined Well 199-N-80 and hexavalent chromium in the vicinity of Well 199-N-96A are within the scope of this SAP.

There are areas of inland hexavalent chromium groundwater contamination in the 100-NR-2 OU that are greater than the ambient water criteria of 10 µg/L and less than the MTCA (WAC 173-340) Method B cleanup level of 48 µg/L. The source of this contamination is believed to have originated from the 100-K Area. Groundwater monitoring of these inland areas of hexavalent chromium within the 100-NR-2 OU is addressed in DOE/RL-2013-29, *100-KR-4 Groundwater Operable Unit Monitoring Program Sampling and Analysis Plan* (Draft A). The hexavalent chromium plumes in the 100-NR-2 OU are shown in Figure A-10 for the unconfined aquifer.

A1.2.4.6 Other CERCLA Contaminants of Interest

Antimony, cadmium, and cobalt are not identified as plumes within the 100-NR-2 OU. The occurrence of antimony, cadmium, and cobalt in groundwater is uncertain because these analytes historically have been detected in groundwater at concentrations above their respective action level; however, their presence was not associated with a specific location or a trend and the analytical methods used were not sufficient for risk characterization purposes. As such, groundwater shall continue to be sampled and analyzed for antimony, cadmium, and cobalt. These constituents were retained as COPCs in DOE/RL-2012-15 Draft A, Chapter 6.

A1.3 Data Quality Objective Summary

In association with development of this SAP, the DQO process was undertaken to support identification of sampling requirements appropriate for the current SAP objectives. The DQO process followed for this SAP and its resulting application to refine the well network and focus the sampling requirements is provided in the 100-NR-2 DQO summary report (Insert A1). The purpose of this DQO process also supports the optimization of the long-term/routine groundwater monitoring and two performance monitoring groundwater networks in the 100-NR-2 Groundwater OU. This SAP will direct CERCLA monitoring activities needed for the 100-NR-2 Groundwater OU until an update is needed or the final ROD is issued.

Characteristics/conditions impacting the sampling design include the following:

- Interim safe storage of the 105-N Reactor in 2011 and removal of most reactor support facilities
- Completion of remediation and backfill of most waste sites by 2014
- Decommissioning/removal of many monitoring wells during remediation activities
- Discontinuing operation of the 100-NR-2 OU pump and treat system for Sr-90 in March 2006
- Construction of part of an apatite PRB for Sr-90 in the saturated zone after 2006
- Construction of a bioventing treatment system for vadose zone TPH in 2009
- New waste site characterization during the 100-N Area RI/FS process in 2011
- Construction of new monitoring wells and aquifer tubes during the 100-N Area RI/FS in 2011
- Revision of the 100-N Area conceptual site model during the 100-N Area RI/FS process in 2012
- Declining/stabilizing water table following cessation of 100-N reactor operations.
- Adjacent groundwater pump and treat activities at the 100-KR-4 Groundwater OU

The goals of the 100-NR-2 groundwater DQO were identified based on seven principal study questions (PSQs). The PSQs identify what the SAP will address and decisions that will be resolved by collecting data. Data will be collected to resolve the following PSQs:

- Is the Sr-90 permeable reactive (apatite) barrier performing as intended?
- Are TPH remedies (i.e., bioventing and smart sponge) contributing to groundwater quality improvements?
- Is there evidence of Interim Action ROD COC plume, concentration, area, or location changes?
- Are there continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?
- Is there evidence that Columbia River water quality is being protected?
- How do adjacent OUs influence 100-NR-2 OU remedies?
- Is additional information needed for a final ROD?

Following PSQ development, seven decision statements were identified to address the study questions, and key assumptions were defined. The following decision statements were identified:

- Determine if the permeable reactive (apatite) barrier is trapping Sr-90 and preventing it from reaching the Columbia River.
- Determine if TPH remedies (bioventing and "smart sponge") are contributing to groundwater quality improvement.
- Determine if Interim Action ROD COC plume, concentration, area, and locations are changing.
- Determine if there are continuing sources of contamination (e.g., Sr-90 and tritium near the 1908-N Outfall).
- Determine if Columbia River water quality is being protected.
- Determine if adjacent OUs influence 100-NR-2 OU remedies.
- Determine if additional information is needed for final Interim Action ROD decisions.

The key assumptions of the plan are as follows:

1. The monitoring plan developed through this DQO will address CERCLA groundwater monitoring requirements.
2. Some of the existing 100-N groundwater monitoring wells may not be sufficient in their construction and/or locations to support the various monitoring needs identified in the project objectives.
3. Given the overlapping nature of several of the groundwater plumes, some monitoring wells may serve multiple needs. The wells used historically for monitoring the various 100-N groundwater plumes and general groundwater quality are listed in Table 6-20 of the RI/FS for the 100-NR-1 and 100-NR-2 OUs (DOE/RL-2012-15, Draft A) and are included in the DQO.
4. Hexavalent and total chromium are present in 100-NR-2 OU groundwater, and total chromium is identified as a COPC. Their presence is primarily due to groundwater contamination from the 100-KR-4 OU. Therefore, minimal groundwater monitoring and plume tracking is proposed.
5. New wells will be needed to supplement or replace existing monitoring wells. New wells will be constructed according to WAC 173-160. Monitoring well locations, construction, sampling frequency, and target analytes for groundwater monitoring will require approval from the U.S. Department of Energy, Richland Operations Office (DOE-RL), Ecology, and EPA (all SAP signatories).
6. A process will be considered for "triggers" to monitoring modifications (e.g., add/subtract wells and/or analytes; increase/decrease sampling frequencies). Consider OSWER 9355.0-129, *Guidance for Evaluating Completion of Groundwater Restoration Remedial Action*; OSWER 9283.1-44, *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well*; OSWER 9283.1-46, *Groundwater Statistics Tool User's Guide*; and EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities; Unified Guidance*, as possible guidance in developing these "triggers." Monitoring requirements in this SAP may change in the future based on triggers.
7. New aquifer tubes may be needed to supplement or replace the existing aquifer tubes.
8. Vadose zone characterization is not within the scope of the 100-NR-2 OU groundwater monitoring DQO. Vadose zone sampling conducted during new well drilling activities will be documented and conducted as part of the associated drilling process.
9. Apatite barrier baseline and short-term PRB injection monitoring was fully assessed as part of the RD/RAWP SAP (Rev. 1); it will not be discussed further in the DQO summary report.
10. DOE/RL-2005-93 includes some required groundwater sampling. It was aligned with the TPH vadose remediation (i.e., bioventing) sampling and analysis but did not have a stated purpose. This DQO will address the purpose of the groundwater sampling aligned with bioventing.
11. Smart sponge requirements for weighing and reporting removal quantities of TPH light nonaqueous-phase liquids are documented in the 100-NR-2 RD/RAWP (Rev. 1). More detail about placement, removal, weighing, and reporting will be added to the SAP but not included as part of the DQO.

Table 16 in the 100-NR-2 DQO summary report (Insert A1) identifies groundwater wells, aquifer tubes, and other information applicable to the 100-NR-2 OU groundwater monitoring network. Quality requirements for the environmental data collection are addressed in Chapter A2, "Quality Assurance Project Plan." It includes planning, implementation, and assessment of sampling tasks, field measurements, and laboratory analysis.

A1.4 Groundwater Monitoring Constituents

Specific constituents for CERCLA and RCRA groundwater monitoring are provided in Table A-3. The CERCLA contaminants listed are those identified in the DQO summary report (Insert A1). The constituents for RCRA monitoring are identified in the RCRA groundwater monitoring documents (WHC-SD-EN-AP-038 and PNNL-13914).

Table A-3. Analytes for 100-NR-2 OU Groundwater Monitoring[a]

Constituent	Chemical Abstract Service Number
Inorganics – Metals	
Aluminum	7429-90-5
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Cadmium	7440-43-9
Calcium	7440-70-2
Chromium	7440-47-3
Cobalt	7440-48-4
Copper	7440-50-8
Hexavalent Chromium	18540-29-9
Iron*	7439-89-6
Lead	7439-92-1
Magnesium	7439-95-4
Manganese*	7439-96-5
Molybdenum	7439-98-7
Nickel	7440-02-0
Phosphorous	7723-14-0
Potassium	7440-09-7
Sodium*	7440-23-5
Silver	7440-22-4
Selenium	7782-49-2
Strontium	7440-24-6
Vanadium	7440-62-2
Zinc	7440-66-6
Inorganics – Anions	

Table A-3. Analytes for 100-NR-2 OU Groundwater Monitoring[a]

Constituent	Chemical Abstract Service Number
Bromide	24959-67-9
Chloride*	16887-00-6
Fluoride	16984-48-8
Nitrogen in Nitrate	14797-55-8 – NO3-N
Nitrogen in Nitrite	14797-65-0A – NO2-N
Phosphorus in Phosphate	14265-44-2 – PO4-P
Sulfate*	14808-79-8
Organics	
TPH-Diesel Range	68334-30-5, TPHDIESEL
TPH-Gasoline Range	8006-61-9, TPHGASOLINE
TPH-Motor Oil	TPH/OILH
Oil and Grease	CASID30133/OIL/GREASE
Total Organic Carbon[b]	7440-44-0
Total Organic Halides[b]	59473-04-0
BTEX	
Benzene	71-43-2
Ethylbenzene	100-41-4
Toluene	108-88-3
Xylene	1330-20-7
Polycyclic Aromatic Hydrocarbons	
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(b)fluoranthene	205-99-2
Benzo(ghi)perylene	191-24-2
Benzo(k)fluoranthene	207-08-9
Chrysene	218-01-9
Dibenzo(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(1,2,3-cd)pyrene	193-39-5
Naphthalene	91-20-3
Phenanthrene	85-01-8

Table A-3. Analytes for 100-NR-2 OU Groundwater Monitoring[a]

Constituent	Chemical Abstract Service Number
Pyrene	129-00-0
Radionuclides and Indicators	
Strontium-90	10098-97-2
Tritium	10028-17-8
Gross alpha*	12587-46-1
Gross beta	12587-47-2
Field Measurements	
Alkalinity*	Not applicable
Dissolved Oxygen	Not applicable
Oxidation-Reduction Potential	Not applicable
pH*	Not applicable
Specific Conductance*	Not applicable
Temperature	Not applicable
Sheen and Odor	Not applicable
Turbidity*	Not applicable
Depth to Groundwater*	Not applicable

a. Constituents all apply to CERCLA unless noted otherwise. Constituents monitored for RCRA are those identified with an asterisk (*).

b. Applicable only to RCRA monitoring.

BTEX = benzene, ethylbenzene, toluene, and xylenes

TPH = total petroleum hydrocarbons

A1.5 Project Schedule

This SAP will direct CERCLA monitoring activities needed for the 100-NR-2 OU until an update is needed or the final ROD is issued. The yearly sampling schedule will be established by the Sample Management and Reporting (SMR) organization through processes and software applications, such as the *Sample Management Integrated Lifecycle Environment* (SMILE), which optimizes the overall number of sampling trips and limits schedule redundancy. The SMR organization tracks overlapping requirements so single sampling events can co-sample wells and optimize schedules.

A2 Quality Assurance Project Plan

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the QA elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). Sections 6.5 and 7.8 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, require the QA/quality control (QC) and sampling and analysis activities to specify the QA requirements for treatment, storage, and disposal units, as well as for past-practice processes. This QAPjP also describes the applicable requirements and controls based on

guidance found in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following four sections, which describe the quality requirements and controls applicable to Hanford Site OU groundwater monitoring activities: Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Validation and Usability.

A2.1 Project Management

This section addresses project goals, the management approaches planned, and planned output documentation.

A2.1.1 Project/Task Organization

The contractor, or its approved subcontractor, is responsible for planning, coordinating, sampling, and shipping samples to the laboratory. The contractor is also responsible for preparing and maintaining configuration control of the SAP and assisting the DOE-RL project manager in obtaining approval of the SAP and future proposed revisions. Project organization (regarding routine groundwater monitoring) is described in the following sections and illustrated in Figure A-11. Sections A2.1.1.5 through A2.1.1.14 describe contractor roles and responsibilities.

A2.1.1.1 Regulatory Lead

The lead regulatory agency (LRA) is responsible for regulatory oversight of cleanup projects and activities. The LRA has SAP approval authority for the OUs they manage. The LRA works with DOE-RL to resolve concerns over the work described in this SAP in accordance with the Tri-Party Agreement (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*).

A2.1.1.2 DOE-RL Project Manager

The DOE-RL Project Manager is responsible for the following:

- Monitoring the contractor's performance of activities under CERCLA, RCRA, the AEA, and the Tri-Party Agreement (Ecology et al., 1989a,) for the Hanford Site
- Obtaining LRA approval of the SAP
- Authorizing field sampling activities
- Approving the SAP
- Functioning as primary interface with regulators

A2.1.1.3 DOE-RL Technical Lead

The DOE-RL Technical Lead is responsible for the following:

- Providing day-to-day oversight of the contractor's work scope performance
- Working with the contractor and the regulatory agencies to identify and resolve technical issues
- Providing technical input to the DOE-RL Project Manager

A2.1.1.4 Operable Unit Project Manager

The OU Project Manager (or designee) is responsible and accountable for the following:

- Project-related activities
- Coordinating with DOE-RL, regulators, and contactor management in support of sampling activities to ensure work is performed safely and cost effectively
- Managing sampling documents and requirements, field activities, subcontracted tasks, and for ensuring the project file is properly maintained

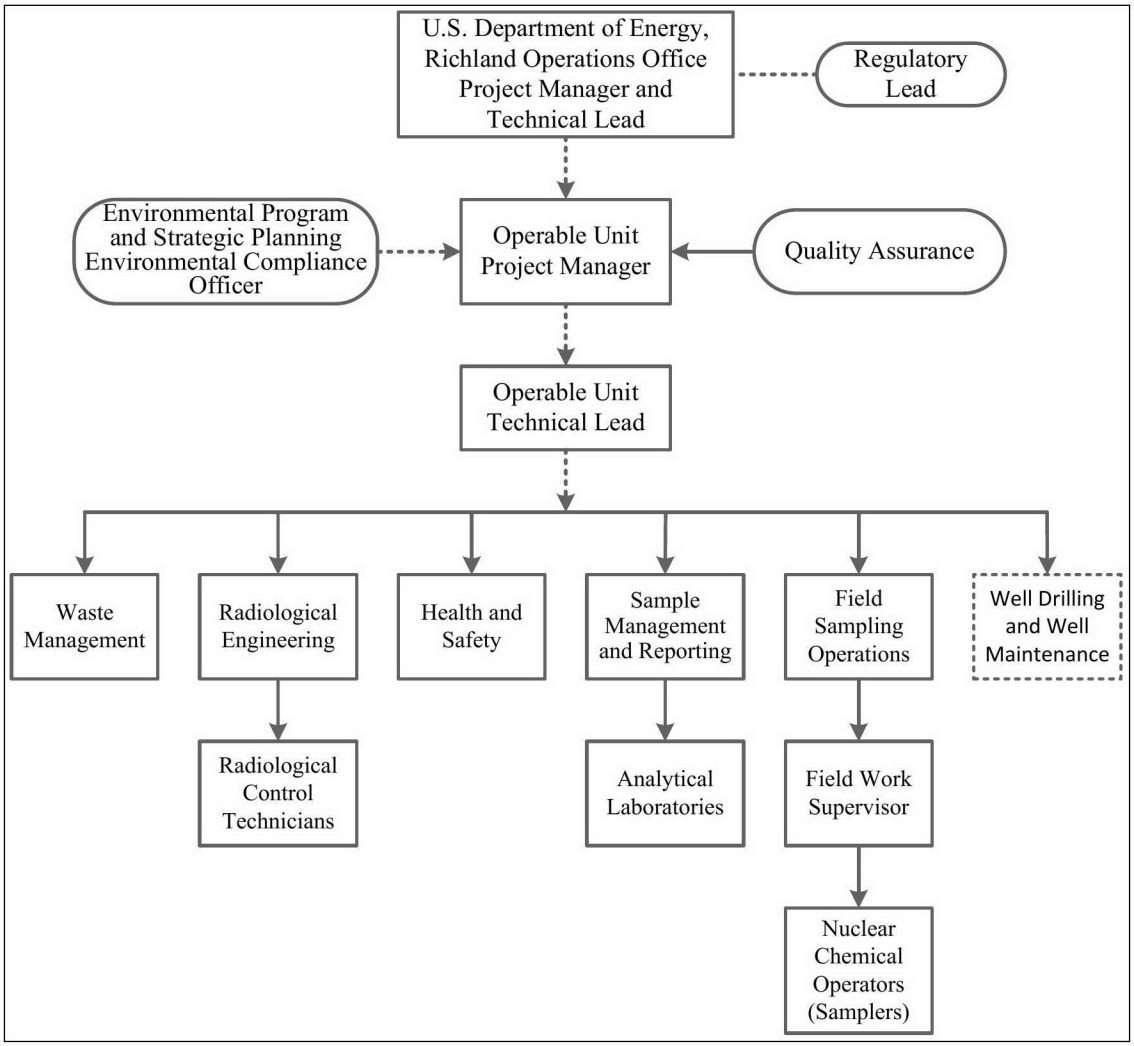


Figure A-11. Project Organization

A2.1.1.5 Operable Unit Technical Lead

The OU Technical Lead is responsible for the following:

- Developing specific sampling design, analytical requirements, and QC requirements, either independently or as defined through a systematic planning process
- Ensuring that sampling and analysis activities as delegated by OU Project Manager are carried out in accordance with the SAP

- Working closely with the Environmental Compliance Officer (ECO), QA, Health and Safety, the field work supervisor (FWS), and the SMR organization to integrate these and other technical disciplines in planning and implementing the work scope

A2.1.1.6 Environmental Compliance Officer

The ECO is responsible for the following:

- Providing technical oversight, direction, and acceptance of project and subcontracted environmental work
- Developing appropriate mitigation measures to minimize adverse environmental impacts
- Reviewing plans, protocols, and technical documents to ensure environmental requirements have been addressed
- Identifying environmental issues affecting operations and developing cost effective solutions
- Responding to environmental/regulatory issues or concerns
- Overseeing project implementation for compliance with applicable internal and external environmental requirements

A2.1.1.7 Quality Assurance

The QA point of contact is responsible for the following:

- Addressing QA issues on the project
- Overseeing implementation of the project QA requirements
- Reviewing project documents (including the DQO summary report, QAPjP, and SAP)
- Reviewing data validation reports from third-party data validation contractors, as appropriate
- Participating in QA assessments on sample collection and analysis activities, as appropriate

A2.1.1.8 Health and Safety

The Health and Safety organization is responsible for the following:

- Coordinating industrial safety and health support within the project, in accordance with the health and safety program, job hazard analyses, and other pertinent federal regulation
- Assisting project personnel in complying with the applicable health and safety program
- Coordinating with Radiological Engineering to determine personal protective equipment (PPE) requirements

A2.1.1.9 Radiological Engineering

Radiological Engineering is responsible for the following:

- Radiological engineering and project health physics support
- Conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization
- Identifying radiological hazards and ensuring appropriate controls are implemented to maintain worker exposures to hazards at ALARA levels

- Interfacing with the project Health and Safety representative and other appropriate personnel, as needed, to plan and direct project radiological control technician (RCT) support

A2.1.1.10 Sample Management and Reporting Organization

The SMR organization is responsible for the following activities:

- Interfacing between the OU Technical Lead, the Field Sampling Operations (FSO), the Well Maintenance Organization, and the analytical laboratories
- Generating field sampling documents, labels, and instructions for field sampling personnel
- Developing the sample authorization form (SAF), which provides information and instruction to the analytical laboratories)
- Providing instructions to the FSO nuclear chemical operators (NCOs) (samplers) on the collection of samples as specified in a SAP
- Monitoring the entire sample and data process
- Coordinating laboratory analytical work, and ensuring that the laboratories conform to Hanford Site QA requirements (or their equivalent), as approved by DOE, EPA, and Ecology
- Resolving sample documentation deficiencies or issues associated with the FSO, laboratories, or other entities to ensure that project needs are met
- Receiving the analytical data from the laboratories
- Ensuring data are uploaded into the HEIS database
- Arranging for, and overseeing, data validation, as requested
- Informing the OU Project Manager and/or OU Technical Lead of any issues reported by the analytical laboratory

A2.1.1.11 Analytical Laboratories

Analytical laboratories are responsible for the following:

- Analyzing samples in accordance with established methods
- Providing data packages containing analytical and QC results
- Providing explanations in response to resolution of analytical issues
- Meeting the requirements of this plan
- Being on the Mission Support Alliance Evaluated Suppliers List
- Being accredited by Ecology for the analyses performed for the Soil and Groundwater Remediation Project

A2.1.1.12 Waste Management

Waste Management is responsible for the following:

- Communicating policies and protocols

- Ensuring compliance for waste storage, transportation, disposal, and tracking in a safe and cost effective manner
- Identifying waste management sampling/characterization requirements to ensure regulatory compliance
- Interpreting data to determine waste designations and profiles
- Preparing and maintaining other documents confirming compliance with waste acceptance criteria

A2.1.1.13 Field Sampling Organization

The FSO is responsible for the following:

- Planning, coordinating, and conducting field sampling activities
- The FWS directing the NCOs (samplers) and ensuring they are appropriately trained and available
- The FWS reviewing the SAP for field sample collection concerns, analytical requirements, and special sampling requirements
- Ensuring the sampling design is understood by the NCOs and can be performed as specified; this is achieved by performing mockups and holding practice sessions with field personnel
- The NCOs collecting all salient samples in accordance with sampling documentation
- Completing field logbook entries, chain-of-custody forms, shipping paperwork, and ensuring delivery of the samples to the analytical laboratory
- The FWS acting as a technical interface between the OU Project Manager and the field crew supervisors (such as the Drilling Buyer's Technical Representative [BTR] and Geologist BTR) and ensuring technical aspects of the field work are met
- In consultation with the OU Project Manager and the SMR organization, resolving issues regarding arising from translation of technical requirements to field operations and coordinating resolution of sampling issues

A2.1.1.14 Well Maintenance

The Well Maintenance Manager is responsible for the following:

- Well maintenance activities
- Coordinating with the OU Technical Lead to identify field constraints that could affect groundwater sampling

A2.1.2 Quality Objectives and Criteria

The QA objective of this plan is to ensure the generation of analytical data of known and appropriate quality that are acceptable and useful for decision making. In support of this objective, statistics and data descriptors known as data quality indicators (DQIs) help determine the acceptability and utility of data to the user. The principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. These are defined for the purposes of this document in Table A-4.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. Typically, the acceptance criteria are set by the analytical method itself; however, project-specific requirements as

indicated by DQOs may result in more stringent acceptance criteria. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section A2.4.3).

Table A-4. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Precision	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity) • Request reanalysis or remeasurement • Qualify the data before use
Accuracy	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. Quality control analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use • Request reanalysis or remeasurement
Representativeness	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for them not being representative • Flag for further review • Review data for usability • If data are usable, qualify the data for limited use and define the portion of the system that the data represent • If data are not usable, flag as appropriate • Redefine sampling and measurement requirements and protocols

Table A-4. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
			• Resample and reanalyze, as appropriate
Comparability	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods • Identify quantifiable bias, if applicable • Qualify the data as appropriate • Resample and/or reanalyze if needed • Revise sampling/analysis protocols to ensure future comparability
Completeness	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/ acceptance criteria).	If data set does not meet completeness objective: • Identify appropriate changes to data collection and/or analysis methods • Identify quantifiable bias, if applicable • Resample and/or reanalyze if needed • Revise sampling/analysis protocols to ensure future completeness.
Bias	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools • Institute correct sampling and subsampling procedures to limit preferential selection or loss of sample media • Use sample handling procedures, including proper sample preservation, that limit the loss or gain of constituents to the sample media Analytical data that are known to be affected by either

Table A-4. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
			sampling or analytical bias are flagged to indicate possible bias. Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other laboratories for analysis.
Sensitivity	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or remeasurement using methods or analytical conditions that will meet required detection or limit of quantitation • Qualify/reject the data before use

Reference: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended.

A2.1.3 Special Training/Certification

A graded approach is used to ensure workers receive a level of training commensurate with their responsibilities and compliant with applicable DOE orders and government regulations. The FWS, in coordination with line management, will ensure special training requirements for field personnel are met.

In addition, pre-job briefings will be held in accordance with work management and work release requirement documents to evaluate activities and associated hazards including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

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

A2.1.4 Documents and Records

The OU Project Manager (or designee) is responsible for ensuring the current version of the SAP is being used and providing updates to field personnel. Version control is maintained by the administrative document control process. Changes to the sampling document are handled consistent with the HASQARD (DOE/RL-96-68) and the Tri-Party Agreement Action Plan (Ecology et al., 1989b). The OU Project Manager is responsible for tracking all SAP changes, obtaining appropriate review, and alerting DOE-RL of these changes. Appropriate documentation will follow, in accordance with the requirements for the type of change. Table A-5 summarizes the changes that may be made and their documentation requirements.

Table A-5. Change Control for Sampling Projects

Type of Change[a]	Type of Change (Tri-Party Agreement Action Plan[b])	Action	Documentation
Minor Change. Change has no impact on the sample or field analytical result, and little or no impact on performance or cost. Further, the change does not affect the DQOs specified in the SAP.	**Minor Field Change**. Changes that have no adverse effect on the technical adequacy of the job or the work schedule.	The field personnel recognizing the need for a field change will consult with the OU Project Manager (or designee) prior to implementing the field change.	Minor field changes will be documented in the field logbook. The logbook entry will include the field change, the reason for the field change, and the names and titles of those approving the field change.
Significant Change. Change has a considerable effect on performance or cost, but still allow for meeting the DQOs specified in the SAP.	**Minor Change**. Changes to approved plans that do not affect the overall intent of the plan or schedule.	The OU Project Manager will inform the DOE-RL Project Manager and the Regulatory Lead of the change and seek concurrence at a Unit Manager's Meeting or comparable forum. The lead regulatory agency determines there is no need to revise the document.	Documentation of this change approval would be in the Unit Manager's Meeting minutes or comparable record such as a Change Notice.[c]
Fundamental Change. Change has significant effect on the sample or the field analytical result, performance, or cost, and the change does not meet the requirements specified in the DQOs in the sampling document.	**Revision Necessary**. Lead regulatory agency determines changes to approved plans require revision to document.	If it is anticipated that a fundamental change will require the approval of the Regulatory Lead, the applicable DOE-RL Project Manager will be notified by the OU Project Manager and will be involved in the decision prior to implementation of a fundamental change. The lead regulatory agency determines the change requires a revision to the document.	Formal revision of the sampling document.

Table A-5. Change Control for Sampling Projects

Type of Change[a]	Type of Change (Tri-Party Agreement Action Plan[b])	Action	Documentation

a. Consistent with DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document*.

b. Consistent with Sections 9.3 and 12.4 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*.

c. Section 9.3 of Ecology et al., 1989b defines the minimum elements of a change notice.

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

DQO = data quality objective

OU = operable unit

SAP = sampling and analysis plan

The FWS, SMR organization, and appropriate BTR are responsible for ensuring that the field instructions are maintained and aligned with any revisions or approved changes to the SAP. The SMR organization will ensure that any deviations from the SAP are reflected in revised paperwork for the samplers and the analytical laboratory. The FWS or appropriate BTR will ensure that deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook) in accordance with corrective action protocols.

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

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR organization)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160 and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Field sampling logbooks
- Groundwater sample reports and field sample reports
- Chain-of-custody forms
- Sample receipt records

- Laboratory data packages
- Analytical data verification and validation reports, if any
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by the offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Records may be stored in either electronic or hardcopy format. Documentation and records, regardless of medium or format, are controlled in accordance with work requirements and processes to ensure stored records are accurate and can be retrieved. Records required by the Tri-Party Agreement (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

A2.2 Data Generation and Acquisition

The following sections present the requirements for analytical methods, measurement and analysis, data collection or generation, data handling, and field and laboratory QC. The requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

A2.2.1 Analytical Methods Requirements

Analytical method performance requirements for samples collected are presented in Table A-6. In consultation with the laboratory and the OU Project Manager, the SMR organization can approve changes to analytical methods as long as the new method is based upon a nationally recognized standard method (e.g., EPA, American Society for Testing and Materials [ASTM]) and the new method delivers analytical data that are comparable to those provided by the old method. The new method must achieve project DQOs as well or better than the replaced method, and is required due to the nature of the sample (e.g., high radioactivity). The laboratory using the new method must be accredited by Ecology to perform that method. Issues that may affect analytical results are resolved by the SMR organization in coordination with the OU Project Manager.

A2.2.2 Field Analytical Methods

Chemical field screening and radiological field survey data used for site characterization will be measured in accordance with HASQARD-approved method (as applicable). Field analytical methods may also be performed in accordance with the manufacturers' manuals. Chapter A3 provides the parameters identified for field survey analyses.

A2.2.3 Quality Control

The QC requirements specified in the SAP must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC sample requirements are summarized in Table A-7. Acceptance criteria for field and laboratory QC are shown in Table A-8.

Data will be qualified and flagged in the HEIS database, as appropriate.

Table A-6. Performance Requirements for Groundwater Analysis[a]

Constituent	Chemical Abstract Services Number	Action Level[b]	Analytical Method[c]	Required Quantitation Limit
Radionuclides (pCi/L)				
Strontium-90	10098-97-2	8	Strontium-89/90-Total Rad Sr	2
Tritium	10028-17-8	20,000	Tritium liquid scintillation (mid-level)	400
Gross beta	12587-47-2	4 mrem/yr	9310_ALPHABETA_GPC	4
Gross alpha	12587-46-1	15	9310_ALPHABETA_GPC	3
Inorganics – Metals (µg/L)				
Aluminum	7429-90-5	87	ICP Metals – 6010 or 6020**	50
Antimony	7440-36-0	6	ICP Metals – 6010 or 6020 LL	5
Arsenic	7440-38-2	0.058[d]	ICP Metals – 6010 or 6020 LL	*2
Barium	7440-39-3	2000	ICP Metals – 6010 or 6020	20
Cadmium	7440-43-9	0.25[d]	ICP Metals – 6010 or 6020	*2
Calcium	7440-70-2	No value	ICP Metals – 6010 or 6020	1,000
Chromium	7440-47-3	65	ICP Metals – 6010 or 6020	10
Cobalt	7440-48-4	4.8	ICP Metals – 6010 or 6020 LL	2.6
Copper	7440-50-8	9	ICP Metals – 6010 or 6020	8
Iron	7439-89-6	300[d]	ICP Metals – 6010 or 6020	50
Lead	7439-92-1	2.1	ICP Metals – 6010 or 6020	*15
Magnesium	7439-95-4	No value	ICP Metals – 6010 or 6020	750
Manganese	7439-96-5	50	ICP Metals – 6010 or 6020	5

Table A-6. Performance Requirements for Groundwater Analysis[a]

Constituent	Chemical Abstract Services Number	Action Level[b]	Analytical Method[c]	Required Quantitation Limit
Molybdenum	7439-98-7	80	ICP Metals – 6010 or 6020	20
Nickel	7440-02-0	52	ICP Metals – 6010 or 6020	40
Phosphorous	7723-14-0	0.32	ICP Metals – 6010 or 6020 LL	*4
Potassium	7440-09-7	No value	ICP Metals – 6010 or 6020	4,000
Selenium	7782-49-2	5[d]	ICP Metals – 6010 or 6020	4
Silver	7440-22-4	2.6[d]	ICP Metals – 6010 or 6020 LL	2
Sodium	7440-23-5	No value	ICP Metals – 6010 or 6020	500
Strontium	7440-24-6	9600	ICP Metals – 6010 or 6020	10
Vanadium	7440-62-2	80	ICP Metals – 6010 or 6020	25
Zinc	7440-66-6	91	ICP Metals – 6010 or 6020	10
Hexavalent chromium	18540-29-9	10	EPA 7196	5
Inorganics – Anions (µg/L)				
Bromide	24959-67-9	No value	Anions by IC – 300.0	250
Chloride	16887-00-6	230,000	Anions by IC – 300.0	400
Fluoride	16984-48-8	960	Anions by IC – 300.0	500
Nitrogen in nitrate	14797-55-8 NO3-N	10,000	Anions by IC – 300.0	100
Nitrogen in nitrite	14797-65-0A NO2-N	1,000	Anions by IC – 300.0	100
Phosphorus in phosphate	14265-44-2 PO4-P	No value	Anions by IC – 300.0	500
Sulfate	14808-79-8	250,000	Anions by IC – 300.0	550

Table A-6. Performance Requirements for Groundwater Analysis[a]

Constituent	Chemical Abstract Services Number	Action Level[b]	Analytical Method[c]	Required Quantitation Limit
Total Petroleum Hydrocarbons (µg/L)				
TPH-Gasoline range	8006-61-9, TPHGASOLINE	1000	WTPH-G	500
TPH-Diesel range	68334-30-5, TPHDIESEL	500	WTPH-D	500
TPH-Motor oil	TPH/OILH	No value	WTPH-D	500
Oil and grease	CASID30133	No value	EPA Method 9070	5,000
Volatile Organic Analysis (µg/L)				
Benzene	71-43-2	0.8	EPA Method 8260	*5
Ethylbenzene	100-41-2	4	EPA Method 8260	4
Toluene	108-88-3	640	EPA Method 8260	5
Xylenes (total)	1330-20-7	1600	EPA Method 8260	10
Polynuclear Aromatic Hydrocarbons (µg/L)				
Acenaphthene	83-32-9	480	EPA Method 8270 or 8270 SIM	10
Acenaphthylene	208-96-8	No value	EPA Method 8270 or 8270 SIM	10
Anthracene	120-12-7	2,400	EPA Method 8270 or 8270 SIM	10
Benzo(a)anthracene	56-55-3	0.12	EPA Method 8270 or 8270 SIM LL-PAH	*0.3
Benzo(a)pyrene	50-32-8	0.012	EPA Method 8270 or 8270 SIM LL-PAH	*0.5
Benzo(b) fluoranthene	205-99-2	0.12	EPA Method 8270 or 8270 SIM LL-PAH	*0.5

Table A-6. Performance Requirements for Groundwater Analysis[a]

Constituent	Chemical Abstract Services Number	Action Level[b]	Analytical Method[c]	Required Quantitation Limit
Benzo(k) fluoranthene	207-08-9	0.12	EPA Method 8270 or 8270 SIM LL-PAH	*0.5
Benzo(g,h,i) perylene	191-24-2	No value	EPA Method 8270 or 8270 SIM	5.5
Chrysene	218-01-9	1.2	EPA Method 8270 or 8270 SIM	*5
Dibenzo(a,h) anthracene	53-70-3	0.12	EPA Method 8270 or 8270 SIM LL-PAH	*1
Fluoranthene	206-44-0	640	EPA Method 8270 or 8270 SIM	10
Fluorene	86-73-7	320	EPA Method 8270 or 8270 SIM	4
Indeno (1,2,3-cd)pyrene	193-39-5	0.12	EPA Method 8270 or 8270 SIM LL-PAH	*0.3
Phenanthrene	85-01-8	No value	EPA Method 8270 or 8270 SIM	10
Pyrene	129-00-0	240	EPA Method 8270 or 8270 SIM	10
Naphthalene	91-20-3	160	EPA Method 8270 or 8270 SIM	10
Contamination Indicator Parameters (40 CFR 265.92[b][3]) (µg/L)				
Total Organic Carbon	7440-44-0	No value	SW-846 Method 9060	1000
Total Organic Halides	59473-04-0	No value	SW-846 Method 9020	10
Laboratory Indicators				
Alkalinity	CASID10164	NA	Alkalinity EPA Method 310.1	5,000 µg/L
Corrosivity (pH)	12408-02-5	NA	EPA Method 9040	N/A

Table A-6. Performance Requirements for Groundwater Analysis[a]

Constituent	Chemical Abstract Services Number	Action Level[b]	Analytical Method[c]	Required Quantitation Limit
Apatite Formation Testing (Sediment)				
Apatite	N/A	NA	Fluorescence of substituted apatites	N/A[e]
Phosphate	14265-44-2	NA	Acid dissolution of sediment and phosphate measurement	N/A[e]
Strontium-90	10098-97-2	NA	Strontium-89/90 – Total Rad-Sr	N/A[e]

a. For convenience, this table also includes information for apatite formation testing of sediments to support requirements identified in Insert A2.

b. Action Level is the lower of EPA MCLs for drinking water quality, WAC 173-340-720, "Model Toxics Control Act —Cleanup," "Groundwater Cleanup Standards," Method B; WAC 173-200, "Water Quality Standards for Groundwaters of the State of Washington," or Criteria For Chronic Exposure In Freshwater, WAC 173-201A-240, "Water Quality Standards for Surface Waters of the State of Washington (AWQC)."

c. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples.* For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*. Equivalent methods may be substituted.

d. Action level is less than the DOE/RL-96-61 background value.

e. PNNL's laboratory procedures and quality assurance plan will apply to all analyses performed by PNNL.

*Required quantitation limit is greater than the cleanup level for one or more of the following: MCL, WAC, or AWQC

** EPA Method 6020 is an equivalent method to EPA Method 6010 and provides lower detection levels.

AWQC = ambient water quality criteria
GPC = gas proportional counting
IC = ion chromatography
N/A = not applicable
PNNL = Pacific Northwest National Laboratory
MCL = maximum contaminant level
TPH = total petroleum hydrocarbons
SIM = selective ion monitoring
WTPH = Washington total petroleum hydrocarbons
LL = low level

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Table A-7. Project Quality Control Requirements

Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Field duplicates	1 in 20 well trips	Precision, including sampling and analytical variability
Field splits (SPLIT)	As needed When needed, the minimum is one for every analytical method, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Analytical Performance Requirements table	Precision, including sampling, analytical, and inter-laboratory
Full trip blanks (FTB)	1 in 20 well trips	Cross-contamination from containers or transportation
Field transfer blanks (FXR)	One each day that VOCs are sampled	Contamination from sampling site
Equipment blanks (EB)	As needed If only disposable equipment is used or equipment is dedicated to a particular well, then an EB is not required. Otherwise, 1 for every 20 samples [a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical Quality Control[b]		
Laboratory duplicates	1 per analytical batch[c]	Laboratory reproducibility and precision
Matrix spikes (MS)	1 per analytical batch[c]	Matrix effect/laboratory accuracy
Matrix spike duplicates (MSD)	1 per analytical batch[c]	Laboratory accuracy and precision
Laboratory control samples (LCS)	1 per analytical batch[c]	Evaluate laboratory accuracy
Method blanks (MB)	1 per analytical batch[c]	Laboratory contamination
Surrogates (SUR)	1 per analytical batch[c]	Recovery/yield
Tracers	1 per analytical batch[c]	Recovery/yield

a. For portable pumps, EBs are collected 1 for every 10 well trips. Whenever a new type of nondedicated equipment is used, an EB will be collected every time sampling occurs until it can be shown that less frequent collection of EBs is adequate to monitor the decontamination methods for the nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., all Hanford Site groundwater).

c. Unless not required or different frequency is called out in laboratory analysis methods.

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Table A-8. Field and Laboratory QC Elements and Acceptance Criteria

Analyte[a]	Quality Control Element	Acceptance Criteria	Corrective Action
General Chemical Parameters			
Alkalinity Conductivity Hexavalent chromium pH	MB[b]	<MDL <5% Sample concentration	Flagged with "C"
	LCS	80 – 120% recovery[c]	Data reviewed[d]
	Laboratory duplicate or MS/MSD	<20% RPD	Data reviewed[d]
	MS[b]	75 – 125% recovery[c]	Flagged with "N"
	EB	<2 Times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[e]	Flagged with "Q"
Anions			
Anions by IC	MB	<MDL <5% Sample concentration	Flagged with "C"
	LCS	80 – 120% recovery[c]	Data reviewed [d]
	Laboratory duplicate or MS/MSD	≤20% RPD	Data reviewed [d]
	MS	75 – 125% recovery[c]	Flagged with "N"
	EB, FTB	<2X MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[e]	Flagged with "Q"
Metals			
ICP Metals ICP/MS metals Mercury	MB	<Required detection limit <5% Sample concentration	Flagged with "C"
	LCS	80 – 120% recovery[c]	Data reviewed[d]
	MS	75 – 125% recovery[c]	Flagged with "N"
	MSD	75 – 125% recovery[c]	Flagged with "N"
	MS/MSD	≤20% RPD	Data reviewed[d]
	EB, FTB	<2X MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[e]	Flagged with "Q"

Table A-8. Field and Laboratory QC Elements and Acceptance Criteria

Analyte[a]	Quality Control Element	Acceptance Criteria	Corrective Action
Volatile Organic Compounds			
Volatile Organics by GC/MS Total petroleum hydrocarbons by GC	MB	<MDL[f] <5% Sample concentration	Flagged with "B"
	LCS	Statistically derived[c]	Data reviewed[d]
	MS	% Recovery statistically derived[c]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MSD	% Recovery statistically derived[c]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MS/MSD	%RPD statistically derived[c]	Data reviewed[d]
	SUR	Statistically derived[c]	Data reviewed[d]
	EB, FTB, FXR	<MDL[f]	Flagged with "Q"
	Field duplicate	≤20% RPD[e]	Flagged with "Q"
Semivolatile Organic Compounds (Includes PAH)			
Semivolatiles by GC/MS	MB	<MDL[f] <5% Sample concentration	Flagged with "B"
	LCS	Statistically derived[c]	Data reviewed[d]
	MS	% Recovery statistically derived[c]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MSD	% Recovery statistically derived[c]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MS/MSD	% RPD statistically derived[c]	Data reviewed[d]
	SUR	Statistically derived[c]	Data reviewed[d]
	EB, FTB	<2X MDL[f]	Flagged with "Q"
	Field duplicate	≤20% RPD[e]	Flagged with "Q"

Table A-8. Field and Laboratory QC Elements and Acceptance Criteria

Analyte[a]	Quality Control Element	Acceptance Criteria	Corrective Action
General Chemical Analysis			
Total Organic Carbon	MB	<MDL <5% Sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[d]
	Laboratory Duplicate or MS/MSD	≤20% RPD[e]	Data reviewed[d]
	MS or PS, and MSD (if MS/MSD)	75–125% recovery	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[e]	Flagged with "Q"
Total Organic Halogen Oil and Grease	MB	<MDL <5% Sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[d]
	Laboratory Duplicate or MS/MSD	≤20% RPD[e]	Data reviewed[d]
	MS and MSD (if MS/MSD)	75–125% recovery	Flagged with "N"
	EB, FTB	<2 Times MDL	Flagged with "Q"
	Field Duplicate	≤20% RPD[e]	Flagged with "Q"
Radiochemical Analyses			
Gross alpha Gross beta Strontium-89/90 Tritium Tritium (low level)	MB	<Minimum detectable concentration <5% Sample concentration	Flagged with "C"
	LCS	70 – 130% recovery	Data reviewed[d]
	Laboratory duplicate[e]	≤20% RPD	Data reviewed[d]
	MS[g]	60 – 140% recovery	Flagged with "N"
	Tracer (where applicable)	20 – 105% recovery	Data reviewed[d]
	Carrier (where applicable)	30 – 105% recovery	Data reviewed[d]
	EB, FTB	<2 Times MDA	Flagged with "Q"
	Field duplicate	≤20% RPD[e]	Flagged with "Q"

a. Specific analytes and method for determination are available from the Sample Management and Reporting organization.

b. Does not apply to pH, conductivity, total residue, total suspended solids, total dissolved solids, or alkalinity.

Table A-8. Field and Laboratory QC Elements and Acceptance Criteria

Analyte[a]	Quality Control Element	Acceptance Criteria	Corrective Action

c. Determined by the laboratory based on historical data or statistically derived control limits. Limits are reported with the data. Where specific acceptance criteria are listed, those acceptance criteria may be used in place of statistically derived acceptance criteria.

d. After review, corrective actions are determined on a case-by-case basis.

e. Applies only in cases where both results are greater than 5 times the minimum detectable concentration.

f. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is <5 times the MDL.

g. Applies only to tritium.

EB = equipment blank
FEAD = format for electronic analytical data
FTB = full trip blank
FXR = field transfer blank
GC = gas chromatography
GC/MS = gas chromatography-mass spectrometry
IC = ion chromatography
ICP = inductively coupled plasma
ICP/MS = inductively coupled plasma-mass spectrometry
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
RPD = relative percent difference
SUR = surrogate

Data Flags:

B (organics)/C (inorganics/wetchem) = Analyte was detected in both the associated quality control blank and the sample)
N = All except GC/MS – matrix spike outlier
T = VOA and Semi-VOA GC/MS – Matrix spike outlier
Q = Associated QC sample is out of limits

A2.2.3.1 Field QC Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure reliable data are obtained. Field QC samples include field duplicates, split samples, and three types of field blanks (full trip, field transfer, and equipment). Field blanks are typically prepared using high-purity reagent water. The QC sample definitions and their required frequency for collection are described in this section.

Field Duplicates: Independent samples collected as close as possible to the same time and same location as the schedule sample, and are intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.

Field Splits (SPLIT): Two samples collected as close as possible to the same time and same location and are intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are inter-laboratory comparison samples used to evaluate comparability between laboratories.

Full Trip Blanks (FTBs): Bottles prepared by the sampling team prior to traveling to the sampling site. The preserved bottle set is either for volatile organic analysis (VOA) only or identical to the set that will be collected in the field. It is filled with high-purity reagent water (or dead water from Well 699-S11-E12AP for low-level tritium FTBs) and the bottles are sealed and transported, unopened, to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to

evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation.

Field Transfer Blanks (FXRs): Preserved VOA sample vials filled with high-purity reagent water at the sample collection site where volatile organic compound (VOC) samples are collected. The samples will be prepared during sampling to evaluate potential contamination attributable to field conditions. After collection, FXR sample vials will be sealed and placed in the same storage containers with the samples collected the same day for the associated sampling event. FXR samples will be analyzed for VOCs only.

Equipment Blanks (EBs): Reagent water passed through or poured over the decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. The EB sample bottles are placed in the same storage containers with the samples from the associated sampling event. The EB samples will be analyzed for the same constituents as the samples from the associated sampling event. The EBs are used to evaluate the effectiveness of the decontamination process. EBs are not required for disposable sampling equipment.

A2.2.3.2 Laboratory QC Samples

Internal QA/QC programs are maintained by the laboratories utilized by the project. Laboratory QA includes a comprehensive QC program that includes the use of matrix spikes, matrix duplicates, matrix spike duplicates, laboratory control samples, surrogates, tracers, and method blanks. These samples are recommended in the guidance documents and are required by the EPA protocol (e.g., EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*) and will be run at the frequency specified in the respective references unless superseded by agreement. QC checks outside of control limits are documented in analytical laboratory reports during DQAs, if performed. Laboratory QC and their typical frequencies are listed in Table A-7. Acceptance criteria are shown in Table A-8. The following text describes the various laboratory QC samples.

Laboratory Duplicate: An intra-laboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.

Matrix Spike (MS): An aliquot of a sample spiked with a known concentration of target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.

Post-Preparation Spike: The same as an MS; however, the spiking occurs after sample preparation.

Matrix Spike Duplicate (MSD): A replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.

Laboratory Control Sample (LCS): A control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.

Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparations and analytical procedure. The MB is used to quantify contamination resulting from the analytical process.

Surrogate (SUR): A compound added to all samples in the analysis batch (field samples and QC samples) prior to preparation. The SUR is typically similar in chemical composition to the analyte being determined, yet is not normally encountered. SURs are expected to respond to the preparation and

measurement systems in a manner similar to the analytes of interest. Because SURs are added to all standards, samples, and QC samples, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.

Tracer: A known quantity of radioactive isotope that is different from that of the isotope of interest but is expected to behave similarly and is added to an aliquot of sample. Sample results are generally corrected based on tracer recovery.

The laboratories are required to analyze samples within the holding time specified in Table A-9. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilizing, decomposing, or by other chemical changes. Data from samples analyzed outside the holding times are flagged in the HEIS database with an "H."

Table A-9. Preservation, Container, and Holding Time Guidelines[a]

Constituent/ Parameter	Minimum Volume	Container Type[b]	Preservation[c]	Holding Time
Organic Analyses				
Volatile organics	4 × 40 mL	Amber glass VOA vial with Teflon® lined septum lid	Store <6°C (if free Cl2 add 4 drops of 10% sodium thiosulfate), adjust pH to <2 with HCl	14 days
WTPH-D includes motor oil)	4 × 1 L	Narrow mouth amber glass with Teflon lined lid	Store <6°C pH to <2 with HCl	7 days before extraction (14 days if preserved)
WTPH-Gasoline	4 × 40 mL	Amber glass VOA vial with Teflon lined septum lid	Store <6°C, adjust pH to <2 with HCl	14 days
Oil and grease	4 × 1 L	Narrow mouth glass	Store <6°C, adjust pH to <2 with HCl	28 days
Polynuclear aromatic hydrocarbons by 8270	4 × 1 L	Narrow mouth amber glass with Teflon lined lid	Store <6°C	7 days
Total Organic Carbon	250 mL	Narrow mouth amber glass with Teflon lined lid	Store ≦6°C, adjust pH to <2 with H_2SO_4 or HCl	28 days
Total Organic Halides	1 L	Narrow mouth glass with Teflon lined lid	Store ≦6°C, adjust pH to <2 with H_2SO_4	28 days
Metals [d]				
ICP/MS (with/without mercury)	250 mL	Narrow mouth poly or glass	Adjust pH to <2 with nitric acid	28 days/6 months[c]
ICP/AES (with/without mercury)	250 mL	Narrow mouth poly or glass	Adjust pH to <2 with nitric acid	28 days/6 months[c]

Table A-9. Preservation, Container, and Holding Time Guidelines[a]

Constituent/ Parameter	Minimum Volume	Container Type[b]	Preservation[c]	Holding Time
Dissolved metals (with/without mercury)	500 mL	Narrow mouth poly or glass	Filter prior to pH adjustment to <2 with nitric acid	28 days/6 months[c]
Miscellaneous Inorganic				
Alkalinity	500 mL	Poly or glass	Store ≤6°C	14 days
Hexavalent chromium	60 mL	Poly or glass	Store ≤6°C	24 hours
pH	60 mL	Poly or glass	None required	Analyze immediately (Field measurement)
Specific conductivity	150 mL	Poly or glass	Store ≤6 °C	Analyze immediately (Field measurement)
Inorganic Ions				
Bromide	125 mL	Poly or glass	Store ≤6°C	28 days
Chloride				28 days
Fluoride				28 days
Nitrate				48 hours
Nitrite				48 hours
Phosphate				48 hours
Sulfate				28 days
Radiochemical Analyses				
Gross alpha/beta (plate count)	500 mL	Narrow mouth poly or glass	Adjust pH to <2 with HNO_3	6 months
Sr-90 (total beta radiostrontium)	2 × 1 L	Wide mouth poly or glass	Adjust pH to <2 with HNO_3	6 months
Tritium	500 mL	Narrow mouth glass	None	6 months
Apatite Formation Testing				
Apatite[e]	1 L	Stainless steel or polycarbonate liner	Cool	N/A
Phosphate[e]	1 L	Stainless steel or polycarbonate liner	Cool	N/A
Sr-90[e]	1 L	Stainless steel or polycarbonate liner	Cool	N/A

Note: Teflon is a registered trademark of DuPont Company, Wilmington, Delaware.

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

a. Preservation, container, and holding times guidelines are also included for apatite formation testing of sediments at the end of this table.

b. Under the Container heading, the term poly stands for EPA clean polyethylene bottles.

Table A-9. Preservation, Container, and Holding Time Guidelines[a]

Constituent/ Parameter	Minimum Volume	Container Type[b]	Preservation[c]	Holding Time

c. For preservation identified as store at ≤6ºC, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

d. For metals analysis, 28 days/6 months holding time defines 28 days for mercury, 6 months for all other metals.

e. Sediment core sampling will be conducted between 3 months and 1 year after completion of jet injections.

GEA = gamma energy analysis
ICP-AES = inductively coupled plasma atomic emission spectroscopy
ICP-MS = inductively coupled plasma mass spectrometry
N/A = not applicable
pH = hydrogen ion concentration
VOA = volatile organic analysis
WTPH-D = Washington State Department of Ecology's total petroleum hydrocarbons as diesel
WTPH-G = Washington State Department of Ecology's total petroleum hydrocarbons as gasoline

A2.2.4 Measurement Equipment

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

A2.2.5 Instrument and Equipment Testing, Inspection, and Maintenance

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

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements (DOECAP, 2013, *Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories*, Section 5.0, "Technical Requirements").

A2.2.6 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in Section A3.5. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements (DOECAP, 2013, Section 5.0, "Technical Requirements").

A2.2.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, requirements and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical

and quality requirements must be in place. The procurement system ensures purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

A2.2.8 Nondirect Measurements

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

A2.2.9 Data Management

The SMR organization, in coordination with the OU Project Manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management methods.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS) or a project-specific database, whichever is applicable for the data being stored. Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

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

A2.3 Assessment and Oversight

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

A2.3.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this SAP, project field instructions, the project quality management plan, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies resolutions in accordance with the QA program, the corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the OU Project Manager (or designee).

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. The contractor oversees offsite analytical laboratories and verifies the laboratories are qualified for performing Hanford Site analytical work.

A2.3.2 Reports to Management

Management will be made aware of deficiencies identified by self-assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to the SMR organization, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and to establish resolution with the OU Project Manager.

A2.4 Data Validation and Usability

This section addresses the QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A2.4.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations; reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times, if any, have been met; and reviewing QC data to determine whether analyses have met the data quality requirements specified in this SAP.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors.

Errors identified by the laboratories are reported to the SMR organization's project coordinator, who initiates a sample issue resolution form. This process is used to document analytical errors and to establish resolution with the OU Technical Lead.

Relative to analytical data in sample media, field screening results are of lesser importance in making inferences regarding risk. Field QA/QC results will be reviewed to ensure they are usable.

The OU Technical Lead data review will help determine if observed changes reflect improved/degraded groundwater quality or potential data errors and may result in submittal of a request for data review on questionable data. The laboratory may be asked to check calculations or reanalyze the sample, or the well may be resampled. Results of the request for data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

A2.4.2 Data Validation

Data validation activities will be performed at the discretion of the OU Project Manager and under the direction of the SMR organization. If performed, data validation activities will be based on EPA functional guidelines.

A2.4.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. For routine groundwater monitoring undertaken through this integrated SAP, the DQA is captured in QC associated with the Annual Groundwater Report, which evaluates field and laboratory QC and the usability of data. Further DQAs will be performed at the discretion of the OU Project Manager and documented in a report overseen by the SMR organization.

A3 Field Sampling Plan

This chapter lists the groundwater wells and aquifer tubes to be monitored, the sampling frequency, and the constituents to be analyzed.

A3.1 Sampling Objectives

The objectives of groundwater monitoring in this OU are to:

- Determine the effectiveness of the PRB to reduce Sr-90 concentrations. This evaluation includes remedy performance monitoring for the combined saturated zone and vadose zone PRB.
- In conjunction with the bioremediation of petroleum, monitor the groundwater underlying the area of TPH contamination to support an evaluation of the bioventing system for achieving compliance with the cleanup standards.
- Better define the nature (type and concentration) and extent (distribution) of Sr-90, tritium, nitrate, TPH, chromium, and hexavalent chromium contamination. These contaminants exceed one or more of the following: drinking water standard, ambient water quality criteria, or WAC 173-340, "Model Toxics Control Act—Cleanup" (MTCA B), groundwater cleanup standard.
- Determine the concentrations of chromium and hexavalent chromium in the confined aquifer in Well 199-N-80.
- Determine if antimony, cadmium, and cobalt contamination are present above action/cleanup levels. The occurrence of antimony, cadmium, and cobalt in groundwater is uncertain because these analytes historically have been detected in groundwater at concentrations above their respective action level; however, their presence was not associated with a specific location or a trend and the analytical methods used were not sufficient for risk characterization purposes.

These objectives are accomplished by sampling groundwater at designated wells and aquifer tubes and analyzing the samples for the COCs, COPCs, and analytes of interest.

A3.2 Sample Location, Frequency, and Constituents Monitored

The sampling requirements and groundwater monitoring wells comprising the 100-NR-2 OU networks are listed in the 100-NR-2 OU DQO summary report (Insert A1). Insert A3 provides information on the aquifer intervals monitored by the wells. Table A-10 lists the specific constituents to be analyzed and the sampling frequency for those wells that have been selected for monitoring. This comprehensive list (Table A-10) contains the sampling requirements for the 100-NR-2 OU program inclusive of the PRB, bioventing, Sr-90, TPH, nitrate, tritium, and hexavalent chromium/metals networks. Where a well is sampled for more than one network, the sampling frequency in Table A-10 reflects the shortest sampling frequency of the networks. Specific sampling requirements (e.g., sampling frequency and constituents analyzed) applicable to each network are shown in Tables A-11 through A-18 and are a subset of Table A-10.

Insert A1 also contains the criteria used to identify the wells needed to answer each of the PSQs of the DQO and to determine the sampling frequency to be employed. Some wells are co-sampled with other monitoring programs (e.g., monitored to meet RCRA requirements). Monitoring requirements for those other monitoring programs are described in separate plans. The reported data from these networks are supplementary to information gathered under this SAP. The breakdown of the well networks to answer individual PSQs is discussed in Section A3.2.1 and summarized below.

- Sampling requirements to address PSQ 1 (Is the Sr-90 permeable reactive [apatite] barrier performing as intended) are listed in Table A-11 and discussed in Section 3.2.1.1. The data will also provide supplemental information for PSQs 3, 4, 5, and 7.
- Sampling requirements to address PSQ 2 (Are TPH remedies contributing to groundwater quality improvement) are listed in Table A-12 and discussed in Section 3.2.1.2. The data will also provide supplemental information for PSQs 3, 4, 5, and 7.
- Sampling requirements to address PSQ 3 (Is there evidence of Interim Action ROD COC plume, concentration, area, or location changes) are listed in Tables A-13 through A-17 and discussed in Section 3.2.1.3.
- Sampling requirements to address PSQ 4 (Are increasing concentrations in groundwater indicating newly identified or continuing sources of contamination [e.g., Sr-90 and tritium near the 1908-N Outfall]) are listed in Tables A-13 through A-18 and discussed in Section 3.2.1.4.
- Sampling requirements to address PSQ 5 (Is there evidence that Columbia River water quality is being protected) are listed in Tables A-11 through A-17 and discussed in Section 3.2.1.5.
- Sampling requirements to address PSQ 6 (How do adjacent operable units influence 100-NR-2 remedies) are listed in Tables A-13 through A-17 and discussed in Section 3.2.1.6.
- Sampling requirements to address PSQ 7 (Is there additional information needed for a final ROD) are listed in Tables A-11 through A-17 and discussed in Section 3.2.1.7.

A3.2.1 Monitoring Network

This SAP organizes the wells within the 100-NR-2 Groundwater OU according to the PSQ that they are associated with. An analysis of the network to identify those wells needed for use in monitoring specific COC plumes is presented in Insert A1. Traditional statistical sampling designs were not identified in the DQO summary report.

A3.2.1.1 PSQ 1: Is the Sr-90 permeable reactive (apatite) barrier performing as intended?

The apatite PRB (Figure A-12), located downgradient of the highest area of Sr-90 contamination, was formed by injecting a calcium citrate phosphate solution into the aquifer through a network of vertical wells installed at the river shoreline (i.e., the barrier well network). After the solution is injected, biodegradation of the citrate releases calcium, which results in formation of apatite (a calcium phosphate [$Ca_{10}(PO_4)_6(OH)_2$] mineral). Sr-90 ions in groundwater substitute for calcium ions in the apatite and eventually become trapped as part of the mineral matrix during apatite crystallization. The Sr-90 in groundwater is sorbed and then incorporated into the apatite crystalline structure within the soils and aquifer sediments as groundwater flows through the barrier. The 2013 data indicate that Sr-90 concentrations have been reduced. Based on previous monitoring data, the PRB is expected to achieve a 90 percent reduction in Sr-90 concentrations in the monitoring wells.

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Table A-10. Sampling and Analysis Schedule for the 100-NR-2 Groundwater OU Program

Well ID	Well Number	Co-Sampled Networks	Aquifer Interval	WAC Compliant[a]	Filtered ICP Metals	Unfiltered ICP Metals	Filtered Hexavalent Chromium	Alkalinity	Anions	VOAs (BTEX)	PAH	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH Oil and Grease	Total Organic Carbon	Total Organic Halides	Gross Alpha	Gross Beta	Strontium-90	Tritium	Field Dissolved Oxygen	Field Oxidation Reduction	Field Temperature	Field pH and Turbidity	Specific Conductance	Odor and Sheen
A4669	199-N-2	RCRA	TU	N1964	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	--	--	--	--	SA	SA	SA	--
A4679	199-N-3	BV, nitrate, TPH, RCRA	TU	N1964	A	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	SA	SA	SA	SA	SA	SA
A4664	199-N-14	Nitrate, Sr-90, metals	TU	N1969	A	A	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A4668	199-N-19	BV, nitrate, TPH	TU	N1981	--	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	--	--	SA	SA	SA	SA	SA	SA
A4671	199-N-21	Sr-90	TU	N1981	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A5	A5	A5	--
A4676	199-N-27	Nitrate, Sr-90	TU	N1983	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A4677	199-N-28	Sr-90, RCRA	TU	N1983	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	A5	--	--	--	SA	SA	SA	--
A4681	199-N-32	RCRA	TU	N1983	SA	SA	--	SA	SA	--	--	--	--	--	--	SA	SA	--	--	--	--	--	--	SA	SA	SA	--
A4683	199-N-34	Nitrate, Sr-90, RCRA	TU	N1983	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	A5	--	--	--	SA	SA	SA	--
A4689	199-N-41	Nitrate, Sr-90, metals, RCRA	TU	N1984	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	A5	--	--	--	SA	SA	SA	--
A5833	199-N-46	Nitrate, Sr-90	TU	ND	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A4693	199-N-50	Nitrate, Sr-90	TU	N1985	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A4694	199-N-51	Sr-90	TU	N1985	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A5	A5	A5	--
A4699	199-N-56	BV, TPH, nitrate	TU	N1987	--	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	--	--	SA	SA	SA	SA	SA	SA
A4700	199-N-57	Sr-90, nitrate, metals, RCRA	TU	N1987	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	A5	--	--	--	SA	SA	SA	--
A4708	199-N-64	Nitrate, Sr-90, metals	TU	N1987	A	A	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A4711	199-N-67	Nitrate, Sr-90, metals	TU	N1988	A	A	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A4714	199-N-71	RCRA	TU	C1991	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	--	--	--	--	SA	SA	SA	--
A4715	199-N-72	Nitrate, RCRA	TU	C1991	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	--	--	--	--	SA	SA	SA	--
A4716	199-N-73	Nitrate, RCRA	TU	C1991	A	A	--	A	A	--	--	--	--	--		SA	SA	--	--	--	--	--	--	SA	SA	SA	--
A4717	199-N-74	RCRA	TU	C1991	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	--	--	--	--	SA	SA	SA	--
A4718	199-N-75	Nitrate, Sr-90	TU	C1992	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--

Table A-10. Sampling and Analysis Schedule for the 100-NR-2 Groundwater OU Program

Well ID	Well Number	Co-Sampled Networks	Aquifer Interval	WAC Compliant[a]	Filtered ICP Metals	Unfiltered ICP Metals	Filtered Hexavalent Chromium	Alkalinity	Anions	VOAs (BTEX)	PAH	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH Oil and Grease	Total Organic Carbon	Total Organic Halides	Gross Alpha	Gross Beta	Strontium-90	Tritium	Field Dissolved Oxygen	Field Oxidation Reduction	Field Temperature	Field pH and Turbidity	Specific Conductance	Odor and Sheen
A4719	199-N-76	Nitrate, Sr-90	TU	C1992	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A5442	199-N-77	Nitrate, RCRA	LU	C1992	A	A	--	A	A	--	--	--	--	--	--	SA	SA	SA	--	--	--	--	--	SA	SA	SA	--
A4720	199-N-80	Hexavalent chromium, chromium, metals	Confined	C1992	A	A	A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A	A	A	--
A5443	199-N-81	Nitrate, Sr-90, RCRA	TU	C1993	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	A5	--	--	--	SA	SA	SA	--
A9878	199-N-92A	PRB-E, Sr-90, nitrate, metals	TU	C1994	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
A9882	199-N-96A	Nitrate, Sr-90, BV, TPH, PRB, metals, Cr+6	TU	C1994	--	SA	A	SA	SA	SA	SA	SA	SA	SA	SA	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	SA
A9910	199-N-99A	Sr-90, nitrate	TU	C1994	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A9988	199-N-103A	Sr-90, nitrate	TU	C1995	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
A9989	199-N-104A	Sr-90	TU	C1995	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A5	A5	A5	--
B2408	199-N-105A	Sr-90, nitrate, RCRA	TU	C1995	A	A	--	A	A	--	--	--	--	--	--	SA	SA	--	--	A5	--	--	--	SA	SA	SA	--
C4954	199-N-122	PRB, Sr-90	TU	C2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C4955	199-N-123	PRB, Sr-90	TU	C2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5042	199-N-136	PRB, Sr-90	TU	C2006	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C5052	199-N-146	PRB, Sr-90, metals	TU	C2006	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5116	199-N-147	PRB, Sr-90	TU	C2006	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C6177	199-N-159	PRB	TU	C2008	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C6693	199-N-165	RCRA	TU	C2008	A	A	--	A	A	--	--	--	--	--	--	SA	SA	SA	--	--	--	--	--	SA	SA	SA	--
C7032	199-N-167	BV, nitrate, TPH, metals	TU	C2009	A	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	--	--	SA	SA	SA	SA	SA	SA
C7034	199-N-169	BV, TPH	TU	C2009	--	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	--	--	SA	SA	SA	SA	SA	SA
C7036	199-N-171	BV, TPH	TU	C2009	--	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	--	--	SA	SA	SA	SA	SA	SA
C7037	199-N-172	BV	TU	C2009	--	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	--	--	SA	SA	SA	SA	SA	SA
C7038	199-N-173	BV, PRB, nitrate, TPH, Sr-90, metals	TU	C2009	SA	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	SA

Table A-10. Sampling and Analysis Schedule for the 100-NR-2 Groundwater OU Program

Well ID	Well Number	Co-Sampled Networks	Aquifer Interval	WAC Compliant[a]	Filtered ICP Metals	Unfiltered ICP Metals	Filtered Hexavalent Chromium	Alkalinity	Anions	VOAs (BTEX)	PAH	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH Oil and Grease	Total Organic Carbon	Total Organic Halides	Gross Alpha	Gross Beta	Strontium-90	Tritium	Field Dissolved Oxygen	Field Oxidation Reduction	Field Temperature	Field pH and Turbidity	Specific Conductance	Odor and Sheen
C8184	199-N-182	Nitrate, tritium	LU	C2011	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	--	A	--	--	A	A	A	--
C8185	199-N-183	BV, nitrate, TPH, Sr-90, metals, Cr+6	TU	C2011	--	SA	A	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	A5		SA	SA	SA	SA	SA	SA
C8186	199-N-184	Nitrate, tritium, Sr-90	TU	C2011	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	A	--	--	A	A	A	--
C8187	199-N-185	Nitrate, Sr-90	TU	C2011	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
C8188	199-N-186	Nitrate, Sr-90, tritium	TU	C2011	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	A	--	--	A	A	A	--
C8189	199-N-187	Nitrate, Sr-90	TU	C2011	--	--	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
C8190	199-N-188	Nitrate, Sr-90, metals	TU	C2011	A	A	--	--	A	--	--	--	--	--	--	--	--	--	--	A5	--	--	--	A	A	A	--
C7327	199-N-200[b]	PRB-E	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7326	199-N-201[b]	PRB-E	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7317	199-N-210[b]	PRB-E	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7316	199-N-211	PRB	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7298	199-N-229	PRB	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7297	199-N-230	PRB	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7340	199-N-247	PRB	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7341	199-N-248	PRB	TU	C2009	B	B	--	--	B	--	--	B	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7361	199-N-268	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7362	199-N-269	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7373	199-N-280	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7374	199-N-281	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7390	199-N-297	PRB, Sr-90	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7391	199-N-298	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7408	199-N-315	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7409	199-N-316	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--

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Well ID	Well Number	Co-Sampled Networks	Aquifer Interval	WAC Compliant[a]	Filtered ICP Metals	Unfiltered ICP Metals	Filtered Hexavalent Chromium	Alkalinity	Anions	VOAs (BTEX)	PAH	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH Oil and Grease	Total Organic Carbon	Total Organic Halides	Gross Alpha	Gross Beta	Strontium-90	Tritium	Field Dissolved Oxygen	Field Oxidation Reduction	Field Temperature	Field pH and Turbidity	Specific Conductance	Odor and Sheen
C7425	199-N-332	PRB, Sr-90	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7426	199-N-333	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7435	199-N-342	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7436	199-N-343	PRB	TU	C2010	B	B	--	--	B	--	--	--	--	--	--	--	--	B	B	B	--	B	B	B	B	B	--
C7436	199-N-346[b]	PRB-E, TPH	TU	C2010	SA	SA	--	--	SA	--	--	SA	A	A	A	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7441	199-N-347[b]	Sr-90, PRB-E, nitrate	TU	C2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7440	199-N-348	PRB, Sr-90	TU	C2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7439	199-N-349	PRB, nitrate	TU	C2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7443	199-N-350	PRB	TU	C2009	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7444	199-N-351	PRB	TU	C2009	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7445	199-N-352	PRB, Sr-90	TU	C2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7446	199-N-353	PRB, Sr-90, nitrate, metals	TU	C2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7447	199-N-354[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7448	199-N-355[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7449	199-N-356[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7450	199-N-357[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7451	199-N-358[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7452	199-N-359[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7453	199-N-360[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7454	199-N-361[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7455	199-N-362[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7456	199-N-363[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7457	199-N-364[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--

Table A-10. Sampling and Analysis Schedule for the 100-NR-2 Groundwater OU Program

Well ID	Well Number	Co-Sampled Networks	Aquifer Interval	WAC Compliant[a]	Filtered ICP Metals	Unfiltered ICP Metals	Filtered Hexavalent Chromium	Alkalinity	Anions	VOAs (BTEX)	PAH	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH Oil and Grease	Total Organic Carbon	Total Organic Halides	Gross Alpha	Gross Beta	Strontium-90	Tritium	Field Dissolved Oxygen	Field Oxidation Reduction	Field Temperature	Field pH and Turbidity	Specific Conductance	Odor and Sheen
C7458	199-N-365[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7459	199-N-366[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7463	199-N-367[b]	PRB-E	TU	C2010	SA	SA	--	--	SA	--	--	--	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C9400	199-N-371[d]	Sr-90, tritium	TU	NA	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	--	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	--	--	--	Q/A	Q/A5	Q/A	--	--	Q/A	Q/A	Q/A	--
C9401	199-N-372[d]	Nitrate, Sr-90, tritium	TU	NA	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	Q/A	Q/A[c]	--	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	--	--	--	Q/A	Q/A5	Q/A	--	--	Q/A	Q/A	Q/A	--
C9402	199-N-373[d]	Nitrate, TPH	TU	NA	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	--	--	--	--	Q/A5[c]	Q/A[c]	--	--	Q/A	Q/A	Q/A	--
C9403	199-N-374[d]	Sr-90, tritium	TU	NA	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	--	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	--	--	--	Q/A	Q/A5	Q/A	--	--	Q/A	Q/A	Q/A	--
C9425	199-N-376[d]	Nitrate	LU	NA	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	Q/A	Q/A[c]	--	Q/A[c]	Q/A[c]	Q/A[c]	Q/A[c]	--	--	--	Q/A	Q/A5[c]	Q/A[c]	--	--	Q/A	Q/A	Q/A	--
C9429	199-N-377[d]	Nitrate, BV, TPH, Sr-90	TU	NA	Q/A	Q/A	Q/A	Q/A[c]	Q/A	Q/A	Q/A	Q/SA	Q/SA	Q/SA	Q/SA	--	--	--	Q/A	Q/A5	Q/A	--	--	Q/A	Q/A	Q/A	--
C5269	APT1	PRB	TU	N2006	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5386	APT5	PRB	TU	N2006	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C6132	C6132	PRB-E, BV	TU	N2007	SA	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	SA
C6136	C6136	PRB-E	TU	N2007	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C6135	C6135	BV	TU	N2007	--	SA	--	SA	SA	SA	SA	SA	SA	SA	SA	--	--	--	--	--	--	SA	SA	SA	SA	SA	SA
C6317, C6318, C6319	C6317, C6318, C6319	Sr-90, tritium	TU	N2008	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SA	SA	--	--	SA	SA	SA	--
C6320	C6320	Sr-90	TU	N2008	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SA	--	--	--	SA	SA	SA	--
C6324	C6324	PRB-E	TU	N2008	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C7934, C7935, C7936	C7934, C7935, C7936	Tritium, Sr-90	TU	N2010	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SA	SA	--	--	SA	SA	SA	--
C7937, C7938 C7939	C7937, C7938 C7939	Tritium, Sr-90	TU	N2010	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SA	SA	--	--	SA	SA	SA	--
C7881	C7881	PRB	TU	N2010	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5514	N116m Array-0A[b]	BV, PRB-E	TU	N2006	SA	SA	--	--	SA	SA	SA	SA	SA	SA	SA	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	SA

Table A-10. Sampling and Analysis Schedule for the 100-NR-2 Groundwater OU Program

Well ID	Well Number	Co-Sampled Networks	Aquifer Interval	WAC Compliant[a]	Filtered ICP Metals	Unfiltered ICP Metals	Filtered Hexavalent Chromium	Alkalinity	Anions	VOAs (BTEX)	PAH	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH Oil and Grease	Total Organic Carbon	Total Organic Halides	Gross Alpha	Gross Beta	Strontium-90	Tritium	Field Dissolved Oxygen	Field Oxidation Reduction	Field Temperature	Field pH and Turbidity	Specific Conductance	Odor and Sheen
C5264	N116m Array-10A[b]	PRB-E	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5265	N116m Array-11A[b]	PRB-E	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5512	N116m Array-15A[b]	PRB-E	TU	N2006	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5256	N116m Array-2A	PRB	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5257	N116m Array-3A	PRB	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5258	N116m Array-4A	PRB	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5259	N116m Array-6A	PRB	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5261	N116m Array-8A	PRB	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5262	N116m Array-8.5A	PRB-E	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5263	N116m Array-9A	PRB-E	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--
C5251	NVP2-116.0	PRB	TU	N2005	SA	SA	--	--	SA	--	--	SA	--	--	--	--	--	SA	SA	SA	--	SA	SA	SA	SA	SA	--

A = Annual. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and annually thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

A5 = Annually every 5 years. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and every 5 years thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

B = Biennial; biennial sampling targets high river state (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every other year. Groundwater wells sampled biennially should be sampled during the same year. The 100-NR-2 Operable Unit sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, metals) should not exceed 4 weeks.

Q/A = As a general rule, new long-term groundwater monitoring wells shall be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Otherwise, the well will be sampled as defined by A. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

Q/A5 = As a general rule, new long-term groundwater monitoring wells shall be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Otherwise, the well will be sampled as defined by A5. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

SA = Semiannual; biennial and semiannual targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

a. Includes year of construction, if available.

b. Monitoring in this PRB network well will begin after upgradient wells have been treated with apatite-forming chemicals.

c. Continued monitoring for COPCs following first year of quarterly sampling will be conducted at the specified frequencies only if quarterly sample results indicate COPCs are above cleanup level.

d. Awaiting drilling.

-- = not required
BTEX = benzene, ethylbenzene, toluene, and xylenes
BV = bioventing
C = well construction is compliant with WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells”
PRB-E = planned extension of permeable reactive barrier
TBD = to be determined
TPH = total petroleum hydrocarbons
TU = top of unconfined aquifer

Table A-10. Sampling and Analysis Schedule for the 100-NR-2 Groundwater OU Program

Well ID	Well Number	Co-Sampled Networks	Aquifer Interval	WAC Compliant[a]	Filtered ICP Metals	Unfiltered ICP Metals	Filtered Hexavalent Chromium	Alkalinity	Anions	VOAs (BTEX)	PAH	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH Oil and Grease	Total Organic Carbon	Total Organic Halides	Gross Alpha	Gross Beta	Strontium-90	Tritium	Field Dissolved Oxygen	Field Oxidation Reduction	Field Temperature	Field pH and Turbidity	Specific Conductance	Odor and Sheen

ICP = inductively coupled plasma
ID = identification
LU = lower unconfined aquifer
N = well construction is not compliant with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"
NA = not applicable
ND = no data
PAH = polycyclic aromatic hydrocarbon
PRB = permeable reactive barrier
VOA = volatile organic analysis
WAC = WAC = *Washington Administrative Code*

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Table A-11. Apatite Barrier Performance Monitoring Sampling and Analysis Schedule

Wells and Aquifer Tubes (69)	Purpose	Filtered and Unfiltered ICP Metals[a]	Anions[b]	TPH-Diesel	Gross Alpha	Gross Beta	Strontium-90	Field Dissolved Oxygen	Field Oxidation-Reduction Potential	Other Field Parameters[c]
199-N-122	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-123	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-146	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-147	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-173	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-136	Barrier monitoring	B	B	B	B	B	B	B	B	B
199-N-159	Barrier monitoring	B	B	B	B	B	B	B	B	B
199-N-200	Barrier monitoring[d]	B	B	B	B	B	B	B	B	B
199-N-201	Barrier monitoring[d]	B	B	B	B	B	B	B	B	B
199-N-210	Barrier monitoring[d]	B	B	B	B	B	B	B	B	B
199-N-211	Barrier monitoring	B	B	B	B	B	B	B	B	B
199-N-229	Barrier monitoring	B	B	B	B	B	B	B	B	B
199-N-230	Barrier monitoring	B	B	B	B	B	B	B	B	B
199-N-247	Barrier monitoring	B	B	B	B	B	B	B	B	B
199-N-248	Barrier monitoring	B	B	B	B	B	B	B	B	B
199-N-268	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-269	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-280	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-281	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-297	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-298	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-315	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B

Table A-11. Apatite Barrier Performance Monitoring Sampling and Analysis Schedule

Wells and Aquifer Tubes (69)	Purpose	Filtered and Unfiltered ICP Metals[a]	Anions[b]	TPH-Diesel	Gross Alpha	Gross Beta	Strontium-90	Field Dissolved Oxygen	Field Oxidation-Reduction Potential	Other Field Parameters[c]
199-N-316	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-332	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-333	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-342	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-343	Barrier monitoring[d]	B	B	—	B	B	B	B	B	B
199-N-346	Barrier monitoring[d]	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-347	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-348	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-349	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-350	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-351	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-352	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-353	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-354	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-355	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-356	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-357	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-358	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-359	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-360	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-361	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-362	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA

Table A-11. Apatite Barrier Performance Monitoring Sampling and Analysis Schedule

Wells and Aquifer Tubes (69)	Purpose	Filtered and Unfiltered ICP Metals[a]	Anions[b]	TPH-Diesel	Gross Alpha	Gross Beta	Strontium-90	Field Dissolved Oxygen	Field Oxidation-Reduction Potential	Other Field Parameters[c]
199-N-363	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-364	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-365	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-366	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-367	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-92A	Barrier monitoring	SA	SA	—	SA	SA	SA	SA	SA	SA
199-N-96A	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
APT1	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
APT5	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
C6132	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
C6136	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
C6324	Barrier monitoring	SA	SA	—	SA	SA	SA	SA	SA	SA
C7881	Barrier monitoring	SA	SA	—	SA	SA	SA	SA	SA	SA
N116m Array-0A	Barrier monitoring[d]	SA	SA	SA	SA	SA	SA	SA	SA	SA
N116m Array-10A	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
N116m Array-11A	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
N116m Array-15A	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
N116m Array-2A	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
N116m Array-3A	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
N116m Array-4A	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
N116m Array-6A	Barrier monitoring	SA	SA	SA	SA	SA	SA	SA	SA	SA
N116m Array-8A	Barrier monitoring	SA	SA	—	SA	SA	SA	SA	SA	SA

Table A-11. Apatite Barrier Performance Monitoring Sampling and Analysis Schedule

Wells and Aquifer Tubes (69)	Purpose	Filtered and Unfiltered ICP Metals[a]	Anions[b]	TPH-Diesel	Gross Alpha	Gross Beta	Strontium-90	Field Dissolved Oxygen	Field Oxidation-Reduction Potential	Other Field Parameters[c]
N116m Array-8.5A	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
N116m Array-9A	Barrier monitoring[d]	SA	SA	—	SA	SA	SA	SA	SA	SA
NVP2-116.0	Barrier monitoring	SA	SA	—	SA	SA	SA	SA	SA	SA

B = Biennial; biennial sampling targets high river state (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every other year. Groundwater wells sampled biennially should be sampled during the same year. The 100-NR-2 Operable Unit sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH metals) should not exceed 4 weeks.

SA = Semiannual; biennial and semiannual targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

a. Metals include, but are not limited to, cadmium, calcium, chromium, magnesium, manganese, and sodium.

b. Anions include, but are not limited to, chloride, nitrate, and sulfate.

c. Field parameters include pH, specific conductance, temperature, and turbidity.

d. Monitoring at these wells/aquifer tubes will begin after the upgradient PRB wells have been treated with apatite-forming chemicals for the PRB.

ICP = inductively coupled plasma

PRB = permeable reactive barrier

TPH = total petroleum hydrocarbons

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Table A-12. Bioventing Performance Monitoring Sampling and Analysis Schedule

Wells and Aquifer Tubes (14)	Purpose	Unfiltered ICP Metals	Anions	TPH-Diesel, TPH-Gas, TPH Motor Oil, and TPH Oil and Grease	PAH	VOA (BTEX)	Alkalinity	Field Dissolved Oxygen	Field Oxidation-Reduction Potential	Odor and Sheen[a]	Other Field Parameters[b]
199-N-3	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-19	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-56	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-96A	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-167	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-169	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-171	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-172	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-173	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-183	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
199-N-377	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
C6132	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
C6135	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
N116mArray-0A	Bioventing	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA

SA = semiannual; semiannual targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

a. Prior to purging the well, a transparent bailer will be used to collect a grab sample to evaluate the presence of sheen.

b. Temperature, pH, specific conductivity, and turbidity.

BTEX = benzene, ethylbenzene, toluene, and xylenes
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons
VOA = volatile organics analysis

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Table A-13. Sr-90 Sampling and Analysis Schedule

Wells and Aquifer Tubes (53)	Purpose	Sr-90	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
199-N-14	Sr-90 network	A5	A5	A5	A5	A5
199-N-21	Sr-90 network	A5	A5	A5	A5	A5
199-N-27	Sr-90 network	A5	A5	A5	A5	A5
199-N-28	Sr-90 network	A5	A5	A5	A5	A5
199-N-34	Sr-90 network	A5	A5	A5	A5	A5
199-N-41	Sr-90 network	A5	A5	A5	A5	A5
199-N-46	Sr-90 network	A5	A5	A5	A5	A5
199-N-50	Sr-90 network	A5	A5	A5	A5	A5
199-N-51	Sr-90 network	A5	A5	A5	A5	A5
199-N-57	Sr-90 network	A5	A5	A5	A5	A5
199-N-64	Sr-90 network	A5	A5	A5	A5	A5
199-N-67	Sr-90 network	A5	A5	A5	A5	A5
199-N-75	Sr-90 network	A5	A5	A5	A5	A5
199-N-76	Sr-90 network	A5	A5	A5	A5	A5
199-N-81	Sr-90 network	A5	A5	A5	A5	A5
199-N-92A	Sr-90 network	A5	A5	A5	A5	A5
199-N-96A	Sr-90 network	A5	A5	A5	A5	A5
199-N-99A	Sr-90 network	A5	A5	A5	A5	A5
199-N-103A	Sr-90 network	A5	A5	A5	A5	A5
199-N-104A	Sr-90 network	A5	A5	A5	A5	A5
199-N-105A	Sr-90 network	A5	A5	A5	A5	A5
199-N-122	Sr-90 network	A5	A5	A5	A5	A5
199-N-123	Sr-90 network	A5	A5	A5	A5	A5

Table A-13. Sr-90 Sampling and Analysis Schedule

Wells and Aquifer Tubes (53)	Purpose	Sr-90	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
199-N-136	Sr-90 network	A5	A5	A5	A5	A5
199-N-146	Sr-90 network	A5	A5	A5	A5	A5
199-N-147	Sr-90 network	A5	A5	A5	A5	A5
199-N-173	Sr-90 network	A5	A5	A5	A5	A5
199-N-183	Sr-90 network	A5	A5	A5	A5	A5
199-N-184	Sr-90 network	A5	A5	A5	A5	A5
199-N-185	Sr-90 network	A5	A5	A5	A5	A5
199-N-186	Sr-90 network	A5	A5	A5	A5	A5
199-N-187	Sr-90 network	A5	A5	A5	A5	A5
199-N-188	Sr-90 network	A5	A5	A5	A5	A5
199-N-297	Sr-90 network	A5	A5	A5	A5	A5
199-N-332	Sr-90 network	A5	A5	A5	A5	A5
199-N-347	Sr-90 network	A5	A5	A5	A5	A5
199-N-348	Sr-90 network	A5	A5	A5	A5	A5
199-N-352	Sr-90 network	A5	A5	A5	A5	A5
199-N-353	Sr-90 network	A5	A5	A5	A5	A5
199-N-371	Sr-90 network	Q/A5	Q/A5	Q/A5	Q/A5	Q/A5
199-N-372	Sr-90 network	Q/A5	Q/A5	Q/A5	Q/A5	Q/A5
199-N-374	Sr-90 network	Q/A5	Q/A5	Q/A5	Q/A5	Q/A5
199-N-377	Sr-90 network	Q/A5	Q/A5	Q/A5	Q/A5	Q/A5
C6317, C6318, C6319*	Sr-90 network	SA	SA	SA	SA	SA
C6320*	Sr-90 network	SA	SA	SA	SA	SA

Table A-13. Sr-90 Sampling and Analysis Schedule

Wells and Aquifer Tubes (53)	Purpose	Sr-90	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
C7934, C7935, C7936*	Sr-90 network	SA	SA	SA	SA	SA
C7937, C7938, C7939*	Sr-90 network	SA	SA	SA	SA	SA

A5 = Annually every 5 years. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and every 5 years thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Q/A5 = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and every 5 years thereafter. If, after the first year, contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four consecutive quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter). Then, the well will be sampled as defined by A5.

SA = Semiannual; semiannual targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

* Sr-90 detected at these locations suggests there may be a continuing source associated with the 1908-N Outfall that is not a part of the larger stable plume. As such, these locations are sampled semiannually.

1

Table A-14. Nitrate Sampling and Analysis Schedule

Wells (39)	Purpose	Anions	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
199-N-3	Nitrate network	A	A	A	A	A
199-N-14	Nitrate network	A	A	A	A	A
199-N-19	Nitrate network	A	A	A	A	A
199-N-27	Nitrate network	A	A	A	A	A
199-N-34	Nitrate network	A	A	A	A	A
199-N-41	Nitrate network	A	A	A	A	A
199-N-46	Nitrate network	A	A	A	A	A
199-N-50	Nitrate network	A	A	A	A	A
199-N-56	Nitrate network	A	A	A	A	A

Table A-14. Nitrate Sampling and Analysis Schedule

Wells (39)	Purpose	Anions	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
199-N-57	Nitrate network	A	A	A	A	A
199-N-64	Nitrate network	A	A	A	A	A
199-N-67	Nitrate network	A	A	A	A	A
199-N-72	Nitrate network	A	A	A	A	A
199-N-73	Nitrate network	A	A	A	A	A
199-N-75	Nitrate network	A	A	A	A	A
199-N-76	Nitrate network	A	A	A	A	A
199-N-77	Nitrate network	A	A	A	A	A
199-N-81	Nitrate network	A	A	A	A	A
199-N-92A	Nitrate network	A	A	A	A	A
199-N-96A	Nitrate network	A	A	A	A	A
199-N-99A	Nitrate network	A	A	A	A	A
199-N-103A	Nitrate network	A	A	A	A	A
199-N-105A	Nitrate network	A	A	A	A	A
199-N-167	Nitrate network	A	A	A	A	A
199-N-173	Nitrate network	A	A	A	A	A
199-N-182	Nitrate network	A	A	A	A	A
199-N-183	Nitrate network	A	A	A	A	A
199-N-184	Nitrate network	A	A	A	A	A
199-N-185	Nitrate network	A	A	A	A	A
199-N-186	Nitrate network	A	A	A	A	A
199-N-187	Nitrate network	A	A	A	A	A
199-N-188	Nitrate network	A	A	A	A	A
199-N-347	Nitrate network	A	A	A	A	A
199-N-349	Nitrate network	A	A	A	A	A
199-N-353	Nitrate network	A	A	A	A	A
199-N-372	Nitrate network	Q/A	Q/A	Q/A	Q/A	Q/A
199-N-373	Nitrate network	Q/A	Q/A	Q/A	Q/A	Q/A
199-N-376	Nitrate network	Q/A	Q/A	Q/A	Q/A	Q/A
199-N-377	Nitrate network	Q/A	Q/A	Q/A	Q/A	Q/A

Table A-14. Nitrate Sampling and Analysis Schedule

Wells (39)	Purpose	Anions	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity

A = Annual. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and annually thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four consecutive quarters of sampling. Otherwise, the well will be sampled as defined by A. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

1

Table A-15. TPH Sampling and Analysis Schedule

Wells (10)	Purpose	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH-Oil and Grease	PAH	VOA (BTEX)	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
199-N-3	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-56	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-96A	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-169	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-171	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-173	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-183	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-346	TPH network	A	A	A	A	A	A	A	A	A	A
199-N-373	TPH network	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A
199-N-377	TPH network	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A	Q/A

A = Annual. Sample in 2015 at low river stage (mid-September through mid-November) and annually thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four consecutive quarters of sampling. Otherwise, the well will be sampled as defined by A. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

Table A-15. TPH Sampling and Analysis Schedule

Wells (10)	Purpose	TPH-Diesel	TPH-Gas	TPH-Motor Oil	TPH-Oil and Grease	PAH	VOA (BTEX)	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity

PAH = polycyclic aromatic hydrocarbon
TPH = total petroleum hydrocarbons
VOA = volatile organics analysis

1

Table A-16. Tritium Sampling and Analysis Schedule

Wells and Aquifer Tubes (15)	Purpose	Tritium	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
199-N-182	Tritium network	A	A	A	A	A
199-N-184	Tritium network	A	A	A	A	A
199-N-186	Tritium network	A	A	A	A	A
199-N-371	Tritium network	Q/A	Q/A	Q/A	Q/A	Q/A
199-N-372	Tritium network	Q/A	Q/A	Q/A	Q/A	Q/A
199-N-374	Tritium network	Q/A	Q/A	Q/A	Q/A	Q/A
C6317, C6318, C6319[a]	Tritium network	SA	SA	SA	SA	SA
C7934, C7935, C7936[a]	Tritium network	SA	SA	SA	SA	SA
C7937, C7938, C7939[a]	Tritium network	SA	SA	SA	SA	SA

A = Annual. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and annually thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four consecutive quarters of sampling. Otherwise, the well will be sampled as defined by A. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

SA = Semiannual; semiannual targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks. [a] Tritium detected at these locations may be indicative of a continuing source associated with the 1908-N Outfall. As such, these locations are sampled semiannually.

2

Table A-17. Hexavalent Chromium and Metals Sampling and Analysis Schedule

Wells	Purpose	Filtered and Unfiltered ICP Metals	Filtered Hexavalent Chromium	Field pH	Field Temperature	Field Specific Conductance	Field Turbidity
199-N-14	Metals network	A	--	A	A	A	A
199-N-41	Metals network	A	--	A	A	A	A
199-N-57	Metals network	A	--	A	A	A	A
199-N-64	Metals network	A	--	A	A	A	A
199-N-67	Metals network	A	--	A	A	A	A
199-N-80	Metals network	A	A	A	A	A	A
199-N-92A	Metals network	A	--	A	A	A	A
199-N-96A	Metals network	A	A	A	A	A	A
199-N-146	Metals network	A	--	A	A	A	A
199-N-167	Metals network	A	--	A	A	A	A
199-N-173	Metals network	A	--	A	A	A	A
199-N-183	Metals network	A	A	A	A	A	A
199-N-188	Metals network	A	--	A	A	A	A
199-N-353	Metals network	A	--	A	A	A	A

A = Annual. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and annually thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

-- = not required

ICP = inductively coupled plasma

1

Table A-18. 100-N RCRA Sites Sampling and Analysis Schedule

Wells	Purpose	Chloride	Iron	Manganese	Sodium	Sulfate	Alkalinity	Gross Alpha	Total Organic Carbon	Total Organic Halides	Field pH	Field Specific Conductance	Field Turbidity
1324-N/NA (120-N-1, 120-N-2)													
199-N-71	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA

Table A-18. 100-N RCRA Sites Sampling and Analysis Schedule

Wells	Purpose	Chloride	Iron	Manganese	Sodium	Sulfate	Alkalinity	Gross Alpha	Total Organic Carbon	Total Organic Halides	Field pH	Field Specific [illegible]	Field Turbidity
199-N-72	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-73	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-77	RCRA Monitoring	A	A	A	A	A	A	SA	SA	SA	SA	SA	SA
199-N-165	RCRA Monitoring	A	A	A	A	A	A	SA	S4	S4	S4	S4	SA
1301-N (116-N-1)													
199-N-2	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-3	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-34	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-57	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-105A	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
1325-N (116-N-3)													
199-N-28	RCRA Monitoring	A	A	A	A	A	A	--	SA	SA	SA	SA	SA
199-N-32	RCRA Monitoring	SA	SA	SA	SA	SA	SA	--	S4	S4	S4	S4	SA
199-N-41	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-74	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA
199-N-81	RCRA Monitoring	A	A	A	A	A	A	--	S4	S4	S4	S4	SA

A = Annual, SA = Semi-annual, S4 = Semi-annual with quadruplicate samples. Sampling frequency as summarized from PNNL-13914, *Groundwater Monitoring Plan for the 1301-N, 1324-N/NA, and 1325-N RCRA Facilities.*

-- = not required

1

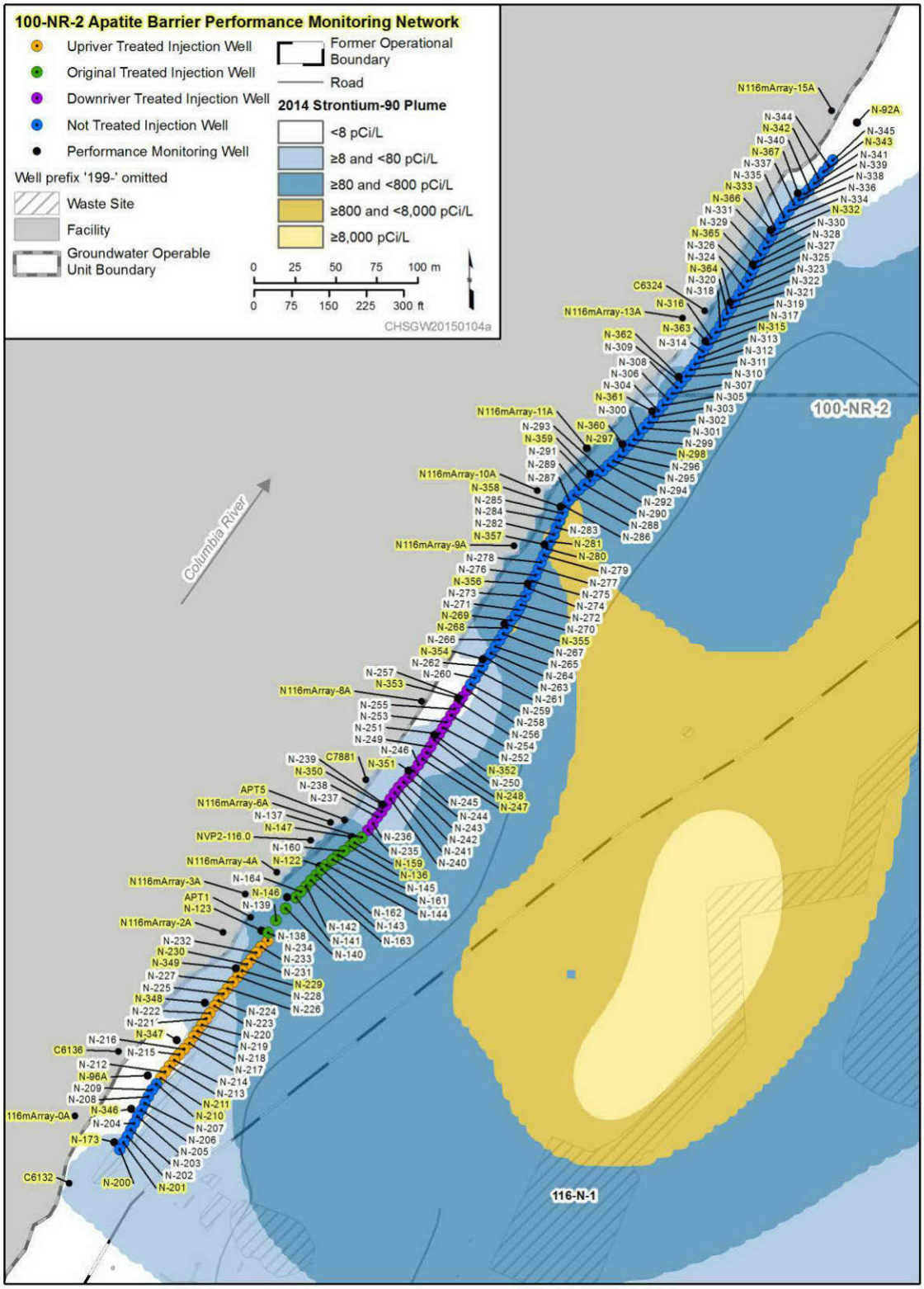

Figure A-12. Monitoring Locations for PSQ 1: Is the Sr-90 permeable reactive (apatite) barrier performing as intended?

Monitoring locations for PSQ 1 (Figure A-12) were selected based on a judgmental sampling design. The main goal of the monitoring is to determine if the PRB is effective in reducing concentrations of Sr-90 in groundwater downgradient of the barrier and reducing the flux into the Columbia River. Selection of the wells in the apatite barrier well network was based on the extent of Sr-90 contamination, location of the PRB and Columbia River, potential exposure areas near the river shore, and the physical characteristics and behavior of Sr-90 within the aquifer. As such, sample locations were selected within and downgradient of the PRB. Because Sr-90 extends into the river above the drinking water standard of 8 pCi/L, aquifer tubes are also positioned to collect samples along the Columbia River. A semiannual to biannual sample frequency was selected to monitor Sr-90 associated with the PRB (Table A-11). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

A3.2.1.1.1 Performance Monitoring Objective

The objective of performance monitoring is to determine if the PRB is effective in reducing concentrations of Sr-90. This is determined by comparing Sr-90 or gross beta concentrations from downgradient wells to baseline (pre-injection) values (FH, 2008, "100/300 Area Unit Managers Meeting Minutes"). The performance of the vadose zone PRB will be monitored indirectly by the monitoring network in place for the saturated zone PRB. Sediment cores samples collected in accordance with Insert A2 will determine apatite loading in the vadose zone PRB for sequestration of Sr-90 that would be mobilized in the periodically rewetted vadose zone sediments from seasonal variation in river water elevation. Sequestration of mobilized Sr-90 by the vadose zone PRB would be reflected in further flux reduction of Sr-90 to the river, as measured in the PRB monitoring wells compared to pre-vadose zone jet injections.

The monitoring network may be adjusted and the frequency of sampling may be reduced after 2 years following injection treatments. Any special monitoring for additional barrier emplacement activities (e.g., infiltration) not currently included in the RD/RAWP is beyond the scope of this SAP and will require a revision to this SAP.

Radiological decay is not factored into the baseline concentrations at this time in order to maintain a comparison to monitoring well concentrations for PRB performance. Future modifications to this SAP should consider evaluation of radiological decay with barrier performance monitoring.

Performance monitoring is conducted to compare Sr-90 concentrations downgradient of the barrier to baseline values. Only limited pre-injection data were available from many of the wells in the original segment of the barrier. A geostatistically based approach was implemented to estimate baseline conditions at the injection well locations based on the observed range of concentrations in nearby aquifer tubes. The statistical method is described in PNNL-17429, *Interim Report: 100-NR-2 Apatite Treatability Test: Low Concentration Calcium Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization*. Table A-19 lists results for previously treated portions of the PRB up to the year 2008.

Based on previous monitoring data, the PRB is expected to achieve a 90 percent reduction in Sr-90 concentrations in the monitoring wells. Reinjections may be deemed necessary for sections of the groundwater PRB based on the decision flow diagram presented in Figure A-13. The decision flow diagram considers monitoring data collected for the following:

- **Volume of high-concentration Ca-citrate-PO_4 solution injected into each multipurpose well:** Wells that received less than 80 percent of the target volume equivalent to 1.7 mg apatite/g sediment (227,125 L [60,000 gal]) will be considered for potential reinjection.

Table A-19. Mean and 95 Percent Confidence Interval of Pretreatment Sr-90 Concentrations at Injection Wells

Statistic	N-138	N-139	N-140	N-141	N-142	N-143	N-144	N-145	N-136	N-137
Mean	417.09	573.77	627.05	972.25	1,590.10	1,944.96	2,814.61	1,886.27	951.24	1,056.80
95% Confidence Interval Upper	706.51	1,115.39	812.41	1,077.59	1,866.73	2,597.18	3,235.32	2,621.08	1,483.42	2,825.77
95% Confidence Interval Lower	127.66	32.14	441.69	866.91	1,313.48	1,292.74	2,393.89	1,151.47	419.06	-712.16

Reference: PNNL-17429, *Interim Report: 100-NR-2 Apatite Treatability Test: Low-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization* (Table 8).

Note: Well prefixes are "199-" for the wells listed in this table.

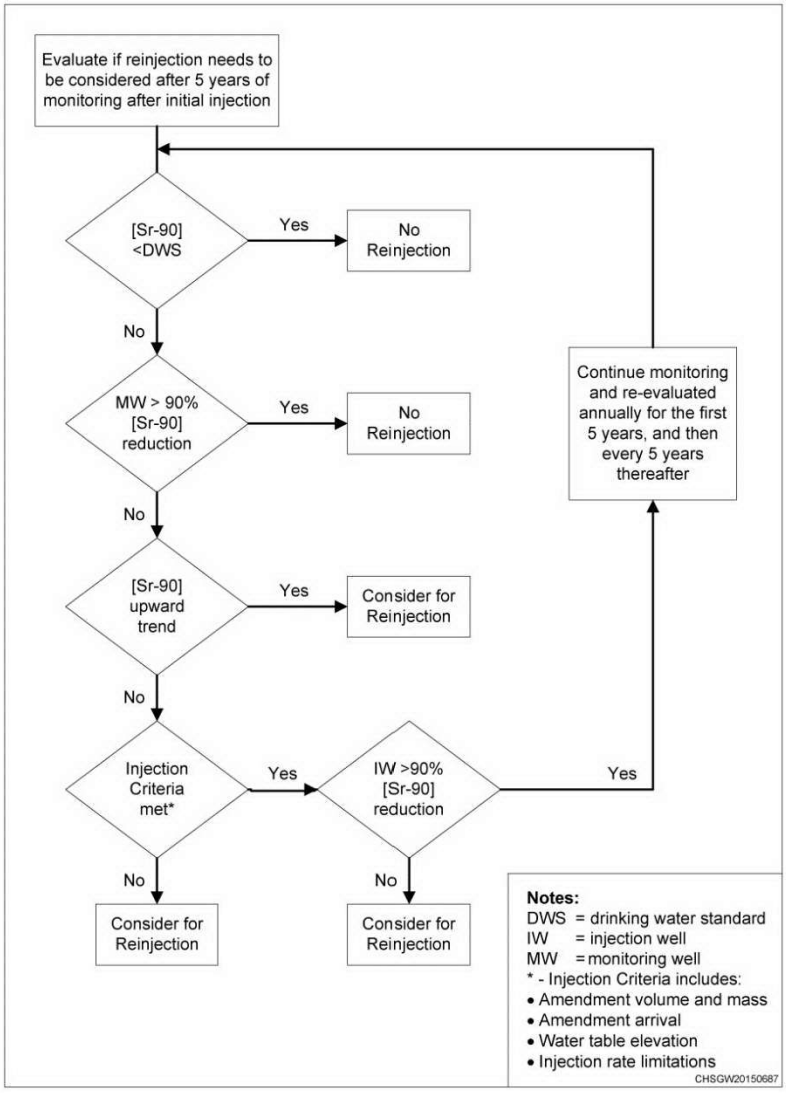

Figure A-13. Reinjection Decision Flow Diagram

A3.2.1.1.2 Performance Monitoring Criteria for Determining Need for Additional Injections

- **Sr-90 concentrations in downgradient monitoring wells:** Four-event moving average concentrations will be determined individually for all monitoring wells for up to a 5-year period. Time-series charts will be prepared for individual wells, and moving average concentrations will be calculated annually.

- **Sr-90 concentrations in injection wells:** Samples will also be collected at select injection (or multipurpose) wells for comparison to baseline Sr-90 concentrations. As with downgradient monitoring wells, four-event moving averages will be calculated.

Wells will be monitored for an initial 5-year period from the completion of first-round apatite injections. Following 5 years of monitoring, the decision process for reinjection is as follows:

- Additional injections will not be needed if after 5 years of monitoring the following occur:
  - Moving average Sr-90 concentrations in monitoring wells are below the cleanup level.
  - Moving average Sr-90 concentrations in individual monitoring wells show 90 percent reduction from baseline concentrations.
- Additional injections will be considered where target reduction is not achieved and the following occur:
  - Moving average Sr-90 concentrations in monitoring wells show upward trend.
  - Moving average Sr-90 concentrations in monitoring wells are stable, but operational criteria are not met during injections (operational criteria include meeting target injection volumes and phosphate concentrations, and radial distribution of amendment).
  - Moving average Sr-90 concentrations in treated injection wells do not show target reduction.
  - If Sr-90 concentration target reduction is observed in treated injection wells, then monitoring will continue and the need for additional injection will be reevaluated annually for the first 5 years and every 5 years thereafter.

A3.2.1.2 PSQ 2: Are TPH remedies contributing to groundwater quality improvement?

Bioventing is being implemented for the in situ bioremediation of deep vadose petroleum contamination at the UPR-100-N-17, 166-N Diesel Oil Supply Line Leak waste site. Although vadose monitoring is not within the scope of this SAP, an important element of the remediation of the deep vadose zone contamination is the monitoring of groundwater to support an evaluation of achieving groundwater cleanup standards. Monitoring locations for PSQ 2 (Figure A-14) were selected based on a judgmental sampling design with the goal of establishing baseline conditions and providing data to support an evaluation of achieving cleanup goals for a bioventing remedy. Selection of the wells was based on the extent of TPH groundwater contamination above cleanup levels in the vicinity of UPR-100-N-17. Wells were selected to determine concentrations in areas of known TPH contamination and adjacent to the plume to determine the lateral extent of the groundwater contamination. Because the TPH plume extends into the Columbia River, aquifer tubes were also selected where releases exceed 500 μg/L along the river. Concentrations in groundwater exceed 27,000 μg/L in Well 199-N-18. Wells and aquifer tubes used to monitor the bioremediation of TPH will be sampled semiannually as indicated in Table A-12. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, and metals) should not exceed 4 weeks.

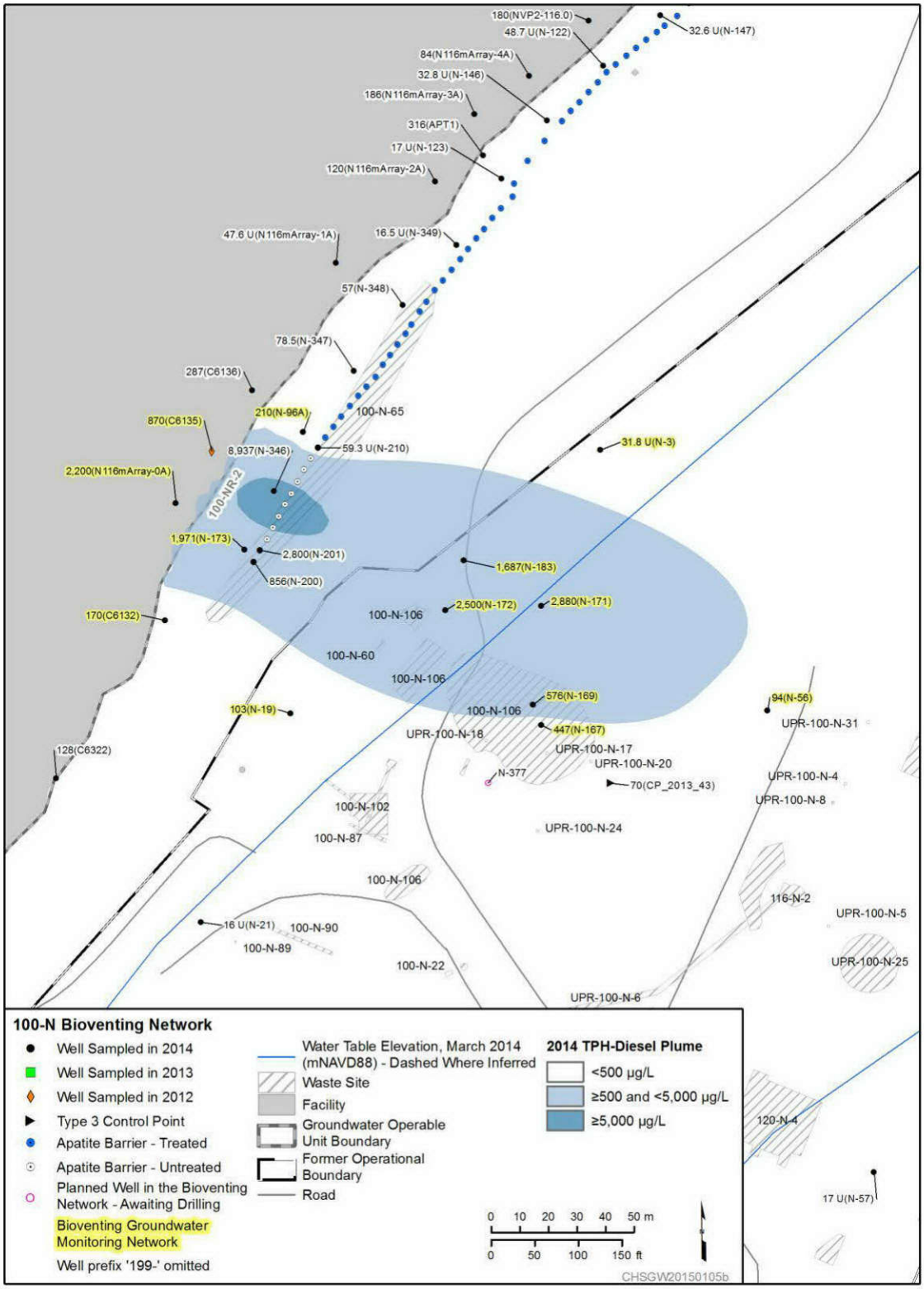

Figure A-14. Monitoring Locations for PSQ 2: Are TPH Remedies Contributing to Groundwater Quality Improvement?

A3.2.1.3 PSQ 3: Is there evidence of Interim Action ROD COC plume, concentration, area, or location changes?

Monitoring locations for PSQ 3 (Figures A-15, A-16, A-17, A-18, and A-19) were selected based on a judgmental sampling design. The goal of the sample design is to collect data on the nature and extent of Sr-90, TPH, nitrate, tritium, and hexavalent chromium plumes. Wells were selected to determine concentrations in areas of known contamination and adjacent to the plume to determine the lateral extent of the contamination and potential changes in plume geometry. The sample design addresses three areas of Sr-90 contamination: main plume and two isolated areas of contamination (Figure A-15), a nitrate and TPH plume (Figures A-16 and A-17), and two to three isolated areas of tritium and hexavalent chromium contamination (Figures A-18 and A-19). Wells in the TPH, nitrate, tritium, and hexavalent chromium groundwater monitoring networks will be sampled annually at low river stage. Wells in the Sr-90 network will be sampled every 5 years at low river stage. Any new groundwater monitoring wells will be sampled quarterly for the first year and annually thereafter with exception of Sr-90 (every 5 years). If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, tritium, TPH, tritium, and metals) should not exceed 4 weeks.

Tables A-13, A-14, A-15, A-16, and A-17 identify the wells, aquifer tubes, and the sample frequency applicable to PSQ 3.

A3.2.1.4 PSQ 4: Are increasing concentrations in groundwater indicating newly identified or continuing sources of contamination (e.g., Sr-90 and tritium near the 1908-N Outfall)?

The 100-NR-1, 100-KR-1, and 100-KR-2 OU waste sites and facilities are the source 100-NR-2 Groundwater OU contamination. Hexavalent chromium within the 100-NR-2 OU boundary is considered largely to be from the 100-KR-1 and 100-KR-2 OUs, while hexavalent chromium groundwater impacts from the 100-NR-1 OU appear limited. The remaining groundwater plumes (Sr-90, tritium, nitrate, and TPH) have 100-NR-1 OU sources. These sources have largely been cleaned up according to interim action RODs, with few exceptions (e.g., 105-N Reactor/100-N-66). With cleanup of sources, future impacts to groundwater plume concentrations are anticipated to decrease over time. However, where groundwater plume concentrations increase over time, a continuing source may be present.

Sr-90 and tritium contamination along the 1908-N Outfall at aquifer tube cluster C7934, C7935, and C7936 may represent continuing sources of groundwater contamination from waste sites, facilities, or both.

Monitoring locations for PSQ 4 (Figures A-15, A-16, A-17, A-18, and A-19) were selected based on a judgmental sampling design and existing plume configurations. The goal of the sample design is to collect data on the nature of the contamination with regard to concentrations changes. Wells were selected to determine concentrations in areas of known contamination and adjacent to the plume to determine the lateral extent of the contamination and potential changes in plume geometry. The sample design addresses areas of Sr-90, tritium, nitrate, TPH, and hexavalent chromium contamination as well as isolated areas of Sr-90 and tritium contamination along the river northwest of the 105-N Reactor. With exception of Sr-90, wells in these groundwater monitoring networks will be sampled annually. The Sr-90 network will be sampled every 5 years. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, tritium, TPH, tritium, and metals) should not exceed 4 weeks.

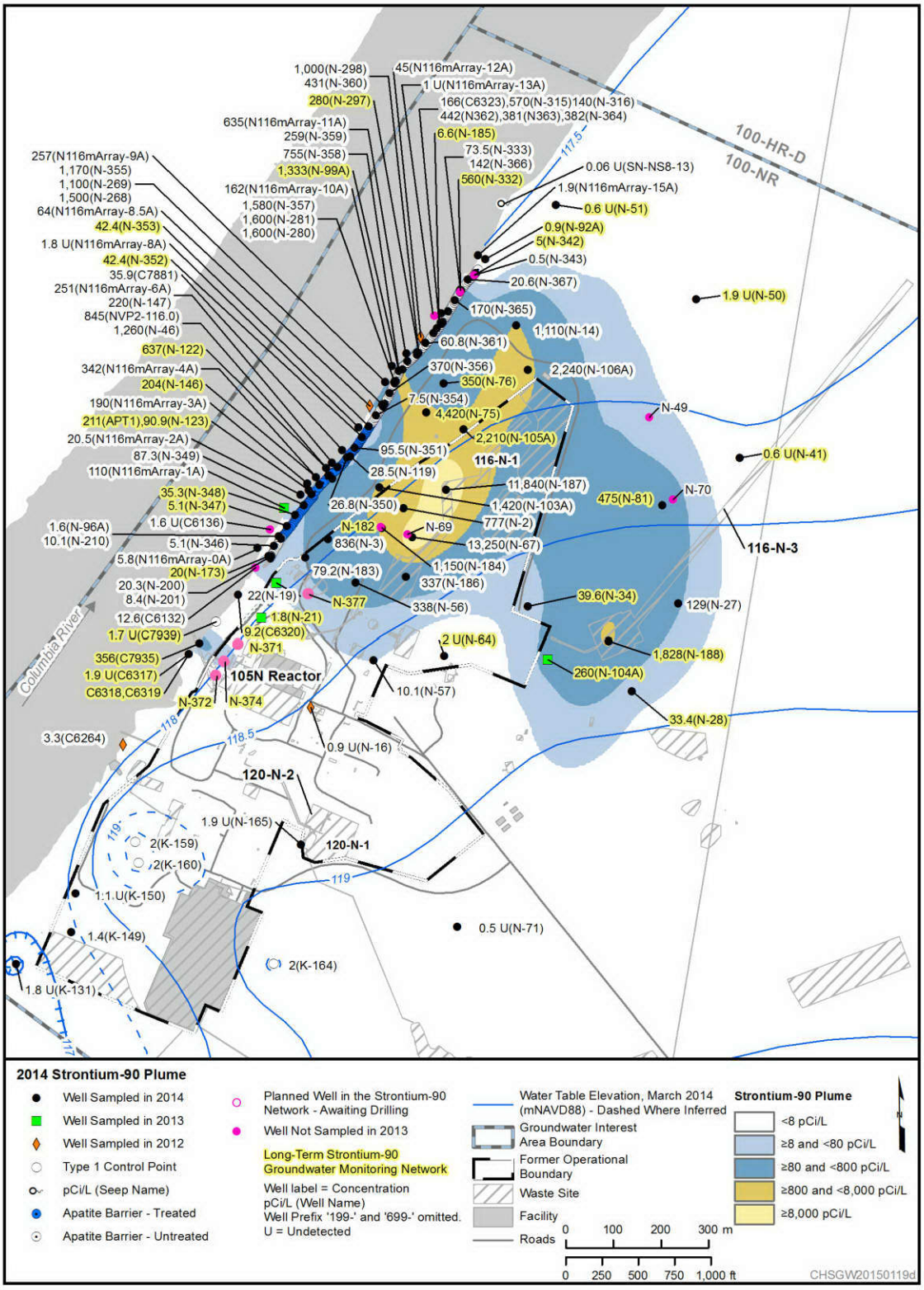

Figure A-15. Sr-90 Monitoring Locations for PSQs 3, 4, 5, and 7

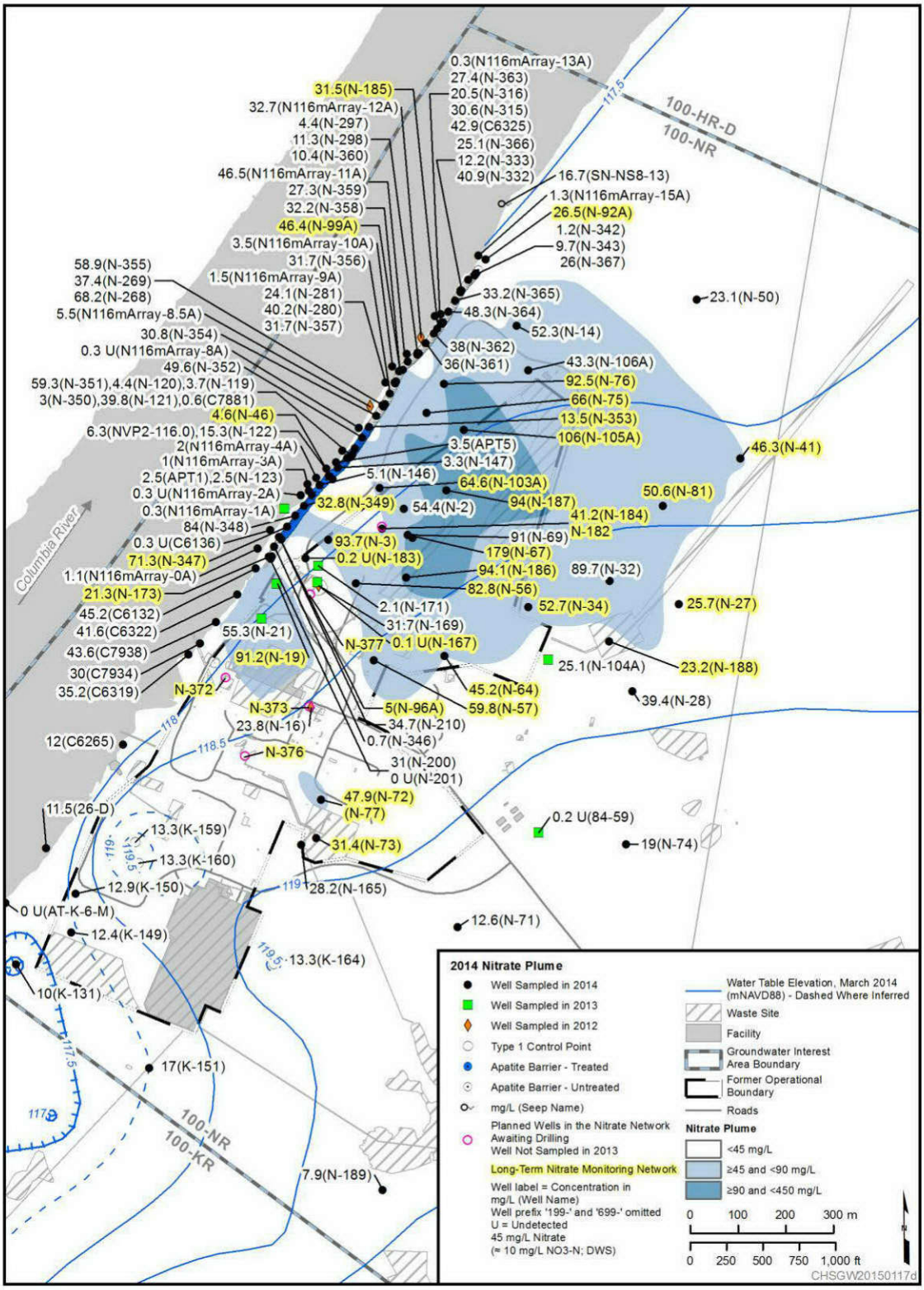

Figure A-16. Nitrate Monitoring Locations for PSQs 3, 4, 5, and 7

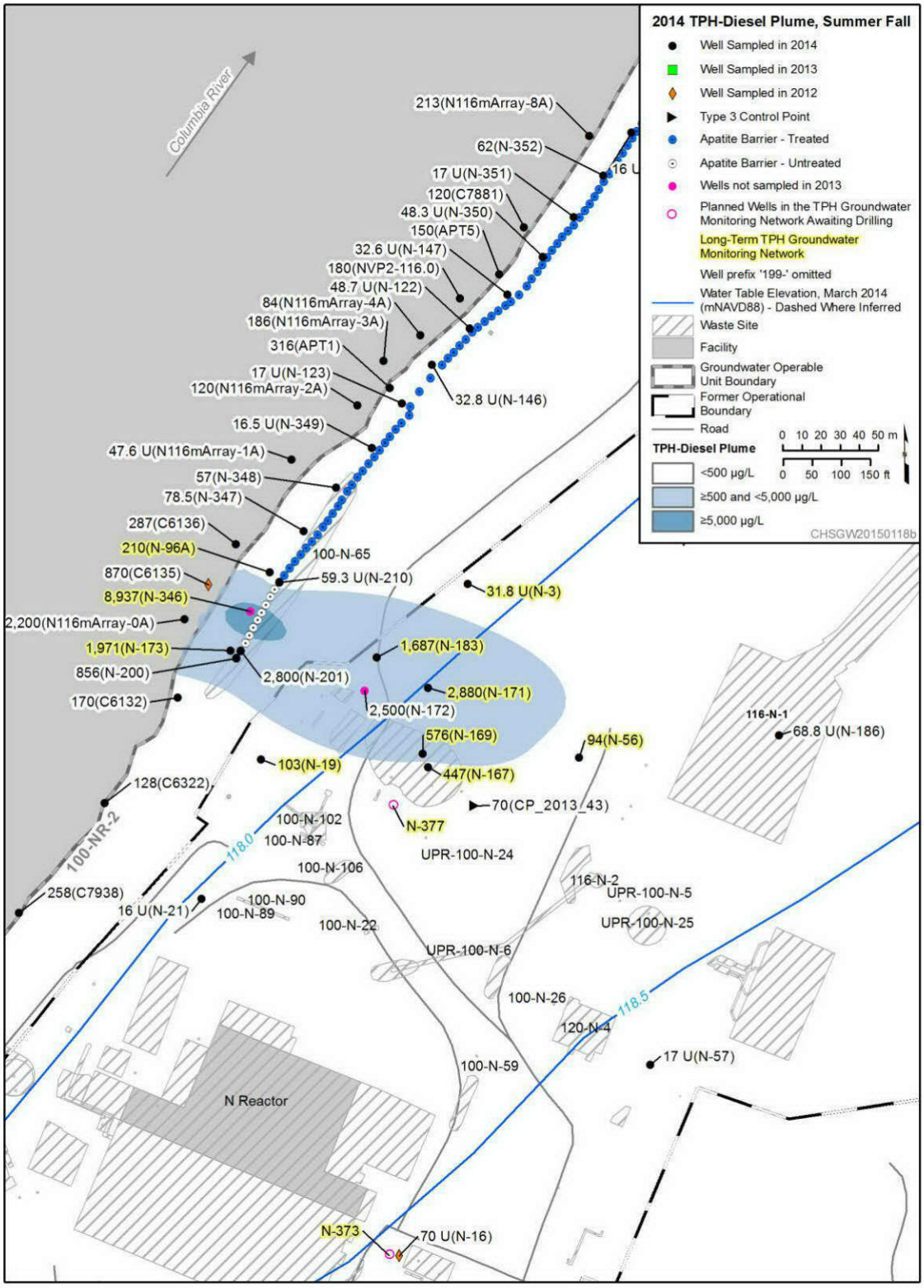

Figure A-17. TPH Monitoring Locations for PSQs 3, 4, 5, and 7

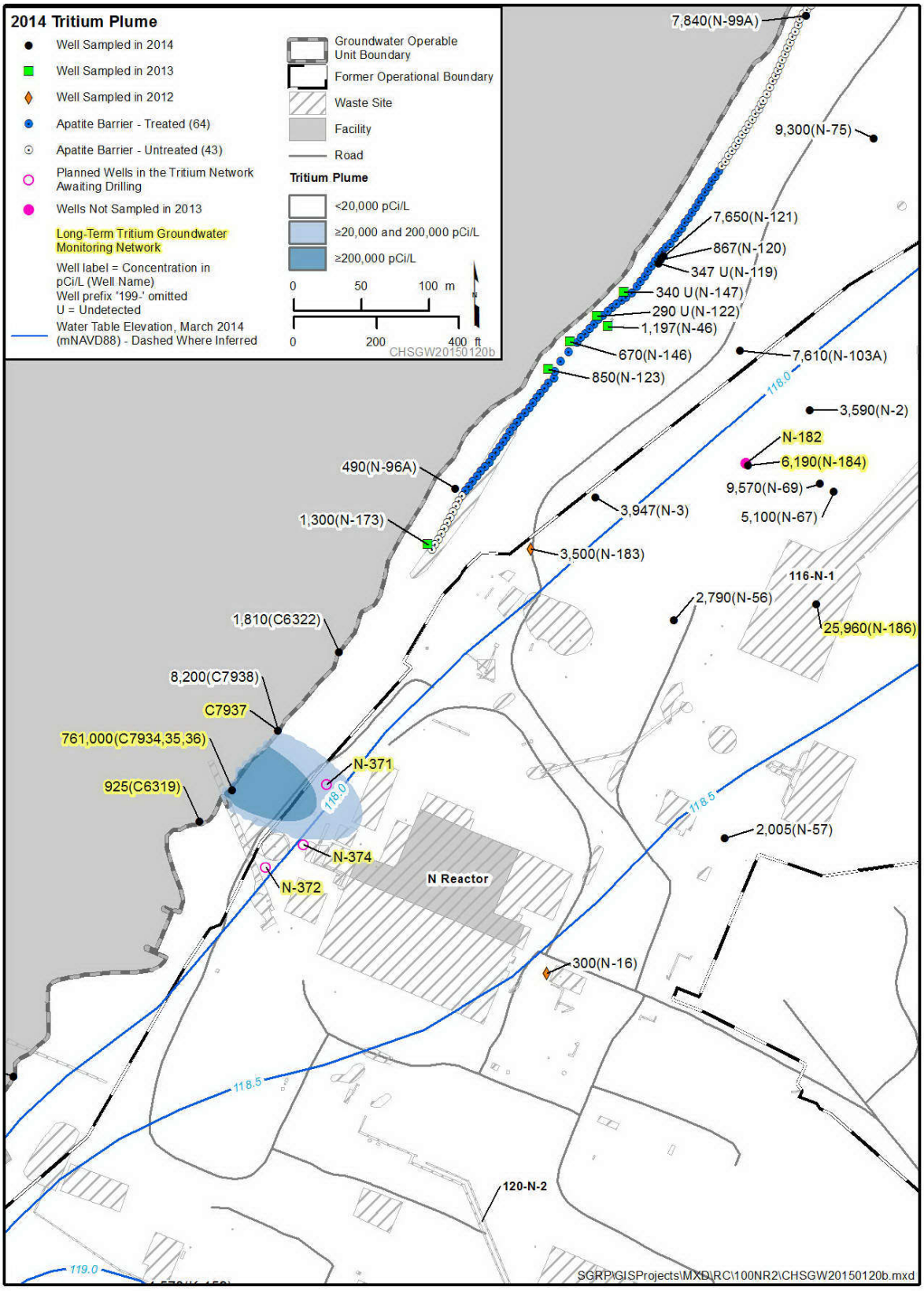

Figure A-18. Tritium Monitoring Locations for PSQs 3, 4, 5, and 7

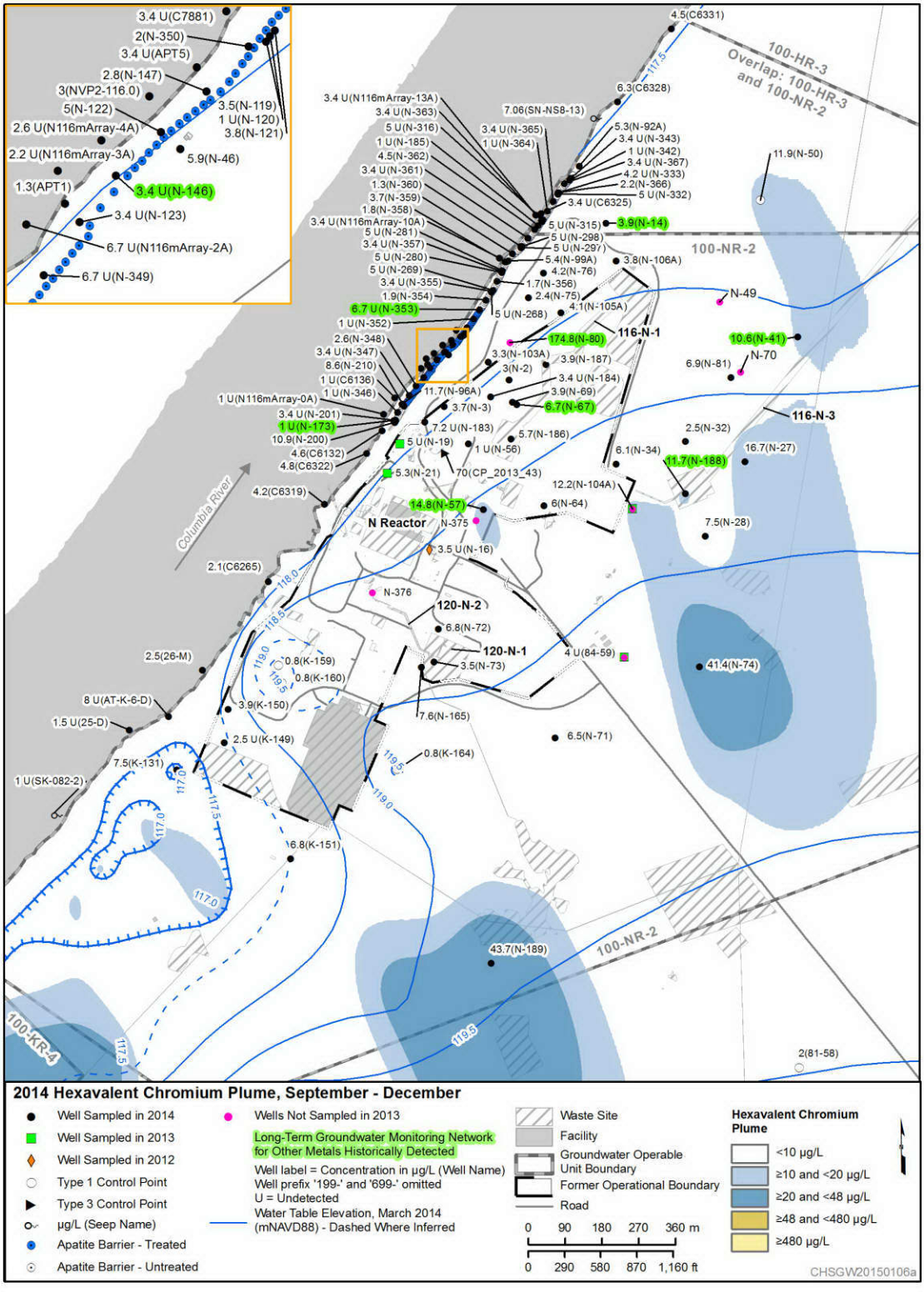

Figure A-19. Hexavalent Chromium and Metals Monitoring Locations for PSQs 3, 4, 5, 6, and 7

Monitoring locations for the RCRA sites 1324-N/NA (120-N-1 and 120-N-2), 1301-N (116-N-1), and 1325-N (116-N-3) are shown in Figures A-20, A-21, and A-22, respectively, as defined in the RCRA groundwater monitoring plans (WHC-SD-EN-AP-038 and PNNL-13914). The sample event duration for RCRA groundwater monitoring should not exceed 1 week for each RCRA TSD unit. If the duration of a sampling interval for all monitoring wells for a TSD unit is more than 1 week, RL and Ecology will evaluate if the sample duration is acceptable or if the wells need to resampled. This determination will be based on the information being collected from the samples and potential effect the sampling duration has on the temporal variability of sample results.

New long-term groundwater monitoring wells will be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

Tables A-13, A-14, A-15, A-16, A-17, and A-18 identify the wells and aquifer tubes applicable to PSQ 4. Furthermore, PSQ-1 and PSQ 4 are applicable to Sr-90 sampling in the OU. Differences associated with sampling the apatite barrier (PSQ-1) and Sr-90 (PSQ-4) groundwater monitoring networks can be ascertained from the information provided in Figures A-12 and A-15 and Tables A-11 and A-13. Information from each of these networks will collectively be used to assess the nature and extent of Sr-90 contamination in the 100-NR-2 OU.

A3.2.1.5 PSQ 5: Is there evidence that Columbia River water quality is being protected?

Monitoring locations to address PSQ 5 were selected based on a judgmental sampling design and shown in Figures A-12, A-142, A-15, A-16, A-17, A-18, and A-19. Wells and aquifer tubes in these networks will be sampled semiannually, annually, and biannually. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Groundwater wells and aquifer tubes identified in this SAP are positioned along and in the Columbia River. Data from these locations will provide evidence on Columbia River water quality. Inland monitoring wells were also selected away from the Columbia River to track and monitor groundwater plumes on approach to this major discharge area. The goal of the sample design is to collect data on the nature and extent of groundwater contamination as well as releases to the river. As such, wells and aquifer tubes were selected to determine concentrations in areas of known contamination and areas adjacent to contamination. Tables A-11, A-12, A-13, A-14, A-15, A-16, and A-17 identify the wells and aquifer tubes applicable to PSQ 5.

A3.2.1.6 PSQ 6: How do adjacent operable units influence 100-NR-2 remedies?

Groundwater within the 100-NR-2 OU will be monitored for contaminant and hydrologic impacts from the adjacent OUs within the 100-K Area. The sources of these impacts are located upgradient and southwest of the 100-NR-2 Groundwater OU. Contaminant impacts are due to hexavalent chromium that extends across OU boundaries. Hydrogen ion concentrations (pH) associated with 100-KR-2 OU pump and treat operation may also influence 100-NR-2 OU water quality and remedies. The subject areas of hexavalent chromium contamination are shown in Figure A-19 as seven inland hexavalent chromium plumes. Hydrologic impacts are mainly the results of pumping and treating 100-KR-4 groundwater. Impacts to the water table are expressed mainly as radial flow in the vicinity of groundwater Well 199-K-148 (see Figure A-3).

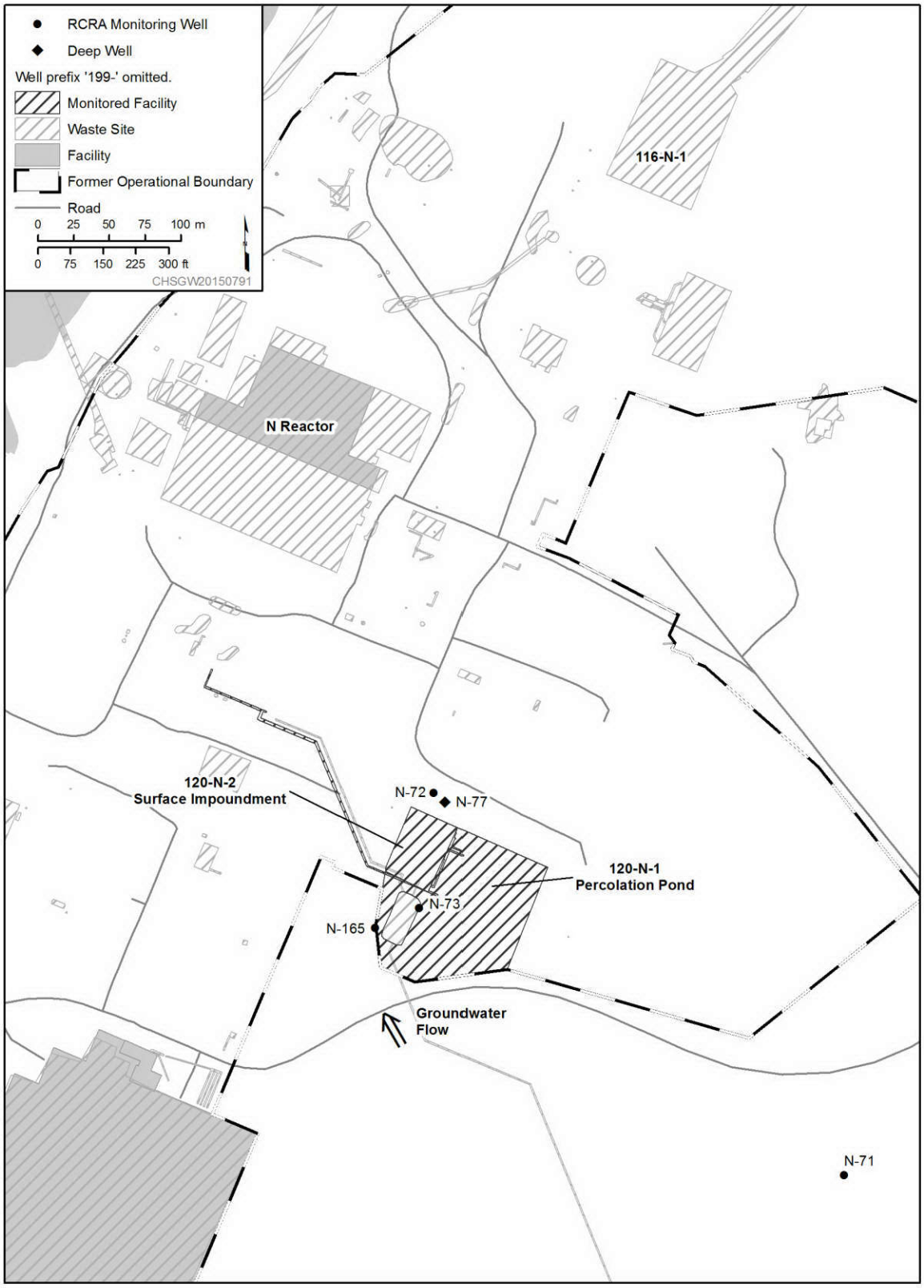

Figure A-20. 1324-N/A (120-N-1, 120-N-2) Monitoring Locations for PSQ 4

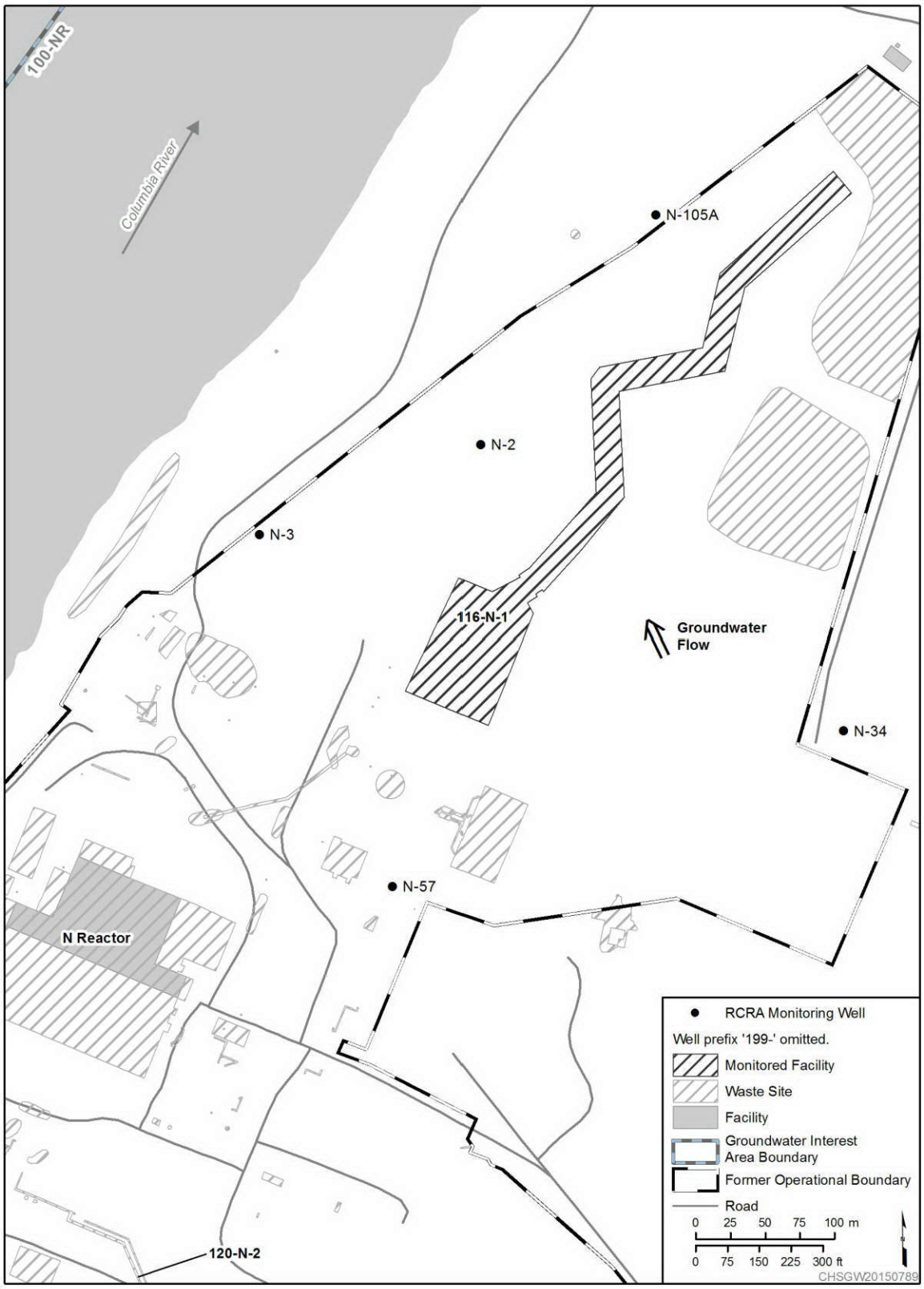

Figure A-21. 1301-N (116-N-1) Monitoring Locations for PSQ 4

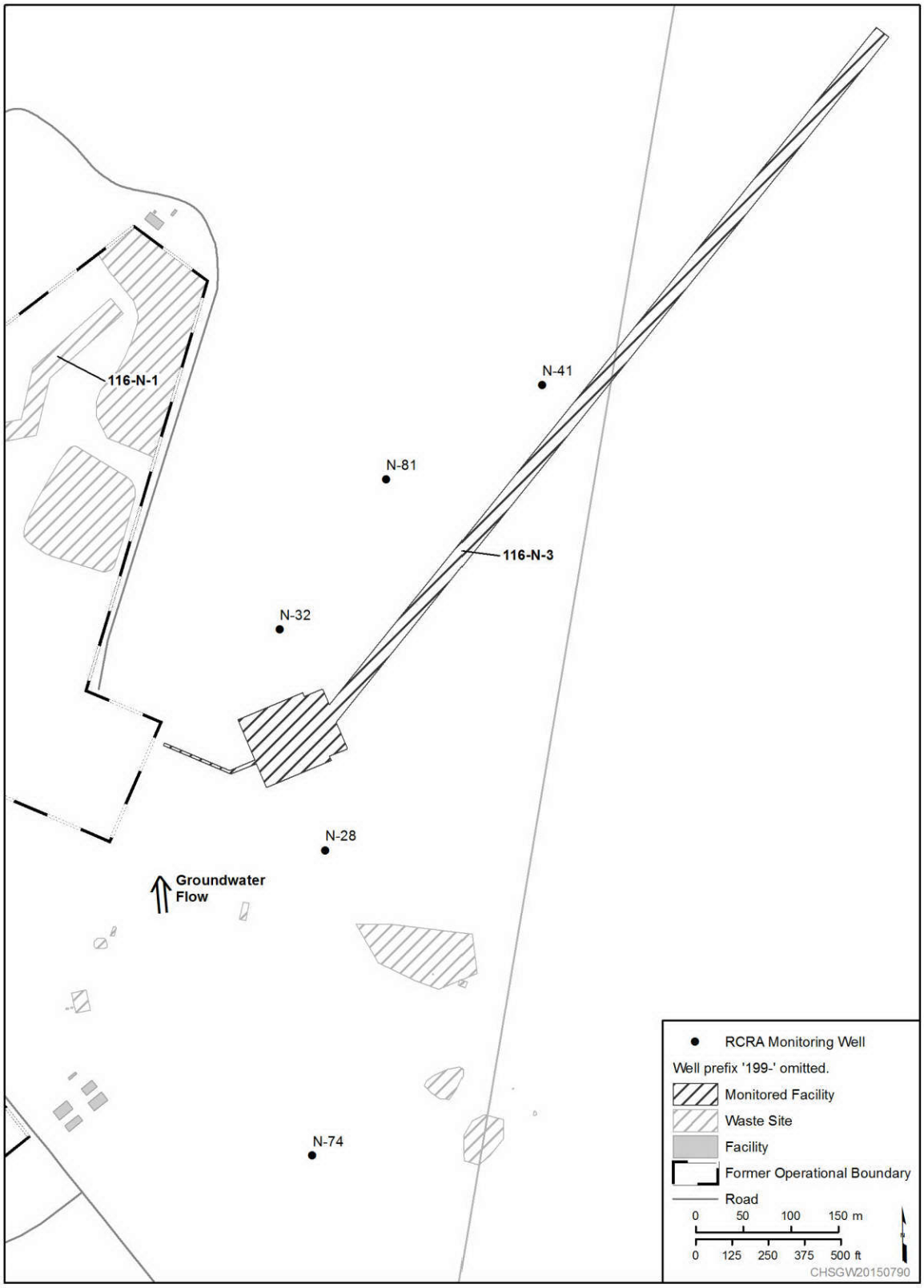

Figure A-22. 1325-N (116-N-3) Monitoring Locations for PSQ 4

Hexavalent chromium; general water quality measurements for pH, temperature, and specific conductivity; and water level monitoring within the boundary of the 100-NR-2 OU (i.e., inland plumes) that is associated with the 100-K Area are addressed in DOE/RL-2013-29. Contaminant migration, geochemical changes (e.g., pH), and groundwater flow will be evaluated in the wells identified in DOE/RL-2013-29 and this SAP to evaluate potential impacts from the 100-K Area on 100-NR-2 OU water quality and remedies. Monitoring locations for PSQ 6 were selected based on a judgmental sampling design and shown in Figures A-15, A-16, A-17, A-18, and A-19. Tables A-13, A-14, A-15, A-16, A-17, and A-19 identify the wells and aquifer tubes applicable to PSQ 6.

A3.2.1.7 PSQ 7: Is there additional information needed for a final ROD?

Characterization of the 100-NR-2 OU will require collection of contaminant and hydrologic data. The data collected will support regulatory decision making and preparation of a ROD. The monitoring networks shown in Figures A-12, A-14, A-15, A-16, A-17, A-18, and A-19 will provide data to address the nature and extent of contamination, elevation changes at the water table (in part), and PSQs identified in this SAP. The DQO summary report (Insert A1) identifies four potential information needs in PSQ 7 that might be required in the final ROD:

- What TPH fractions are present in groundwater?
- Is there evidence to support groundwater contaminant priority changes based on the draft RI/FS?
- Are concentrations of antimony, arsenic, cadmium, chromium (total), cobalt, copper, and manganese below action levels or standards?
- To what extent do seasonal variations in elevation of the water table influence the magnitude and direction of hydraulic gradient in the unconfined aquifer?

The data collected to support the PSQs identified in this SAP will support these potential ROD needs. This is performed by collecting and analyzing samples for the following:

- TPH fractions (TPH-diesel, TPH-gasoline, TPH-motor oil, and TPH-oil and grease) as defined in Tables A-12 and A-15.
- The nature and extent of contamination based on contaminants identified in the draft RI/FS (see Table A-1).
- Metal concentrations using inductively coupled plasma analysis. This method will identify more than 20 metals, including arsenic, cadmium, chromium (total), cobalt, and manganese as shown in Table A-6. More than 80 groundwater wells/aquifer will be sampled for metals (see Table A-10).
- Seasonal changes in the elevation of the water table (as described in Section A3.3.4).

Tables A-11, A-12, A-13, A-14, A-15, A-16, and A-17 identify the wells and aquifer tubes applicable to PSQ 7.

A3.3 Sampling Methods

Sampling may include, but is not limited to, the following methods:

- Field screening measurements
- Groundwater sampling
- Water level measurements

Groundwater samples will be collected according to the current revision of applicable operating methods. Groundwater samples are collected after field measurements of purged groundwater have stabilized:

- pH – two consecutive measurements agree within 0.2 pH units
- Temperature – two consecutive measurements agree within 0.2 °C
- Conductivity – two consecutive measurements agree within 10 percent of each other
- Turbidity – less than 5 nephelometric turbidity units prior to sampling (or project scientist's recommendation)

Dissolved oxygen will also be measured in the field in this plan. Dissolved oxygen is not an indicator parameter and is not required to be stable prior to sample collection.

Absent any special requirements from project scientists, wells are purged utilizing the three borehole volume method. Stable field readings are also required as specified above. The default pumping rate is 7.6 to 45.4 L/min (2 to 12 gal/min) depending on the pump, although this is not practical at every well. On occasions when the purge volume is extraordinarily large, wells are purged a minimum of 1 hour and then sampled once stable field readings are obtained.

Field measurements (except for turbidity) are obtained through the use of a flow-through cell. Groundwater is pumped directly from the well to the flow-through cell. At the beginning of the sample event, field crews attach a clean stainless steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater, and the other is used to supply water to the flow-through cell. Probes are inserted into the flow-through cell for measurement of pH, temperature, conductivity, and dissolved oxygen. Turbidity is measured by inserting a sample vial into a turbidimeter. The purgewater is then discharged to the purgewater truck.

Once field measurements have stabilized, the hose supplying water to the flow-through cell is disconnected and a clean stainless steel drop leg is attached for sampling. The flow rate is reduced during sampling to minimize loss of volatiles, if any, and prevent overfilling of bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles, if any. Filtered samples are collected after the unfiltered samples. For some constituents, like metals, both filtered and unfiltered samples are analyzed. If additional samples require filtration (e.g., at turbidity greater than 5 NTUs), an inline disposable 0.45 µm filter is used.

Typically, three types (i.e., Grundfos, Pacific Hydrostar™, and submersible electrical pumps) of environmental-grade sampling pumps are used for groundwater sampling at Hanford Site monitoring wells. Individual pumps are selected based on the unique characteristics of the well and the sampling requirements. A small number of wells will not support a pumped sample because of yield or the physical characteristics of the well. In these cases, a grab sample may be obtained.

Low purge volume sampling methodology for the collection of groundwater samples is also being implemented at the Hanford Site. Low flow purging and sampling uses a low purge volume, adjustable rate bladder pump with typical flow rates of 0.1 to 0.5 L/min. This methodology is intended to minimize excessive movement of water from the soil formation into the well. The objective is to pump in a manner that minimizes stress (drawdown) to the system. Purge volumes for wells using low purge bladder pumps are determined on a well-specific basis based on drawdown, pumping rate, pump and sample line volume, and volume required to obtain stable field prior to collecting samples.

™ Pacific Hydrostar is a trademark of Harbor Freight Tools, Calabasas, California.

For certain types of samples, preservatives are required (Table A-9). While the preservative may be added to the collection bottles before their use in the field, it is allowable to add the preservative at the sampling vehicle immediately after collection. Samples may require filtering in the field, as noted on the chain-of-custody forms.

To ensure sample and data usability, the sampling associated with this SAP will be performed according to the HASQARD (DOE/RL-96-68) pertaining to sample collection, collection equipment, and sample handling.

Suggested sample container, preservation, and holding time requirements are specified in Table A-9 for groundwater samples. These requirements are in accordance with the analytical method specified in Table A-6. The final container type and volumes will be identified on the SAF and chain-of-custody form. This SAP defines a "sample" as a filled sample bottle for starting the clock for holding time restrictions.

Holding time is the maximum allowable time period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater*, and SW-846. Recommended holding times are also provided in the HASQARD (DOE/RL-96-68) and applicable laboratory contracts.

A3.3.1 Decontamination of Sampling Equipment

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

Radiologically contaminated sampling equipment will be decontaminated to radiologically release the equipment. If sampling equipment cannot be radiologically released, the equipment is disposed as radiologically contaminated waste.

Chemical decontamination is performed by removing all visible particulate matter by wiping, or scraping, using a stiff nylon brush, or equivalent. Two washes are then performed using a nonphosphate detergent or laboratory-grade detergent. The equipment is then rinsed with high-purity water a minimum of three times and air dried.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

A3.3.2 Radiological Field Data

Alpha and beta/gamma data collection in the field will be used as needed to support sampling and analysis efforts. Radiological screening will be performed by an RCT or other qualified personnel. The RCT will record field measurements, noting the depth of the sample and the instrument reading.

Measurements will be relayed to the field geologist (for aquifer tubes and wells) for daily inclusion in the field logbook or operational records, as applicable.

The following information will be distributed to personnel performing work in support of this SAP:

- Instructions to RCTs on the methods required to measure sample activity and media for gamma, alpha, and/or beta emissions, as appropriate
- Information regarding the portable radiological field instrumentation including a physical description of the instruments, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument (these instruments are commonly used on the Hanford Site to obtain measurements of removable surface contamination measurements and direct measurements of the total surface contamination)
- Instructions regarding the minimum requirements for documenting radiological control information in accordance with 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of radiological information
- Minimum standards and practices necessary for preparing, performing, and retaining radiological-related information
- Requirements associated with preparing and transporting regulated material
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities (data will be cross referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results)

A3.3.3 Use of Smart Sponges for Free Product Removal

The 100-NR-1 and 100-NR-2 OUs ROD (EPA/ROD/R10-99/112) requires the remediation of free-phase hydrocarbon product observed in 100-N Area monitoring wells. Petroleum hydrocarbon contamination as free product has occasionally been observed at Wells 199-N-17 and 199-N-18. Well 199-N-17 went dry and was taken out of service and decommissioned. This element of the interim action currently consists of removing free product (diesel) from Well 199-N-18. The passive remediation approach involves the use of a polymer ("smart sponge") that selectively absorbs petroleum product from the surface of water. This approach was taken because the layer of floating petroleum was too thin for removal by active methods. Any additional wells with observed free product will be subject to this remediation approach.

Every 2 months, two sponges are lowered to the surface of the water table in Well 199-N-18. The sponges are weighed before emplacement in the well and after removal from the well, and the difference in weight between the two measurements is the amount of product or diesel fuel contamination removed from the well. Volumetric statuses of removed petroleum will be provided at unit managers' meetings. (Note that groundwater monitoring is no longer conducted at Well 199-N-18; however, monitoring Well 199-N-183 has been installed nearby for groundwater sampling.)

A3.3.4 Water Levels

Groundwater levels are measured annually across the Hanford Site to construct water table maps that are used to determine the direction and rate of groundwater flow in the unconfined aquifer (SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*). Water levels are also measured in wells that are screened in the confined aquifer to help determine horizontal and vertical hydraulic gradients.

A measurement of depth to water is also recorded in each well prior to sampling, using calibrated depth measurement tapes. When two consecutive measurements are taken that agree within 6 mm (0.02 ft), the final determined measurement is recorded along with the date and time for the specific event (e.g., sampling or annual water level measurements). The depth to groundwater is subtracted from the elevation of a reference point (usually the top of casing) to obtain the water level elevation. Tops of casings are known elevation reference points because they have been surveyed to local reference data.

Manual water level measurements will be performed in the wells identified in Tables A-10 through A-18 during each sampling event. Data will also be collected from the automated water level network wells throughout the year (typically hourly), and manual water level measurements will be performed in the wells in March of each year (Table A-20). The proposed automated water level network well locations are identified in Figure A-23.

Table A-20. 100-NR-2 OU Water Level Monitoring Wells

199-N-2*	199-N-92A*
199-N-3	199-N-96A
199-N-14	199-N-99A*
199-N-18	199-N-105A
199-N-19	199-N-106A*
199-N-21*	199-N-119
199-N-27*	199-N-189
199-N-28	699-81-58
199-N-32	699-87-55
199-N-34*	199-K-129
199-N-41	199-K-130
199-N-49*	199-K-131
199-N-50*	199-N-146*
199-N-51*	199-N-147
199-N-52*	199-K-148
199-N-56*	199-K-149*
199-N-57	199-K-151
199-N-62	199-K-152
199-N-64*	199-K-153
199-N-67	199-K-159
199-N-71*	199-K-160
199-N-72*	199-K-164

Table A-20. 100-NR-2 OU Water Level Monitoring Wells

199-N-73	199-K-182
199-N-76*	199-K-189
199-N-81	

* Proposed automated water level network wells.

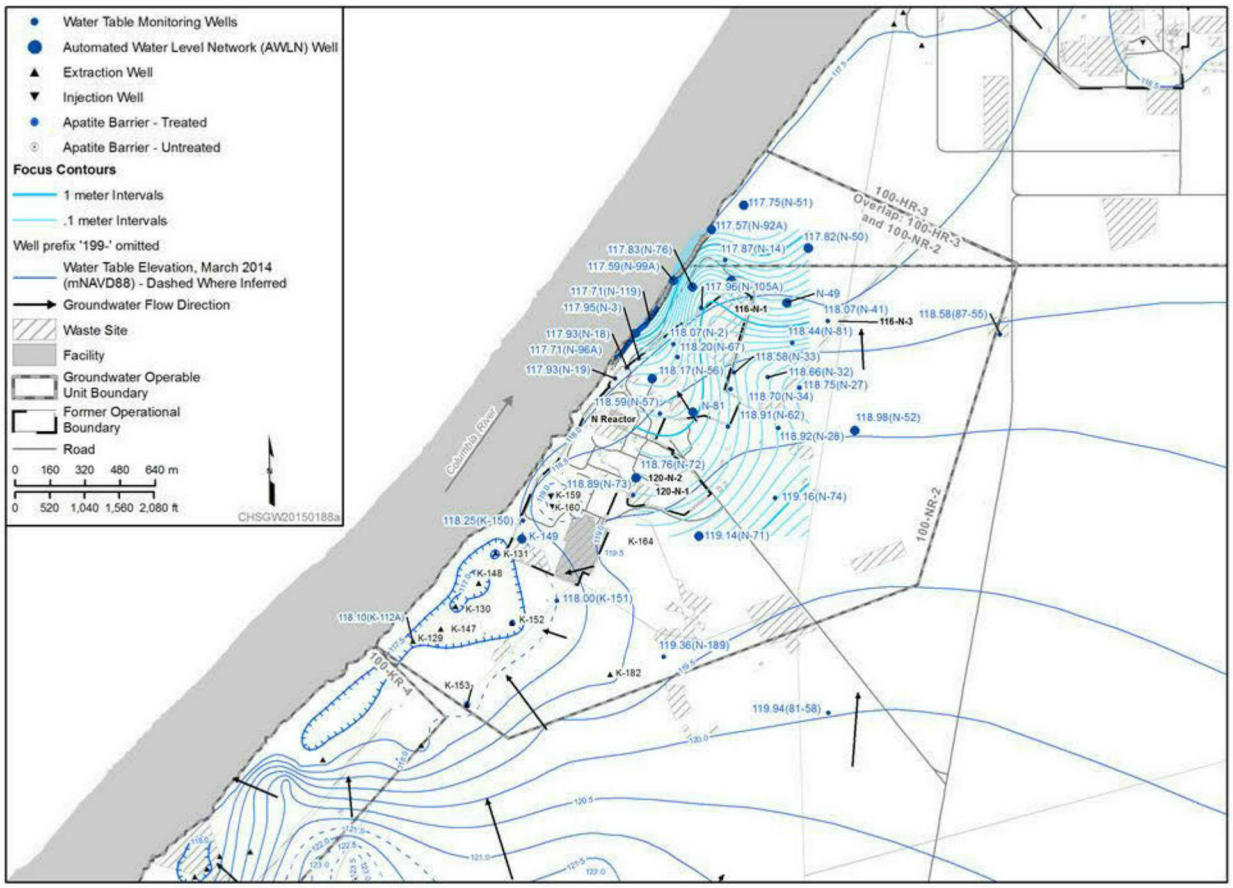

Figure A-23. 100-NR-2 Proposed Automated Water Level Network

A3.4 Documentation of Field Activities

Logbooks or data forms are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the FWS, cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

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

- Purpose of activity
- Day, date, time, and weather conditions
- Names, titles, and organizations of personnel present
- Deviations from the QAPjP
- All site activities, including field tests
- Materials quality documentation (e.g., certifications)
- Details of samples collected (e.g., preparation, splits, duplicates, MS, and EBs)
- Location and types of samples
- Chain-of-custody details and variances relating to the chain of custody
- Field measurements
- Field calibrations testing, inspections, maintenance and surveys, and equipment identification numbers, as applicable
- Equipment decontaminated and number of decontaminations
- Equipment failures or breakdowns and descriptions of any corrective actions
- Telephone calls relating to field activities

A3.4.1 Corrective Actions and Deviations for Sampling Activities

The OU Project Manager, FWS, appropriate BTR (or designee), and SMR personnel must document deviations from protocols, problems pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions, changes in sample locations because of physical obstructions, or additions of sample depth(s).

As appropriate, such deviations or problems will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The OU Project Manager, FWS, appropriate BTR (or designee), or SMR personnel will be responsible for communicating field corrective action requirements and for ensuring immediate corrective actions are applied to field activities.

Changes in sample activities that require notification, approval, and documentation will be performed as specified in Table A-5.

A3.5 Calibration of Field Equipment

Construction management, the appropriate BTR, or the FWS is responsible for ensuring that field equipment is calibrated appropriately. Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or field

instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. The results from all instrument calibration activities are recorded according to the HASQARD (DOE/RL-96-68).

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

- Prior to initial use of a field analytical measurement system.
- At the frequency recommended by the manufacturer or methods, or as required by regulations.
- Upon failure to meet specified QC criteria.
- Calibration of radiological field instruments on the Hanford Site is performed by the Mission Support Alliance prime contractor, as specified by its calibration program.
- Daily calibration checks will be performed and documented for each instrument used to characterize areas under investigation. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to a nationally or internationally recognized standard agency source or measurement system, if available.

A3.6 Sample Handling

Sample handling and transfer will be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

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

A3.6.1 Containers

Pre-cleaned sample containers with certificates of analysis denoting compliance with EPA specifications (EPA 540/R-93/051, *Specifications and Guidance for Contaminant-Free Sample Containers*) for the intended analyses will be used for samples collected for chemical analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits.
The Radiological Engineering organization will measure both the contamination levels and dose rates associated with the filled sample containers. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's radioactivity acceptance criteria. If the dose rate on the outside of a sample container or the curie content exceeds levels acceptable by an offsite laboratory, the FWS (in consultation with the SMR organization) can send smaller volumes to the laboratory. Container types and sample amounts/volumes are identified in Table A-9.

A3.6.2 Container Labeling

Each sample container will be labeled with the following information on firmly affixed, water-resistant labels:

- SAF
- HEIS number

- Sample collection date and time
- Analysis required
- Preservation method (if applicable)
- Chain-of-custody number
- Bottle type and size
- Laboratory performing the analyses
- Sample location

In addition, sample records must include the following information:

- Analysis required
- Source of sample
- Matrix (water)
- Field data (pH, temperature, turbidity, and conductivity)
- Radiological readings

A3.6.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for the custody of the sample changes, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit the copy to the SMR organization within 48 hours of shipping.

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

- Project name
- Signature of sampler
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Signatures of individual involved in sample transfer
- Requested analyses (or reference thereto)

Samplers should note any anomalies with the samples that would prevent batching. If anomalies are found, the samplers should inform the SMR organization before adding any information regarding batching on the chain-of-custody form.

A3.6.4 Sample Transportation

All packaging and transportation instructions shall be in compliance with applicable transportation regulations and DOE requirements. Regulations for classifying, describing, packaging, marking, labeling,

and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 177, "Carriage by Public Highway." Carrier-specific requirements defined in current edition of International Air Transport Association (IATA) *Dangerous Goods Regulations* shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported according to DOT/IATA requirements. If the sample material is known or can be identified, then it will be packaged, marked, labeled, and shipped according to the specific instructions for that material.

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

Prior to shipping radioactive samples to the laboratory, the organization responsible for shipping shall notify the laboratory of the approximate number of and radiological levels of the samples. This notification is conducted through the SMR project coordinator. The laboratory is responsible for ensuring that the applicable license limits are not exceeded. The laboratory shall provide the SMR organization with written acceptance for samples with elevated radioactive contamination or dose.

A4 Management of Waste

Waste materials are generated during sample collection and processing. Waste will be managed in accordance with DOE/RL-2000-41, *Interim Action Waste Management Plan for the 100-NR-2 Operable Unit*, and TPA-CN-256. For waste designation purposes, the maximum concentration in 5 years of historical data from HEIS for the analytes and wells listed in Table A-10, as applicable, will comprise a complete analytical data set.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities. Pursuant to 40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off Site Response Actions," approval from the DOE Remedial Project Manager is required before returning unused samples or waste from offsite laboratories.

A5 Health and Safety

The hazardous waste operations safety and health program for the remediation contractor was developed for employees involved in hazardous waste site activities. The program was developed to comply with the requirements of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," and 10 CFR 835 "Occupational Radiation Protection," to ensure the safety and health of workers during hazardous waste operations.

The health and safety program was developed to define chemical, radiological, and physical hazards and specify the controls and requirements for day-to-day work activities on the overall Hanford Site. The program incorporates applicable core functions and guiding principles outlined in the IntegratedSafety Management System and governs minimal personal training, control of industrial safety and radiological

hazards, PPE, site control, and general emergency response to spills, fire, accidents, injury, and incident reporting. Monitoring locations identified for TPH bioremediation sampling also require industrial hygiene measurements of annular space volatile organic carbon and methane as a component of health and safety.

Field operations will be performed in accordance with health and safety requirements and appropriate Soil and Groundwater Remediation Project requirements. Additionally, work control documents will be prepared to further control site operations. Safety documentation will include an activity hazard analysis and, as applicable, radiological work permits. The sampling procedures and associated activities will implement the integrated safety management system, and ALARA practices to minimize radiation exposure to the sampling team, consistent with the requirements defined in 10 CFR 835.

Access and work activities will be controlled in accordance with approved work packages, as required by established internal work requirements and processes. The health and safety program addresses the health and safety hazards of each phase of site operation, and includes the requirements for hazardous waste operations and/or construction activities, as specified in 29 CFR 1910.120. The Health and Safety officer is responsible for implementing the requirements of 29 CFR 1910.20.

Project field staff will be required to comply with the Health and Safety Plan (HASP) at all times. Unescorted site visitors are required to read and sign the HASP before entering the construction area and must have completed the required training outlined in the HASP. Escorted visitors are briefed on health and safety concerns and must be escorted by the site superintendent (or designee) at all times when they are in the construction area. Construction areas may include the TPH bioremediation system, former P&T system system, or monitoring well locations.

During operations, emergency response for the 100-NR-2 OU interim remedial activities will be covered by the health and safety program. The health and safety program specifies primary emergency response actions for site personnel, area alarms, implementation of the emergency action plan and emergency equipment at the task site, emergency coordinators, emergency response procedures, and spill containment procedures. Emergency contact numbers are 911 or the Hanford Site Emergency number (373-0911) from a mobile phone.

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Data Quality Objectives Summary Report for 100-NR-2 Operable Unit Groundwater Monitoring

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Terms

AEA	*Atomic Energy Act of 1954*
AWLN	automated water level network
AWQC	ambient water quality criteria
BTEX	benzene, toluene, ethylbenzene, and xylene
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M HILL Plateau Remediation Company
COC	contaminant of concern
COPC	contaminant of potential concern
Cr(VI)	hexavalent chromium
CSM	conceptual site model
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DQO	data quality objective
DWS	drinking water standard
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
IAROD	Interim Action Record of Decision
LNAPL	light nonaqueous-phase liquid
LWDF	liquid waste disposal facility
K_d	distribution coefficient
MSA	Mission Support Alliance
NAPL	nonaqueous-phase liquid
OU	operable unit
P&T	pump and treat
PAH	polycyclic aromatic hydrocarbons
PNNL	Pacific Northwest National Laboratory
PRB	permeable reactive barrier

PRZ	periodically rewetted zone
PSQ	principal study question
RCRA	*Resource Conservation and Recovery Act of 1976*
RD/RAWP	remedial design report/remedial action work plan
RI	remedial investigation
ROD	record of decision
RUM	Ringold Formation upper mud
SAP	sampling and analysis plan
SWS	surface water standard
TPH	total petroleum hydrocarbons
UPR	unplanned release
VOA	volatile organic analysis
WAC	*Washington Administrative Code*
WCH	Washington Closure Hanford

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A1.1 Introduction

A data quality objective (DQO) process was conducted to support the development of an integrated sampling and analysis plan (SAP) for the 100-NR-2 Groundwater Operable unit (OU) (Figure A1-1). The monitoring plan in current use (DOE/RL-2001-27, Rev. 1, *Remedial Design/Remedial Action Work Plan for the 100-NR-2 Operable Unit* [RD/RAWP]) was approved in 2014, to implement the Interim Action Record of Decision (IAROD) amendment remedy for installation of the apatite permeable reactive barrier (PRB). The current SAP includes the sampling requirements identified in the Rev. 0 version approved in 2002. Many changes have transpired in the 100-N Area over the intervening 12 years between 2002 (Rev. 0) and 2014 (Rev. 1), including the following:

- Interim safe storage of the 105-N Reactor (N Reactor) in 2011 and removal of most reactor support facilities
- Remediation and backfill of most waste sites was complete by 2014
- Decommissioning/removal of many monitoring wells during remediation activities
- Discontinuing operation of the 100-NR-2 OU pump and treat (P&T) system for strontium-90 (Sr-90) in March 2006
- Construction of part of an apatite PRB for Sr-90 in the saturated zone after 2006
- Construction of a bioventing treatment system for vadose zone total petroleum hydrocarbons (TPH) in 2009
- New waste site characterization during the 100-N Area remedial investigation (RI)/feasibility study (FS) process in 2011
- Construction of new monitoring wells and aquifer tubes during the 100-N Area RI/FS process in 2011
- Revision of the 100-N Area conceptual site model (CSM) during the 100-N Area RI/FS process in 2012
- Declining/stabilizing water table following cessation of NR-2 operations
- Adjacent groundwater P&T activities at the 100-KR-4 Groundwater OU

The long-term monitoring plan, based on this DQO, will incorporate these changes to ensure pertinent and relevant groundwater data are collected to support future groundwater related decisions. The planning team for the 100-NR-2 OU DQO process is identified in Table A1-1.

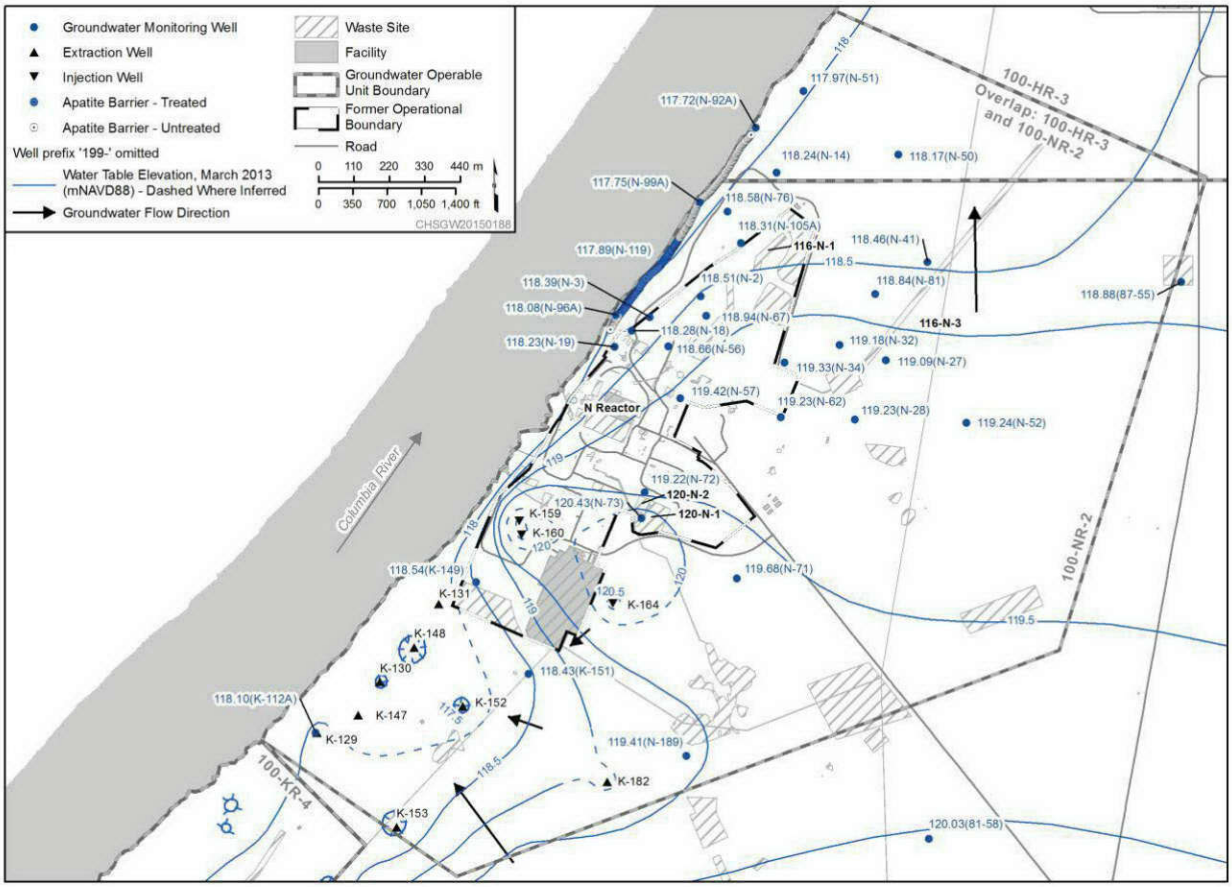
A1.2 Step 1: State the Problem

Summary: The problem statement is created to clearly define the issue that requires new environmental data so that the focus of the study will be clear and unambiguous. Pertinent information from similar studies and assumptions should be organized, reviewed, identified, evaluated, and documented.

A1.2.1 Purpose and Scope

A new long-term monitoring plan is needed that considers the changes that took place in the 100-N Area between 2002 and 2014 to ensure pertinent and relevant *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) groundwater data are collected to support future decisions regarding apatite PRB performance, TPH remedy performance, routine CERCLA monitoring to

meet the requirements of the IAROD, groundwater CSM verification, identification of continuing sources, plume migration, and Columbia River protection.



Note: Modified from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*.

Figure A1-1. Location Map of the 100-NR-2 OU

Table A1-1. 100-NR-2 OU DQO Planning Team

Name	Organization	Role
Alicia Boyd	Ecology	100-NR-2 OU Groundwater Lead
Dwayne Crumpler	Ecology	Geology
Jerel Yokel	Ecology	Chemistry Lead
Zelma Jackson	Ecology	Geologist
Ken Moser	MSA	DQO Review Panel
Kevin Kytola	Sapere	DQO Review Panel
Mike Truex	PNNL	DQO Review Panel
Rob Mackley	PNNL	DQO Review Panel
Bill Faught	CHPRC	Project Delivery Manager

Table A1-1. 100-NR-2 OU DQO Planning Team

Name	Organization	Role
Virginia Rohay	CHPRC	100-NR-2 OU Lead
Bruce Williams	CHPRC	100-NR-2 OU Co-Lead
Donna Morgans	CHPRC	Human Health Risk Assessment
Jessica Ni	CHPRC	100-NR-2 OU SAP Lead
Art Lee	CHPRC	Apatite Barrier Performance Design
Wendy Thompson	WCH	Senior Scientist; 100-NR-2 OU Expertise
Kevin Singleton	WCH	Senior Geologist
Roger Ovink	WCH	DQO Facilitator and Document Author
Greg Sinton	DOE-RL	100-NR-2 Groundwater OU Project Manager
John Neath	DOE-RL	100-NR-1 Source OU Source Project Manager
Joanne Chance	DOE-RL	100-NR-1 Source OU Subject Matter Expert

CHPRC = CH2M HILL Plateau Remediation Company
DOE-RL = U.S. Department of Energy, Richland Operations Office
Ecology = Washington State Department of Ecology
MSA = Mission Support Alliance
PNNL = Pacific Northwest National Laboratory
WCH = Washington Closure Hanford

A1.2.2 Conceptual Site Model

The primary sources of groundwater contamination in the 100-N Area were subsurface disposal of liquid and solid wastes generated during the operation of the 105-N Reactor and unplanned releases (UPRs). These releases resulted in contaminated vadose zone and groundwater beneath reactor facilities and waste sites. The working hypothesis is that groundwater contaminant migration follows groundwater flow paths toward discharge boundaries. The reactor operations responsible for generating and releasing the primary source of contaminants to the environment have all been discontinued. The contaminated vadose zone affected by disposal practices and releases represents secondary (residual) sources, which have the potential to spread contaminants through the environment. Other potential secondary sources evaluated in the RI/FS included the periodically rewetted zone (PRZ) and the upper layers of the Ringold Formation upper mud (RUM) unit. Secondary source contaminants continue to migrate through the environment, depending on the characteristics of the individual constituents. Figure A1-2 presents these primary and secondary waste transport concepts.

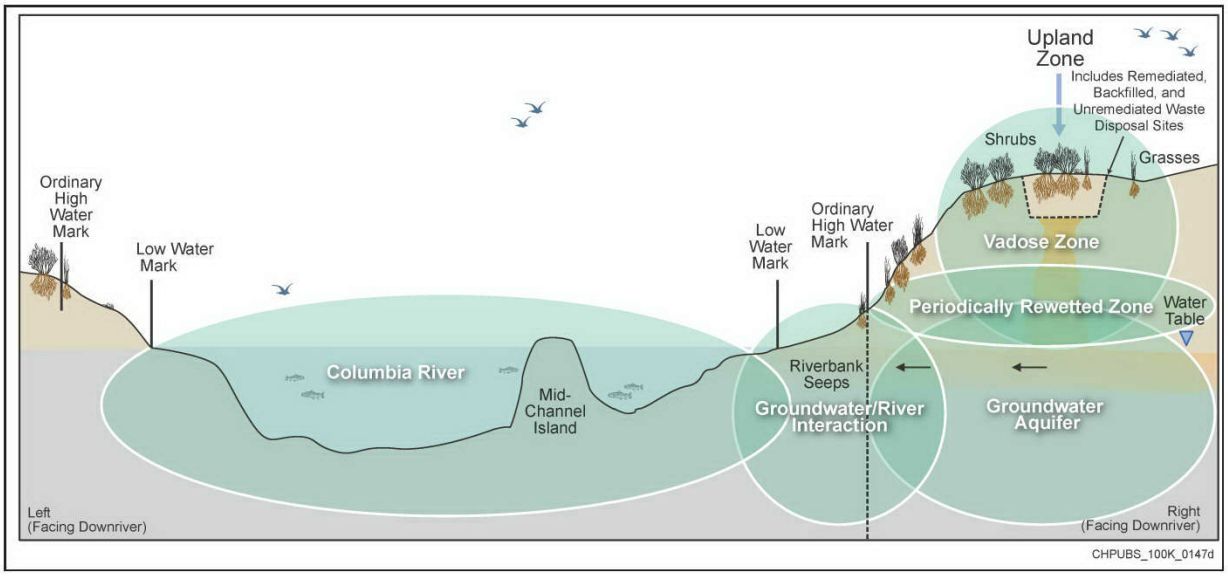


Figure A1-2. Areas of Contaminant Interaction with Vadose Zone Soil, Groundwater, and Surface Water

Available subsurface soil characterization indicates substantial differences exist in the nature and extent of individual contaminants, despite the fact that they were discharged through the liquid waste disposal facilities (LWDFs) and were subjected to the same recharge history (very high recharge during operations and substantially lower recharge following reactor shutdown). These differences are largely attributed to variances in specific chemical sorption. For the 100-NR-2 OU, four broad sorption categories are distinguished in Table A1-2. These contaminants are grouped by their relative mobility and contaminant distribution coefficient (K_d) values as presented in DOE/RL-2012-15, *Remedial Investigation/Feasibility Study for the 100-NR-1 and 100-NR-2 Operable Units*.

Contaminants in the highly mobile group ($K_d = 0$), which includes nitrate and tritium, are not sorbed to vadose zone soil or aquifer sediments and therefore are transported in the subsurface at the same rate as water. However, the observation of elevated tritium in aquifer tubes along the river suggests that residual contamination remain in the vadose zone and can be mobilized where recharge is sufficient (Section A1.4.1.4). Contaminants in the moderately mobile group, including hexavalent chromium and TPH-diesel, transport at rates slightly retarded compared to the rate of water movement.

Table A1-2. Relative Mobility of Selected 100-NR-2 OU COPCs (from DOE/RL-2012-15)

Relative Mobility	Inorganics	Radionuclides	Organics
High	Nitrate (K_d = 0 mL/g)	Tritium (K_d = 0 mL/g)	None
Moderate	Cr(VI) (K_d = 0.8 mL/g)	None	TPH-Diesel (K_d = 1)
Slight	None	Strontium-90 (K_d = 25 mL/g, 15 mL/g*)	None
Low	None	None	None

Table A1-2. Relative Mobility of Selected 100-NR-2 OU COPCs (from DOE/RL-2012-15)

Relative Mobility	Inorganics	Radionuclides	Organics

Sources: ECF-HANFORD-10-0442, *Calculation of Nonradiological Soil Concentrations Protective of Groundwater Using the Fixed Parameter 3-Phase Equilibrium Partitioning Equation for the 100 Areas and 300 Area*.

ECF-100NR1-12-0017, *Stomp 1-D Modeling for Determination of Soil Screening Levels and Preliminary Remediation Goals for the 100-NR-1 Source Operable Unit*.

* Mobility calculated for saturated (aquifer) sediments.

TPH = total petroleum hydrocarbons

Contaminants in the slight mobility group exhibit a high degree of interaction with vadose zone and aquifer solids and, as a result, migrate slowly through the vadose zone and aquifer. Their concentration in the vadose zone decreases rapidly with increasing depth, and their dissolved concentration in groundwater decreases dramatically with distance from a source or release point. The decrease in concentration is due to the relatively large fraction of the contaminant that interacts with vadose zone material and becomes sorbed to the vadose zone material and aquifer solids. The slight mobility group includes Sr-90, which has a K_d value of 25 mL/g for vadose zone sediments and 15 mL/g for aquifer sediments in the 100-N Area.

Contaminants with low mobility sorb more strongly to vadose zone material such that little to no migration is observed with infiltrating water under near-neutral pH in the vadose zone. Liquid waste sources with highly acidic or basic pH values or those that contained complexing agents may have transported these contaminants into the vadose zone at the time of disposal, but migration decreased as the liquid waste equilibrated with the vadose zone material. These constituents are not expected to reach the unconfined aquifer except at waste sites with subsurface release mechanisms and/or very thin vadose zones. Those that may have reached the unconfined aquifer are not expected to migrate further through the aquifer. The essentially immobile contaminants are identified as those that exhibit K_d values greater than 30.

A1.2.3 Resources

The various organizations participating in this DQO process have established accounts with financial resources for the DQO planning team and their administrative support staff. Should additional technical support be required (beyond the planning team members noted above), additional resources will be identified.

A1.3 Step 2: Identify the Goals of the Study

Summary: *Identify the question(s) that the study will address and alternative actions or outcomes that may result based on the results. Define the decision that will be resolved using the data collected to address the problem.*

A1.3.1 Principal Study Questions

1. Is the Sr-90 permeable reactive (apatite) barrier performing as intended?
    a. Do Sr-90 levels downgradient of the barrier reflect 90 percent reduction from the baseline?

b. Do downgradient Sr-90 concentrations comply with the drinking water standard (DWS) (8 pCi/L)?

2. Are TPH remedies contributing to groundwater quality improvement?

a. Can changes in groundwater concentrations be attributed to bioventing?

b. Is a light nonaqueous-phase liquid (LNAPL) layer present on the surface of the aquifer?

i. Is it declining in thickness compared to historical measurements?

c. Are TPH concentrations in groundwater declining?

d. Is the "smart sponge" still removing LNAPL effectively?

e. Are TPH concentrations reaching the Columbia River (i.e., detected in aquifer tube samples) above the DWS (500 µg/L)?

3. Is there evidence of IAROD contaminant of concern (COC) plume, concentration, area, or location changes?

a. Sr-90 plume

i. Are Sr-90 groundwater concentrations changing?

ii. How has the plume geometry changed over time?

iii. Is there evidence of Sr-90 migration?

b. TPH plume/footprint

i. Are TPH groundwater concentrations changing?

ii. How has the plume geometry changed over time?

iii. Is there evidence of a continuing residual vadose zone source to groundwater?

iv. Is there evidence of TPH migration?

c. Nitrate plume

i. Are nitrate concentrations changing?

ii. How has the plume geometry changed over time?

iii. Is there evidence of nitrate migration?

d. Tritium plume

i. Are tritium concentrations changing?

ii. How has the plume geometry changed over time?

iii. Is there evidence of tritium migration?

e. Hexavalent chromium

i. Are hexavalent chromium concentrations changing?

ii. How has the plume geometry changed over time?

iii. Is there evidence of hexavalent chromium migration?

f. Manganese

i. Are manganese concentrations changing?

ii. How has the plume geometry changed over time?

iii. Is there evidence of manganese migration?

g. Sulfate
   i. Are sulfate concentrations changing?
   ii. How has the plume geometry changed over time?
   iii. Is there evidence of sulfate migration?

4. Are there continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

5. Is there evidence that Columbia River water quality is being protected?

   a. Are wells and aquifer tubes located to assess Columbia River impacts?

   b. Are aquifer tube COC and/or contaminant of potential concern (COPC) concentrations less than surface water standard (SWS)/ambient water quality criteria (AWQC) or aquatic benchmark (e.g., 278 pCi/L for Sr-90)?

   c. Are near-shore well COC and/or COPC concentrations increasing or decreasing with respect to the DWS?

6. How do adjacent OUs influence 100-NR-2 OU remedies?

   a. Is there evidence that contaminants from the 100-K Area will migrate further into the 100-N Area?

   b. Is there evidence that contaminants from the 200 Areas will migrate toward/influence the 100-N Area?

   c. Is there evidence of 100-KR-4 OU reinjection influences from pH, geochemical changes, or changing groundwater flow?

7. Is additional information needed for a final ROD?

   a. What TPH fractions are present in groundwater?

   b. Is there evidence to support groundwater contaminant priority changes based on the draft RI/FS?

      i. The groundwater COPCs that apply to the COC plume areas for Sr-90, TPH, and nitrate are listed in Table 6-27 of the RI/FS (DOE/RL-2012-15) as follows:

         1. Apatite barrier and Sr-90 plume: The COPCs for the barrier area are derived from Table 4-29 of the RI/FS (DOE/RL-2012-15) and the apatite barrier performance SAP. Probable COCs, COPCs, and other analyte candidates include Sr-90, antimony, arsenic, nitrate, manganese, and calcium.

         2. TPH plume area: The COPCs are antimony, cadmium, cobalt, chromium (total), ethylbenzene, nitrate, Sr-90 TPH-gasoline, and TPH-diesel. Per Chapter 8 of the RI/FS (DOE/RL-2012-15), the COCs for this area are ethylbenzene, Sr-90, and TPH-diesel. This analyte list is expanded to include the TPH-gasoline, TPH-diesel, and TPH motor oil and grease as identified in the bioventing performance monitoring plan.

         3. Nitrate plume area: The COCs and COPCs are nitrate, Sr-90, and possibly tritium.

4. Remaining 100-N Area: The COPCs listed in Chapter 8 of the RI/FS (DOE/RL-2012-15) include antimony, cadmium, hexavalent chromium, cobalt, tritium, and TPH-gasoline.

c. Are concentrations of antimony, arsenic, cadmium, chromium (total), cobalt, copper, and manganese below action levels or standards?

d. To what extent do seasonal variations in elevation of the water table influence the magnitude and direction of hydraulic gradient in the unconfined aquifer?

i. Is the current network sufficient?

ii. Are additional automated water level networks (AWLNs) needed?

A1.3.2 Alternative Outcomes

Alternative outcomes that could result from addressing the PSQs are as follows:

- Continue monitoring program with no change.
- Modify the monitoring program (e.g., new/different wells, contaminants, and sampling frequencies).
- Reconsider Sr-90 and TPH remediation alternatives.
  - Halt any further apatite barrier expansion.
  - Halt bioventing and/or smart sponge treatments for TPH.
  - Initiate biosparging treatment for TPH.

CERCLA decision documentation will be required to stop or change remedies.

A1.3.3 Decision Statements

The following is a list of statements that address the study questions:

1. Determine if the permeable reactive (apatite) barrier is trapping Sr-90 and preventing it from reaching the Columbia River.
2. Determine if TPH remedies (bioventing and "smart sponge") are contributing to groundwater quality improvement.
3. Determine if IAROD COC plume concentration, area, and locations are changing.
4. Determine if there are continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall).
5. Determine if Columbia River water quality is being protected.
6. Determine if adjacent OUs influence 100-NR-2 OU remedies.
7. Determine if additional information would enhance final ROD decisions.

A1.3.4 Key Assumptions

1. The monitoring plan developed through this DQO process will address CERCLA groundwater monitoring requirements.

   a. *Atomic Energy Act of 1954* (AEA) and *Resource Conservation and Recovery Act of 1976* (RCRA) monitoring is not included in this effort. Groundwater monitoring for these efforts is

performed at four RCRA (i.e., WAC 173-303, "Dangerous Waste Regulations") treatment, storage, and disposal sites: 1324-N/NA (120-N-1, 120-N-2), 1301-N (116-N-1), and 1325-N (116-N-3). Groundwater monitoring requirements at these waste sites are identified in a separate sampling plan (WHC-SD-EN-AP-038, *Groundwater Monitoring Plan for 1301-N, 1324-N, 1324-NA, and 1325-N Sites*, and supplemented by PNNL-13914, *Groundwater Monitoring Plan for the 1301-N, 1324-N/NA and 1325-N RCRA Facilities*). A groundwater monitoring plan is currently being developed to clarify sampling requirement for the AEA groundwater monitoring.

2. Some of the existing 100-N Area groundwater monitoring wells may not be sufficient in their construction and/or locations to support the various monitoring needs identified in the project objectives. New wells may be needed to supplement or replace existing monitoring wells and will be constructed to WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," specifications.

3. Given the overlapping nature of several of the groundwater plumes, some monitoring wells may serve multiple needs. The wells used historically for monitoring the various 100-N Area groundwater plumes and general groundwater quality are listed in Table 6-20 of the RI/FS (DOE/RL-2012-15) and are included in this DQO summary report. Hexavalent and total chromium are present in 100-NR-2 OU groundwater, and total chromium is identified as a COPC. Their presence is believed to be primarily due to groundwater contamination from the 100-KR-4 OU. Therefore, minimal groundwater monitoring and plume tracking is proposed for chromium for the following reasons:

   a. Only one well in the 100-NR-2 OU had hexavalent chromium concentrations above the DWS (48 μg/L) in 2013. The hexavalent chromium concentration in Well 199-N-80, which was completed in a thin, confined water bearing zone in the upper portion of the RUM unit, was 177 μg/L, consistent with previous results and relatively unchanged since monitoring began in 1993. This water bearing zone is not laterally continuous and does not pose a significant threat of releasing contamination to the unconfined aquifer, so annual monitoring at low river stage will be continued in Well 199-N-80 (DOE/RL-2012-15). Additionally, the hexavalent chromium concentration (19.2 μg/L) in Well 199-N-96A, downgradient of the TPH source appears to have a 100-NR-1 OU source. Hexavalent chromium contamination in the vicinity of wells 199-N-80 and 199-N-96A is within the scope of this DQO summary report.

   b. There are areas of inland hexavalent chromium groundwater contamination in the 100-NR-2 OU that are believed to have originated from the 100-K Area. Concentrations are ≥0 μg/L and <48 μg/L. The 100-K Area plume that exceeds DWSs is being cleaned up through 100-K Area remedial actions (i.e., P&T system). Tracking the inland areas of elevated hexavalent chromium groundwater contamination in the 100-NR-2 OU is planned as a 100-K Area monitoring task.

4. Monitoring well locations, construction, sampling frequency, and target analytes for groundwater monitoring will require approval from the U.S. Department of Energy (DOE)-Richland Operations Office (RL), Washington State Department of Ecology (Ecology), and U.S. Environmental Protection Agency (EPA) (all SAP signatories).

5. A process will be defined in the RD/RAWP to develop "triggers" to monitoring modifications (e.g., add/subtract wells and/or analytes; increase/decrease sampling frequencies). Consider OSWER 9355.0-129, *Guidance for Evaluating Completion of Groundwater Restoration Remedial Action*; OSWER 9283.1-44, *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well*; OSWER 9283.1-46, *Groundwater Statistics Tool User's Guide*; and EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities; Unified Guidance*, as possible guidance in developing these "triggers."

6. New aquifer tubes may be needed to supplement or replace the existing aquifer tubes.

7. Vadose zone characterization is not within the scope of the 100-NR-2 OU groundwater monitoring DQO summary report. Vadose zone sampling conducted during new well drilling activities will be documented and conducted as part of the associated drilling process.

8. Apatite barrier baseline and short-term PRB injection monitoring was fully assessed as part of the RD/RAWP SAP (Rev. 1); it will not be discussed further in this DQO summary report.

9. DOE/RL-2005-93, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, has some required groundwater sampling. It was aligned with the TPH vadose remediation (i.e., bioventing) sampling and analysis but did not have a stated purpose; this DQO summary report will address the purpose of the groundwater sampling aligned with bioventing.

10. Smart sponge requirements for weighing and reporting removal quantities of TPH LNAPLs are documented in the 100-NR-2 RD/RAWP (Rev. 1). More detail about placement, removal, weighing, and reporting will be added to the SAP but is not included as part of this DQO summary report.

A1.4 Step 3: Identify Information Inputs

Summary: The third step of the DQO process is to identify information inputs needed to support the decision statements and to specify which inputs will require environmental measurements.

A1.4.1 Types and Sources of Information Needed to Resolve Decision Statements

Unless otherwise indicated, all the information presented in Step 3 was derived from the following documents:

- DOE/RL-2012-15, *Remedial Investigation/Feasibility Study for the 100-NR-1 and 100-NR-2 Operable Units* (Draft A)
- DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*
- DOE/RL-2009-42, *Sampling and Analysis Plan for the 100-NR-1 and 100-NR-2 Operable Units Remedial Investigation/Feasibility Study*
- DOE/RL-2001-27, *Remedial Design Report/Remedial Action Work Plan for the 100-NR-2 Operable Unit*, Appendix A, "100-NR-2 Groundwater Operable Unit Sampling and Analysis Plan for Interim Actions Associated with Saturated and Vadose Injection Projects, Long-Term/Routine Monitoring, Bioremediation, and Barrier Performance Monitoring"
- DOE/RL-2005-93, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, Appendix H, "Phase II Testing/Performance Monitoring Plan for the UPR-100-N-17 Bioremediation"
- DOE/RL-2014-25, *Calendar Year 2013 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*

The 100-NR-2 OU boundary encompasses the 100-N Area and is located adjacent to the Columbia River (Figure A1-1). The N Reactor, which operated from 1963 to 1987, was a dual-purpose reactor that produced plutonium for defense purposes and steam for commercial electrical power generation. Groundwater contamination in the 100-NR-2 OU is primarily associated with waste produced by the reactor and associated support processes and is monitored under CERCLA, with annual sampling conducted within 4 weeks at all wells during low river stage (mid-September through mid-November),

semiannual sampling conducted within 4 weeks at selected wells during high river stage (mid-May through mid-July) and low river stage, and quarterly sampling conducted at a small number of wells. Figure A1-3 illustrates how three of the estimated contaminant plume areas have changed since 2003. Changes in the size of the TPH plume are shown in Figure A1-4.

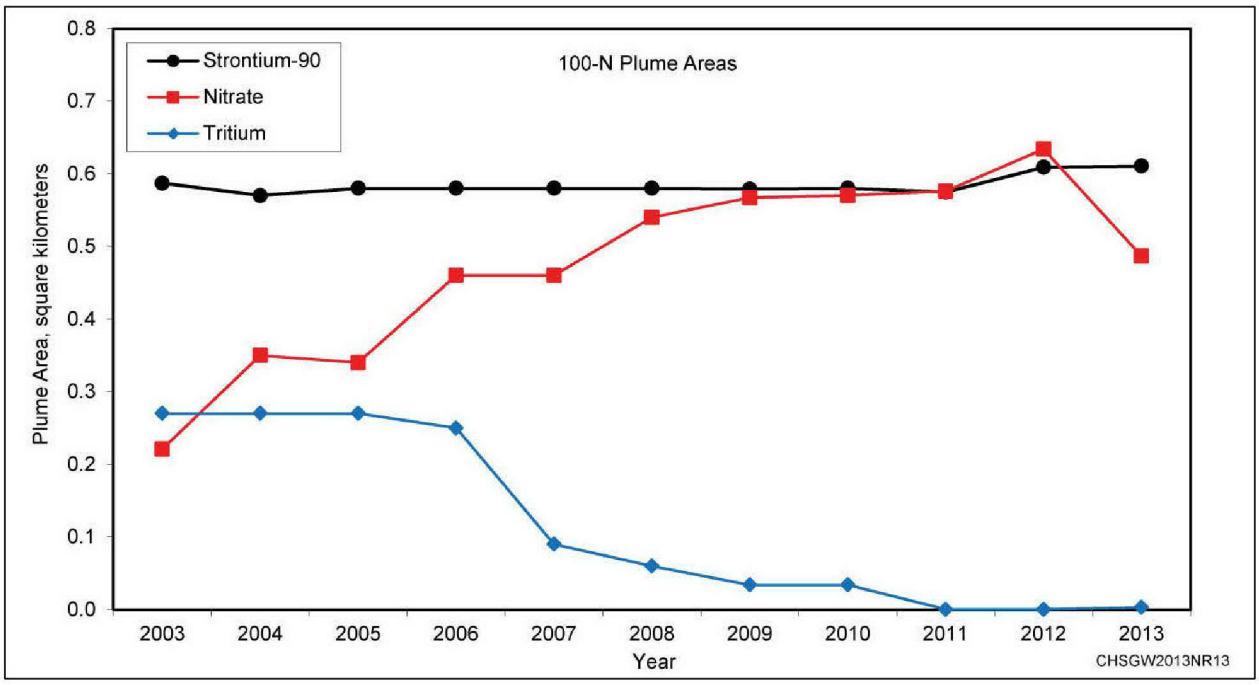


Figure A1-3. 100-NR-2 OU Plume Areas

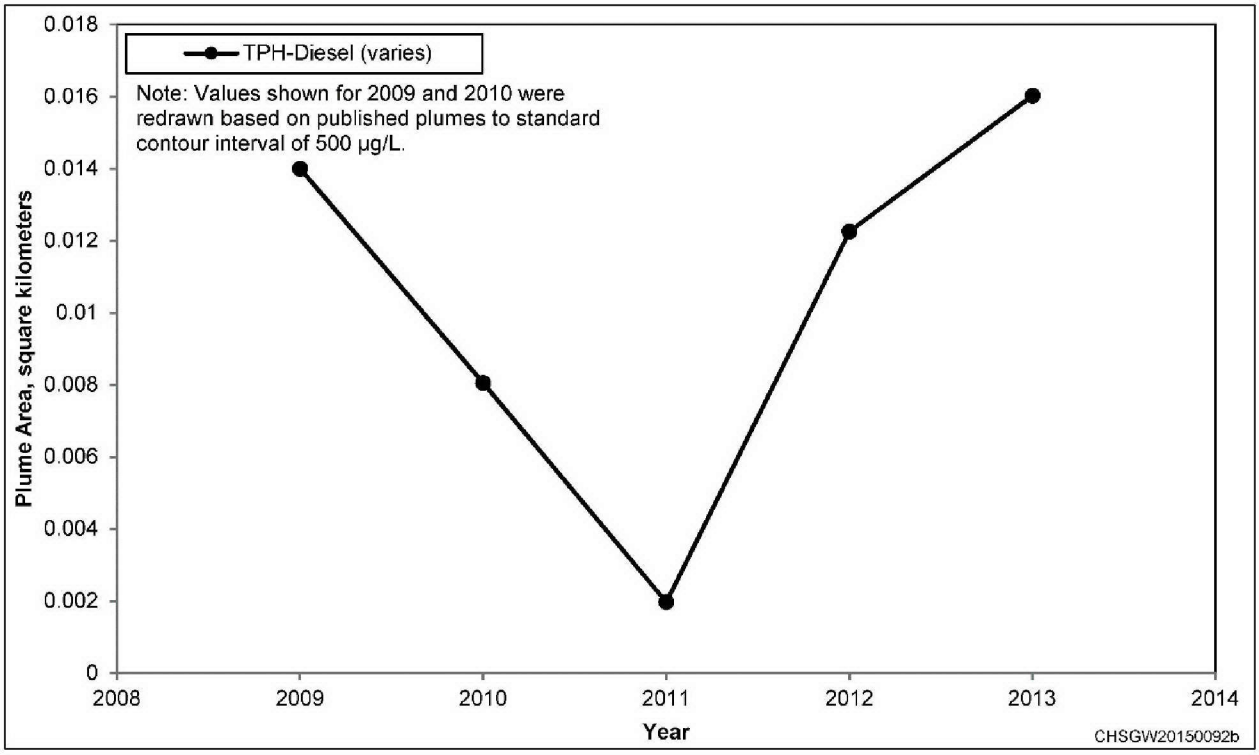


Figure A1-4. TPH Plume Areas

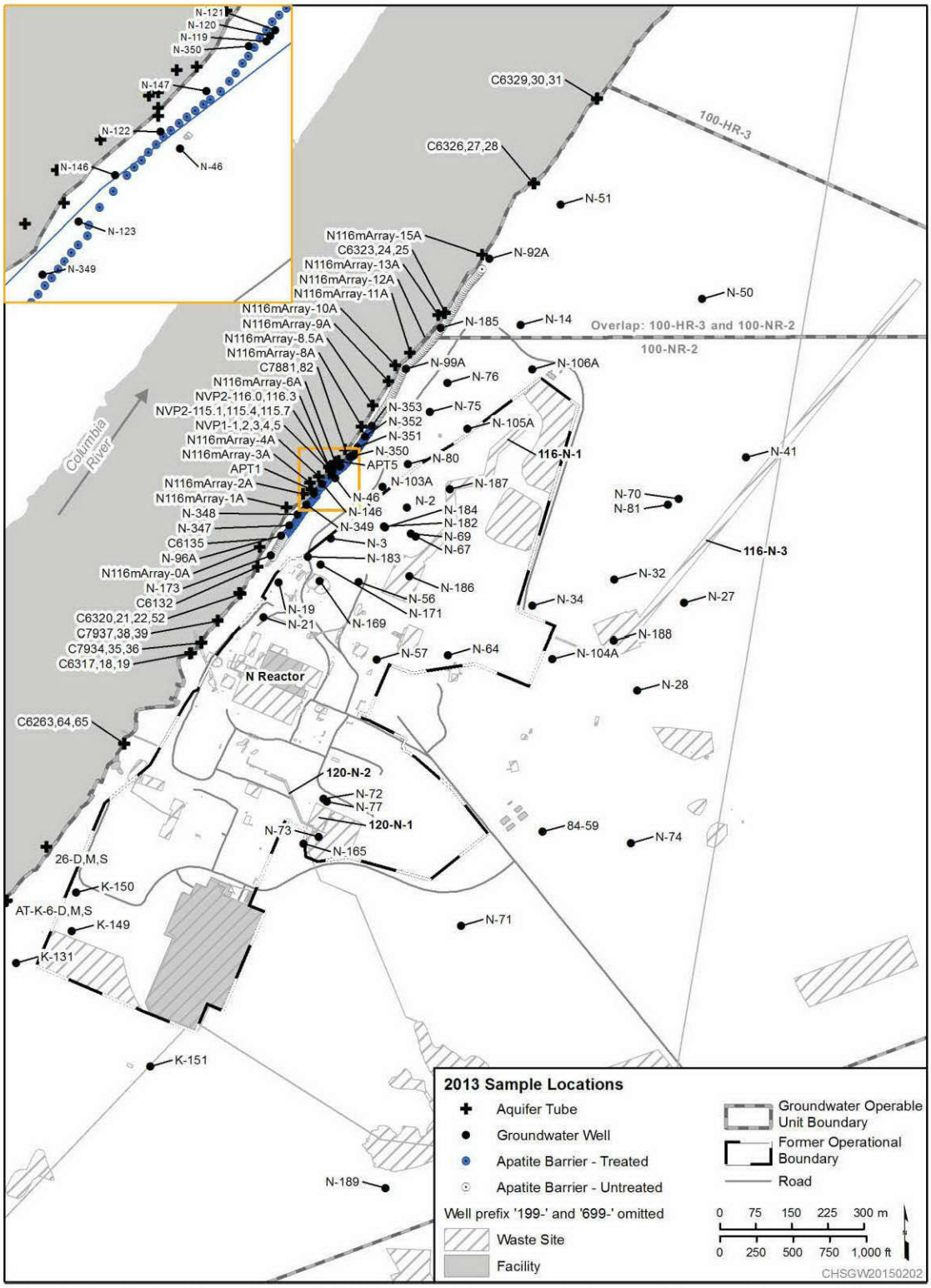
Annual groundwater reports provide updated descriptions of conditions in the 100-NR-2 OU. Figure A1-5 presents the locations and names of most of the groundwater monitoring wells and aquifer tubes for the 100-NR-2 OU. The following subsections present figures of the plume areas and summaries of what is known about the 100-NR-2 OU apatite barrier, groundwater COPC plumes, and the 100-NR-2 OU COPCs under consideration for monitoring.

A1.4.1.1 Apatite Barrier and Sr-90 Plume

The lateral extent of Sr-90 contamination in the unconfined aquifer has not changed appreciably since cessation of effluent discharges to the LWDFs (Figure A1-6). During operations, very high volumes of Sr-90-contaminated effluent were disposed to the 116-N-1 and 116-N-3 waste sites (Figure A1-6). These volumes overwhelmed the existing sedimentary pore structure within the subsurface, rapidly built up the water table, and moved contaminated effluent laterally and vertically away from the sources. This rapid, high-volume intrusion of effluent provided the mechanism that initially carried and spread the Sr-90 away from the source. After cessation of discharges, Sr-90 remains sorbed vertically throughout the entire vadose zone beneath the cribs, and laterally in the former saturated interval within the Ringold Formation and the upper portion of the unconfined aquifer. The main concentrations of Sr-90 currently reside in the upper unconfined aquifer and the PRZ. Based on the depth-discrete data obtained during the RI, in conjunction with the previous data, the residual contaminant remains relatively immobile in the vadose zone and within the sediment of the upper portion of the unconfined aquifer. Sr-90 concentrations are relatively low to undetectable at the base of the unconfined aquifer. The highest Sr-90 concentrations in groundwater remain at the water table and directly beneath the 116-N-1 and 116-N-3 LWDF footprints where most of the Sr-90 was initially sorbed.

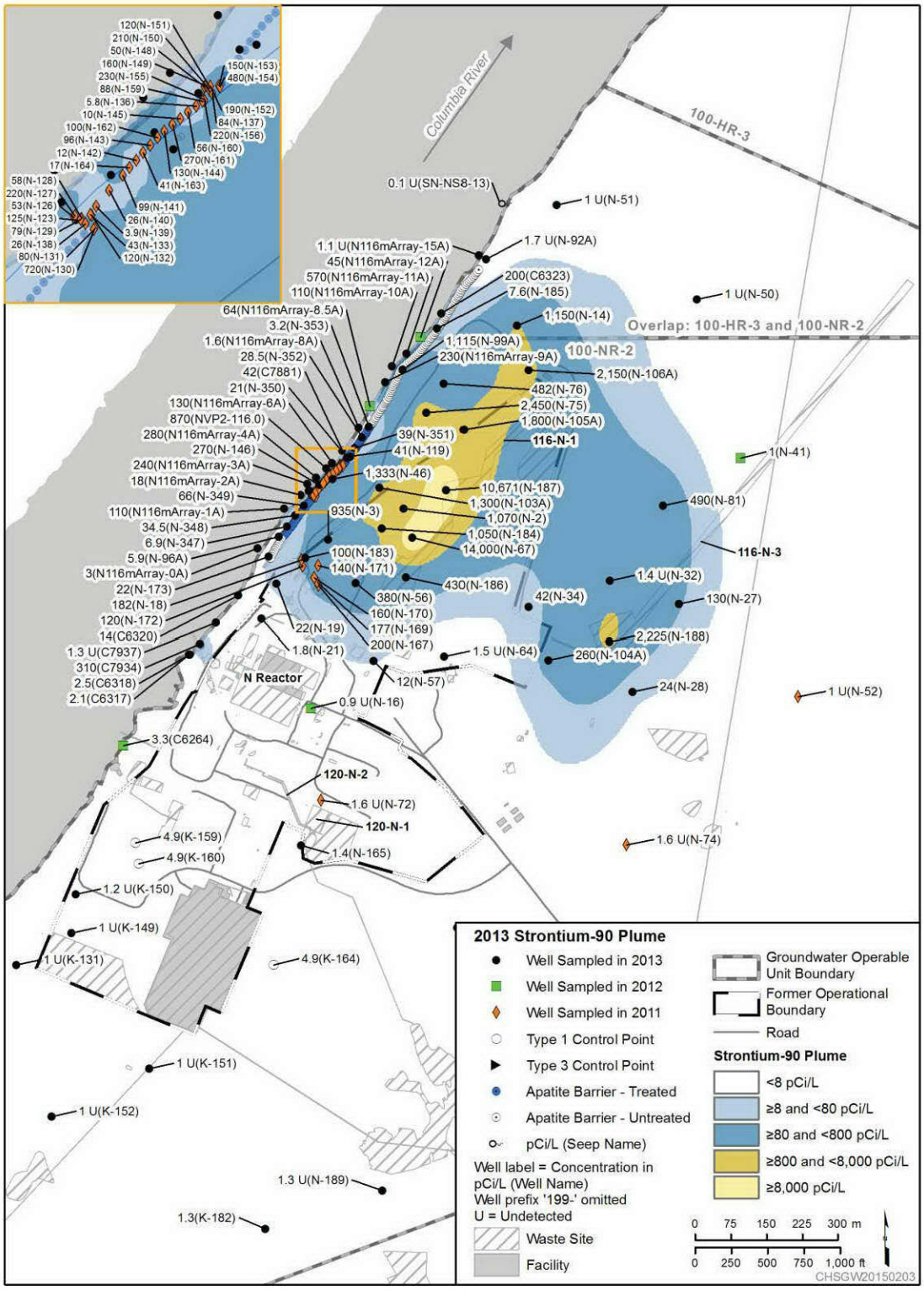
Adjacent to the Columbia River and less than 190 m (624 ft) upriver of the main Sr-90 plume (Figure A1-6), two isolated areas of Sr-90 contamination are present. At the location of the C7934, C7935, C7936 aquifer tube cluster, the highest concentration of Sr-90 detected in 2013 was 310 pCi/L. At the location of the C6320, C6321, C6322 aquifer tube cluster (closer to the main Sr-90 plume), the maximum Sr-90 concentration in 2013 was 14 pCi/L, which is less than two times the DWS (8 pCi/L). The Sr-90 in these two isolated areas is likely due to existing soil contamination that was r-mobilized by the application of water for dust suppression during nearby remedial activities from 2009 to 2013. The C7934, C7935, C7936 aquifer tubes are also located close to the engineered fill around the 1908-N Outfall waste site. The combination of fill material and use of dust-suppression water suggests a likely preferential pathway to the river. The source of this contamination may be multiple leaks from the reactor fuel storage basin. A conceptual illustration of preferential flow along the spillway is shown in Figure A1-7.

An apatite PRB (Figures A1-6 and A1-8) was formed by injecting a calcium-citrate-phosphate solution into the aquifer through a network of vertical wells installed at the river shoreline (i.e., the barrier well network). After the solution is injected, biodegradation of the citrate releases calcium, which results in formation of apatite (a calcium phosphate mineral [$Ca_5(PO_4)_3(F, Cl, OH)$]). Strontium-90 ions in groundwater substitute for calcium ions in the apatite and eventually become trapped as part of the mineral matrix during apatite crystallization. The Sr-90 in groundwater is trapped by the apatite as groundwater flows through the barrier. The sequestered Sr-90 continues to decay within the barrier. The original 91 m (300 ft) long barrier was created from 2006 to 2008 by injecting apatite-forming solutions into 16 wells. This original barrier was extended in September 2011, when two segments of the extended injection well network, one upriver and one downriver of the original barrier, were injected with apatite-forming solution, making the length of the apatite barrier ~274 m (900 ft). Future injection into the remaining wells in the extended injection well network would create a 762 m (2,500 ft) long barrier.



Note: Modified from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*. Not all wells along the river shore are identified at this map scale.

Figure A1-5. Location of Monitoring Wells and Aquifer Tubes



Note: Modified from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*.

Figure A1-6. 100-NR-2 OU 2013 Sr-90 Plume

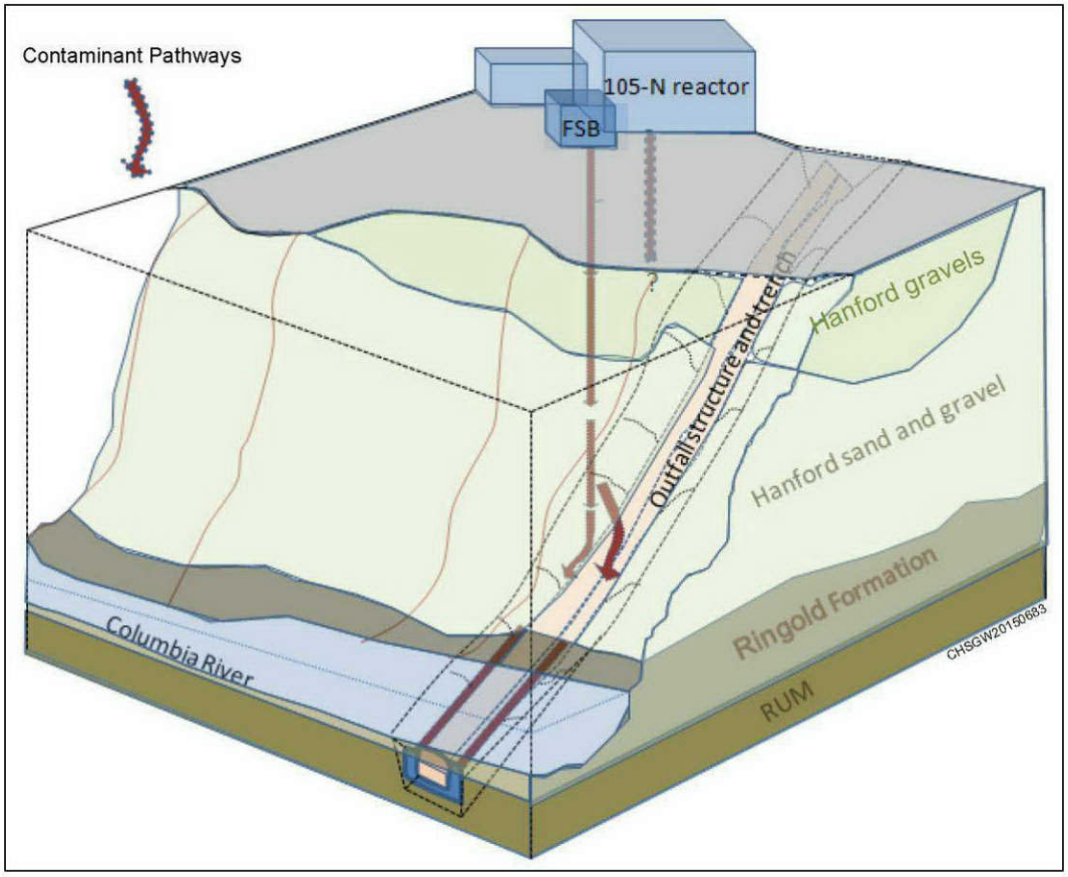


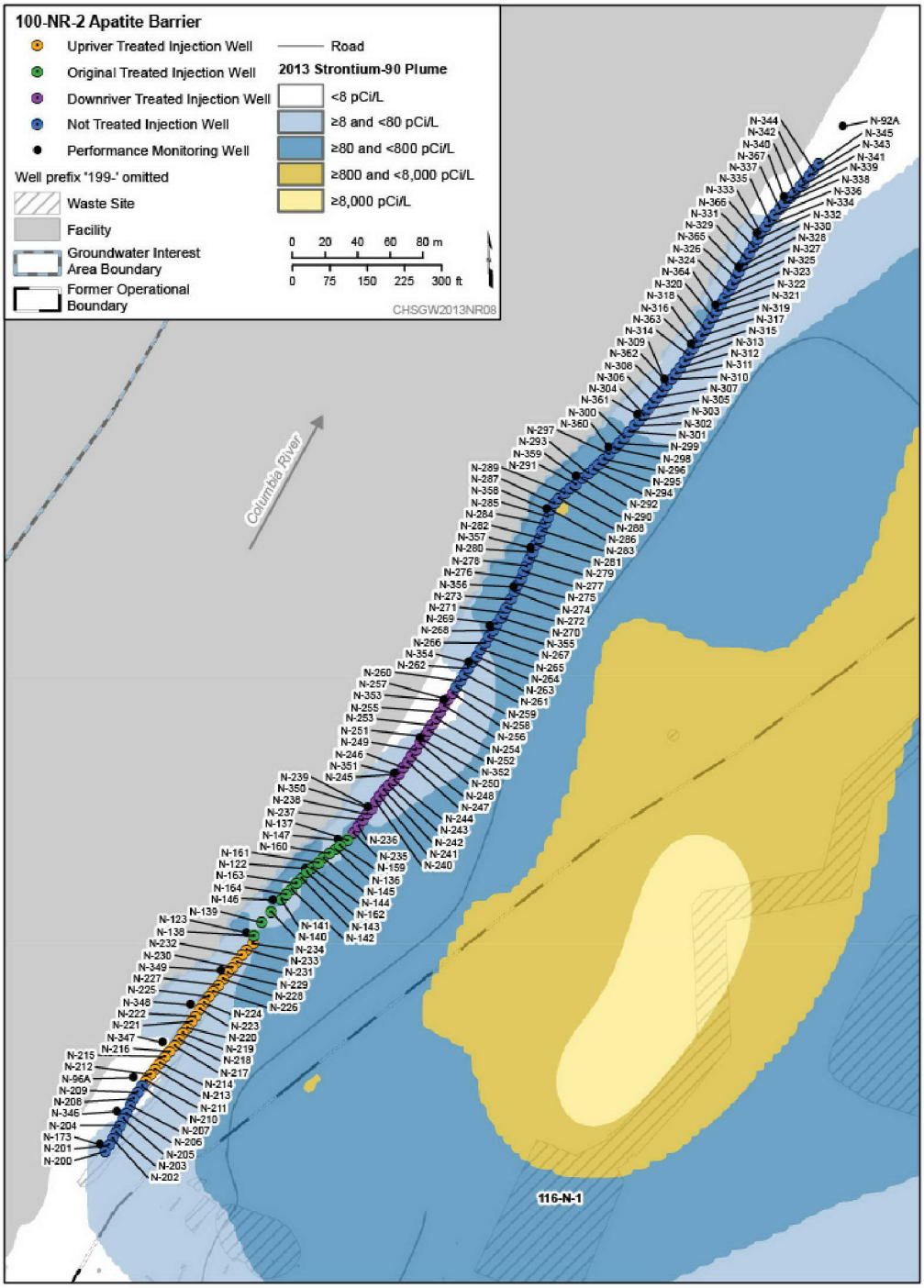
Figure A1-7. Conceptual Model of Preferential Flow Along the 1908-N Outfall Structure

Apatite barrier performance monitoring was conducted twice in 2013. Groundwater samples were collected from performance monitoring wells and aquifer tubes during high (May) and low (September) Columbia River conditions. The following bullets summarize the 2013 performance monitoring results.

- The 2013 data indicate that Sr-90 concentrations have been reduced by ~90 percent in three of the four performance monitoring wells in the original (central) barrier segment. The percent reduction in Sr-90 groundwater concentrations in September 2013 ranged from 73 percent (270 pCi/L in September 2013 compared to pre-injection baseline concentration of 985 pCi/L at Well 199-N-146) to 93 percent (120 pCi/L in November 2013 compared to pre-injection baseline concentration of 1,842 pCi/L at Well 199-N-147).

- Along the upriver barrier extension, the percent reduction in Sr-90 concentrations in September 2013 (the end of the second year following injection) ranged from 17 percent (5.8 pCi/L in September 2013 compared to pre-injection baseline concentration of 7 pCi/L at Well 199-N-347) to 98 percent (41 pCi/L in September 2013 compared to pre-injection baseline concentration of 1,800 pCi/L at Well 199-N-348). The relatively low reduction in Well 199-N-347 reflects the low baseline (pre-injection) Sr-90 concentration for this well (the baseline and the September 2013 concentrations were below the 8 pCi/L DWS).

- Along the downriver barrier extension, the reductions in Sr-90 groundwater concentrations in September 2013 ranged from 87 percent (46 pCi/L in September 2013 compared to pre-injection baseline concentration of 350 pCi/L at Well 199-N-351) to 97 percent (2.8 pCi/L in September 2013 compared to pre-injection baseline concentration of 83 pCi/L at Well 199-N-353).



Note: Modified from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*.

Figure A1-8. 100-NR-2 OU Apatite Barrier

A1.4.1.2 TPH Plume

The primary source of the TPH-diesel groundwater contamination is a 1966 diesel fuel spill (UPR-100-N-17). A small, relatively narrow groundwater plume extends downgradient from the spill location to the river (Figure A1-9). The highest groundwater concentration in 2013 was 9,450 µg/L (Well 199-N-171), which is a substantial decrease from the 2011 and 2010 maximum concentrations (Well 199-N-18) of 48,000 and 420,000 µg/L, respectively, but an increase from the 2012 maximum concentration (Well 199-N-171) of 4,620 µg/L. The overall plume reduction in concentration in 2012 and 2013 is attributed primarily to the bioventing pilot test conducted by Washington Closure Hanford in 2010 and 2011 for remediation of diesel in the deep vadose zone at UPR-100-N-17 (WCH-490, *UPR-100-N-17: Bioventing Pilot Plant Performance Report*).

The petroleum hydrocarbon constituents associated with the 1966 diesel spill exhibit a broad range of characteristics that affect their persistence differently over time. The natural or "weathering" processes influencing petroleum hydrocarbon persistence include volatilization, chemical oxidation, and biodegradation. Direct chemical oxidation is not expected to be an important process at the 100-N Area and is not discussed further. The rate of volatilization and biodegradation is highly dependent on the makeup of the petroleum hydrocarbon released and environmental conditions present near the release. These processes are important in the weathering of volatile petroleum hydrocarbon constituents in the C6 to C12 range. Diesel is composed primarily of hydrocarbons in the C10 to C24 range, so volatilization affects only a small fraction. Volatilization of hydrocarbon decreases with increasing carbon as found in the extended oil range (>C28).

Biodegradation is the most important transformation process. The extent of biodegradation is dependent on many factors including the type of petroleum hydrocarbon released, the microorganisms present, the environmental conditions (temperature, dissolved oxygen concentration, moisture content, and presence/absence of trace nutrients) present in the vicinity of the release, and bioavailability of hydrocarbon contaminants. Evidence indicates that the primary factor controlling the extent of biodegradation is the molecular composition of the hydrocarbon. Furthermore, low dissolved oxygen concentrations can limit the biodegradation of petroleum hydrocarbon. Hydrocarbon constituents in the C6 to C12 range are readily biodegradable if sufficient oxygen and trace nutrients are available. The hydrocarbon in the C12 to C28 range display varying rates of degradation that tend to slow with increasing molecular weight. With the progressive addition of carbon (>C28 oil range) biodegradation may be less effective. Nitrogen, often in the form of nitrate, is consumed directly or as an essential nutrient by various microorganisms to form enzymes needed to degrade petroleum.

The distribution of TPH-diesel in the vadose zone, the rewetted zone, and the groundwater is based on historical knowledge, soil sampling during the bioventing installation, and recent remedial investigation (RI) information (Figure A1-9). The majority of the diesel spill resulted from an underground pipe leak that migrated vertically through the subsurface soil (Hanford formation). Lateral spreading of the diesel as nonaqueous-phase liquid (NAPL) or free product and possibly some dissolved fraction occurred when it encountered either the Ringold Formation or the water table (which was greatly elevated during 100-N Area operations by effluent discharges). Diesel is less dense than water and the NAPL stayed near the surface of the water table, slowly dissolving into the aquifer. The less dense diesel remained near the artificially elevated water table during the 100-N Area operational period and moved along the groundwater flow path toward the Columbia River. As the artificially induced water table subsided following the cessation of 100-N Area operations, some residual NAPL and dissolved petroleum products remained in the previously saturated portion of the Ringold Formation unit E, geochemically bound to and/or physically trapped within sediment grain structures (secondary porosity), and dissolved in the residual sediment pore water.

The residual petroleum within the rewetted vadose interval above the water table will continue to be a source to the groundwater plume during high river stage events, and the groundwater NAPL will continue to introduce contamination into the vadose zone during high water table conditions. The magnitude of the petroleum contribution to the groundwater plume is expected to decrease over time as the PRZ residual source is depleted.

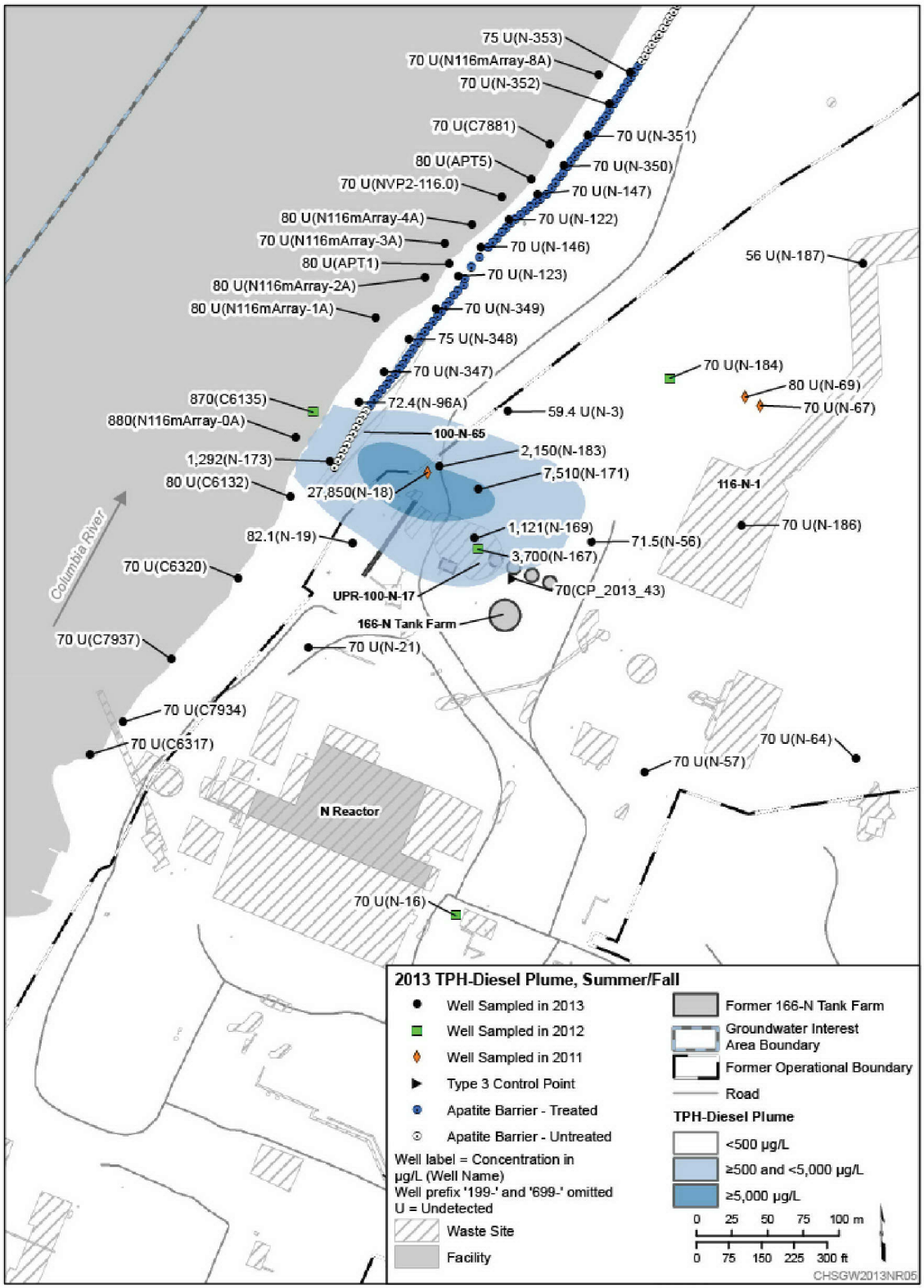
The lateral extent of residual diesel within the PRZ is about the size and extent of the groundwater plume footprint. Plume advection and dispersion toward the river and natural biodegradation of the groundwater plume is expected to continue to shrink the TPH-diesel plume. Continued soil remedial actions (bioventing initiated December 2012) rather than groundwater actions will continue to accelerate the reduction of the plume, benefit cleanup of the PRZ and minimize impacts to the Columbia River.

A1.4.1.3 Nitrate Plume

Nitrate exceeds the DWS of 10 mg/L in groundwater beneath the 116-N-1 and 116-N-3 Trenches and the 105-N Reactor area to the southwest (Figure A1-10). The highest concentration detected in 2013 was 168 mg/L in Well 199-N-186 at the 116-N-1 Crib. The 116-N-1 and 116-N-3 waste sites are implicated as the primary source of nitrate based on the persistent groundwater plume centered beneath them. Nitrate concentrations were relatively low during liquid waste disposal operations at these trenches. The highest concentrations were detected following remediation activities (2000 to 2006), which included excavation, application of dust suppression water and soil fixatives, and backfill. Increases in nitrate concentrations in 2013 may be due to delayed drainage from the deep vadose zone caused by the dust-suppression water applied during waste site remediation.

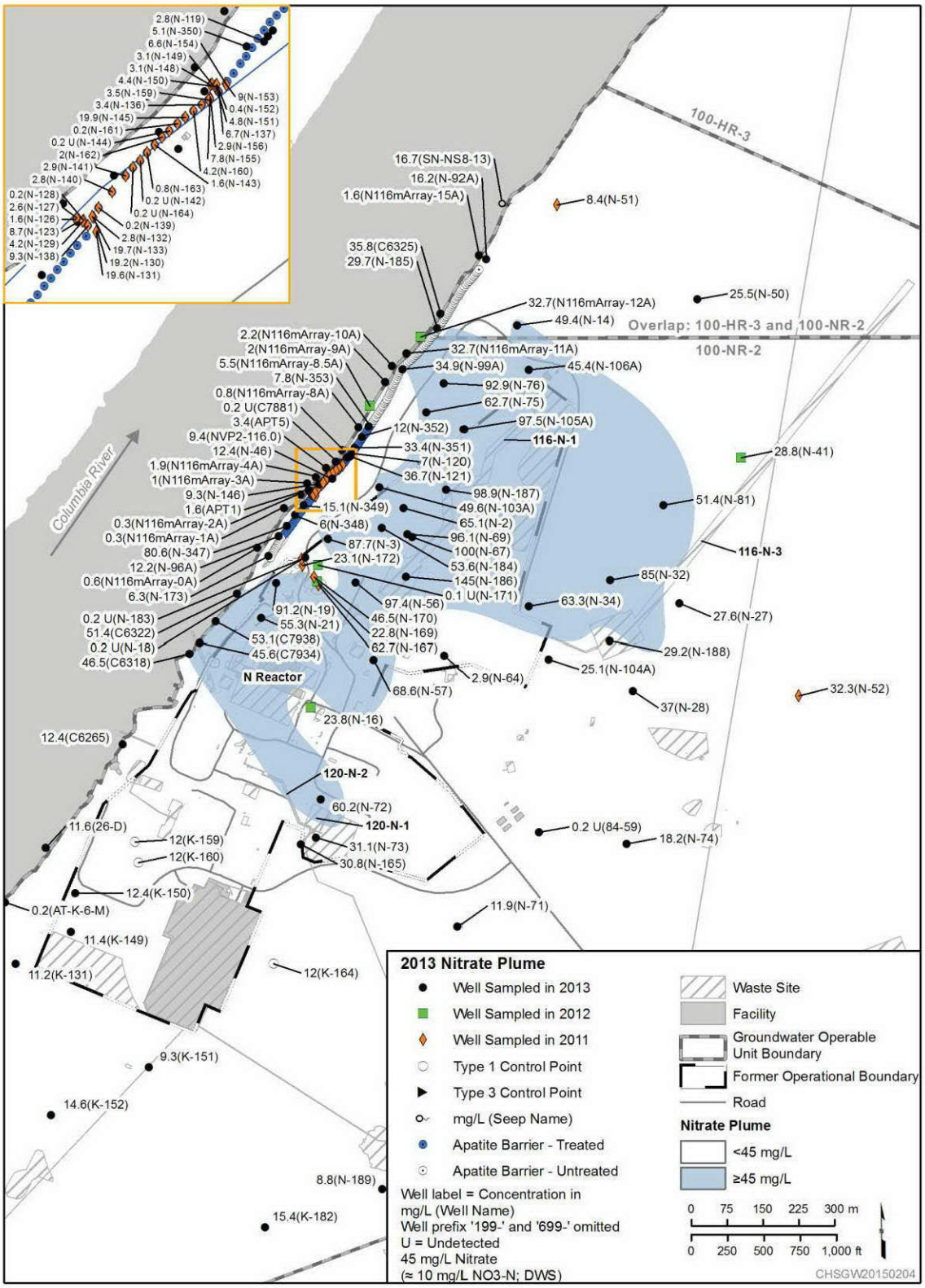
The 105-N Reactor, 10 sanitary septic systems, and 4 waste sites are considered the primary sources of nitrate in the 100-N Area. Septic systems sources are 124-N-1, 124-N-2, 124-N-3, 124-N-4, 124-N-5, 124-N-6, 124-N-7, 124-N-8, 124-N-9, and 124-N-10, even though 124-N-5, 124-N-6, 124-N-7, and 124-N-8 are considered rejected waste sites in the Waste Information Data System database. The primary waste sites sources of nitrate are 100-N-1, 116-N-1, 116-N-3, and 130-N-1. Other facilities and waste sites having a history of using or receiving nitrate include 107-N, 183-N, 183-NB, 100-N-84, 120-N-1, 120-N-2, UPR-100-N-6, and UPR-100-N-31. The chemical source of the nitrate in the 100-N Area includes nitrogen from human waste, ammonium hydroxide, hydrazine, and polyacrylamide (Separan).

Ammonium hydroxide and hydrazine were used in reactor cooling water (WHC-SP-0460, *Chemical Spill Prevention, Control, and Countermeasures Plan – 100 Areas*; UNI-1261, *United Nuclear Industries, Inc. Reactor and Fuels Production Facilities 1978 Effluent Release Report*). Ammonium hydroxide was used for pH control. Hydrazine was used to reduce oxygen concentrations in the cooling water. The ammonium hydroxide was stored near the 109-M Building in a 113,562 L (30,000 gal) storage tank, while dilute hydrazine was stored in a tank inside the 184-N Building (WHC-SP-0460; UNI-1261). Accidental spills of these chemicals were collected in a series of floor drains, sumps, and catch basins, and discharged to the river. However, chemical may have also leaked/spilled to the ground at storage tanks, transfer pumps, and connections along the system. Small quantities of ammonia hydroxide and hydrazine also entered the 116-N-1 and 116-N-3 Cribs as a purity bleed from the primary and shield cooling systems (UNI-1261). Although the quantities of these chemical are described as small in UNI-1261, the two waste sites are considered major nitrate sources.



Note: Modified from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*.

Figure A1-9. 100-NR-2 OU 2013 TPH-Diesel Plume



Note: Modified from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*.

Figure A1-10. 100-NR-2 OU 2013 Nitrate Plume

It is suggested in DOE/RL-2012-15 that the oxidation of the excess ammonium hydroxide in the subsurface over time may provide a continuing source of nitrate to groundwater by nitrification. If 100 percent of the reported ammonium hydroxide were converted to nitrate, more than 17,000 kg (37,600 lb) of nitrate would be generated for each year of operation (DOE/RL-2012-15).

Separan is the remaining chemical that was a source of nitrate in the 100-N Area. Separan was mixed in the 183-N Building, stored in two 3,331 L (880 gal) tanks, and used as a filter aid/coagulant for cooling water and other applications (WHC-SP-0460; UNI-1261). Floor drains in the control room and office areas in the 163-N/183-N Building complex, along with the drains in the pipe gallery area of 183-N (where the Separan tanks are located), all drained to a sump on the north side of the 183-N Building. Water collected in this sump was discharged to the river and is not likely a large source of nitrate. Reactor cooling water containing Separan was also bled off to the 116-N-1 and 116-N-3 Cribs, adding to the source of nitrate in the 100-N Area.

The 163-N/183-N Building complex filter system required occasional backwashing. Effluent for backwashing the gravity filters was supplied from the 183-NB Clearwell. Originally, the filter backwash water was discharged to the river through a circulating raw water return line (HW-69000, *100-N Technical Manual*, p. 2.2-2). From 1977 to 1983, the 183-N filter backwash was discharged into the 120-N-1 Percolation Pond and settling pond system. After 1983, the filter backwash was rerouted to the 130-N-1 Pond.

UNI-1261 states that "most" of the Separan was backwashed to the 163-N/183-N ground disposal ponds (i.e., 120-N-1, 100-N-58, and 130-N-1) southeast of the complex. Sample data from this liquid waste stream indicate that average nitrate concentrations were 0.596 mg/L (DOE/RL-90-22, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-NR-1 Operable Unit, Hanford Site, Richland, Washington*). This low concentration suggests that the effluent from backwash was not a significant source of nitrate. Maximum concentrations (170 mg/kg) of nitrate detected during soil remediation at 120-N-1/120-N-2 suggest that little nitrate was available to impact groundwater at these sites. However, a maximum concentration of 1,420 mg/kg was detected at the 130-N-1 Pond, which indicates a significant source as concentrations greater than 1,000 mg/kg in soil are not considered protective of groundwater.

Nitrate concentrations in groundwater near the 105-N Reactor area to the southwest were also very low during operations, but began to increase in the mid-1990s. Only low levels of nitrate (~1 mg/L) were detected in the 120-N-1 percolation pond effluent. This suggests that the 120-N-1 site was not the source of the nitrate plume in the southwest region of the 100-NR-2 OU. Past releases from upgradient septic systems could have provided the source for this nitrate. The increase in nitrate concentrations in 2013 may be a delayed or ongoing response to dust-suppression water applied during past and ongoing waste site remediation activities southwest of the 105-N Reactor. The source of this nitrate may also be residual ammonium hydroxide in the vadose zone. Also, from 2011 through 2013 the nitrate plume had a more limited extent to the southwest than in previous years due to the treated water entering the aquifer through nearby bordering 100-K Area injection wells.

Nitrate concentrations are generally highest in the upper part of the unconfined aquifer. Wells 199-N-69, 199-N-70, and 199-N-182, screened near the bottom of the unconfined aquifer, consistently have lower concentrations than adjacent wells that are screened near the top of the unconfined aquifer. Nitrate concentrations are low in wells in the area of the TPH-diesel groundwater plume. The lower concentrations are caused by the chemical reduction of nitrate during biodegradation of the TPH-diesel contamination.

A1.4.1.4 Tritium Plumes

Tritium concentrations were elevated in 2013 at aquifer tube cluster C7934/C7935/C7936 (Figure A1-11). The increases are likely due to existing soil contamination that was mobilized by the application of water

for dust suppression during nearby field removal and remedial activities in 2009 and 2013. These aquifer tubes are located close to the engineered fill around the 1908-N Outfall, which suggests that outfall construction created a preferential pathway in the fill for migration of contaminated groundwater to the river (see Figure A1-7). New groundwater monitoring wells will be constructed up-gradient of the aquifer tube cluster to define the extent of tritium contamination.

Tritium concentrations exceeded the DWS (20,000 pCi/L) in Well 199-N-186 in 2013; the maximum value was 41,000 pCi/L. The 116-N-1 Crib was a source of tritium contamination in 100-NR-2 OU groundwater. With the exception of this localized high tritium concentration beneath the 116-N-1 Crib (this is the source identified in the IAROD), tritium results for all other 100-NR-2 OU wells were below the DWS in 2013.

A1.4.1.5 Remaining 100-N Area

In addition to monitoring the apatite barrier and COC plumes described in the previous subsections, the 100-NR-2 OU COPCs will be monitored to track potential changes in their groundwater concentrations that could result in their status being elevated to COCs (should they begin to consistently exceed the DWS in multiple wells) or deleted from the monitoring plan (should they begin to consistently remain below their respective DWS in all wells). The wells and aquifer tubes used to monitor the 100-NR-2 OU apatite barrier and COPC plumes will also be used to monitor associated COCs and COPCs. IAROD, RI/FS, petroleum, and apatite barrier groundwater COCs and COPCs for the various plumes and areas of interest plus their background and action levels (DWS and SWS) are summarized in Table A1-3. Table 4, from DOE/RL-2012-15, Draft A, provides a summary of the 100-NR-2 OU groundwater contaminant evaluation of COCs and COPCs retained and not retained.

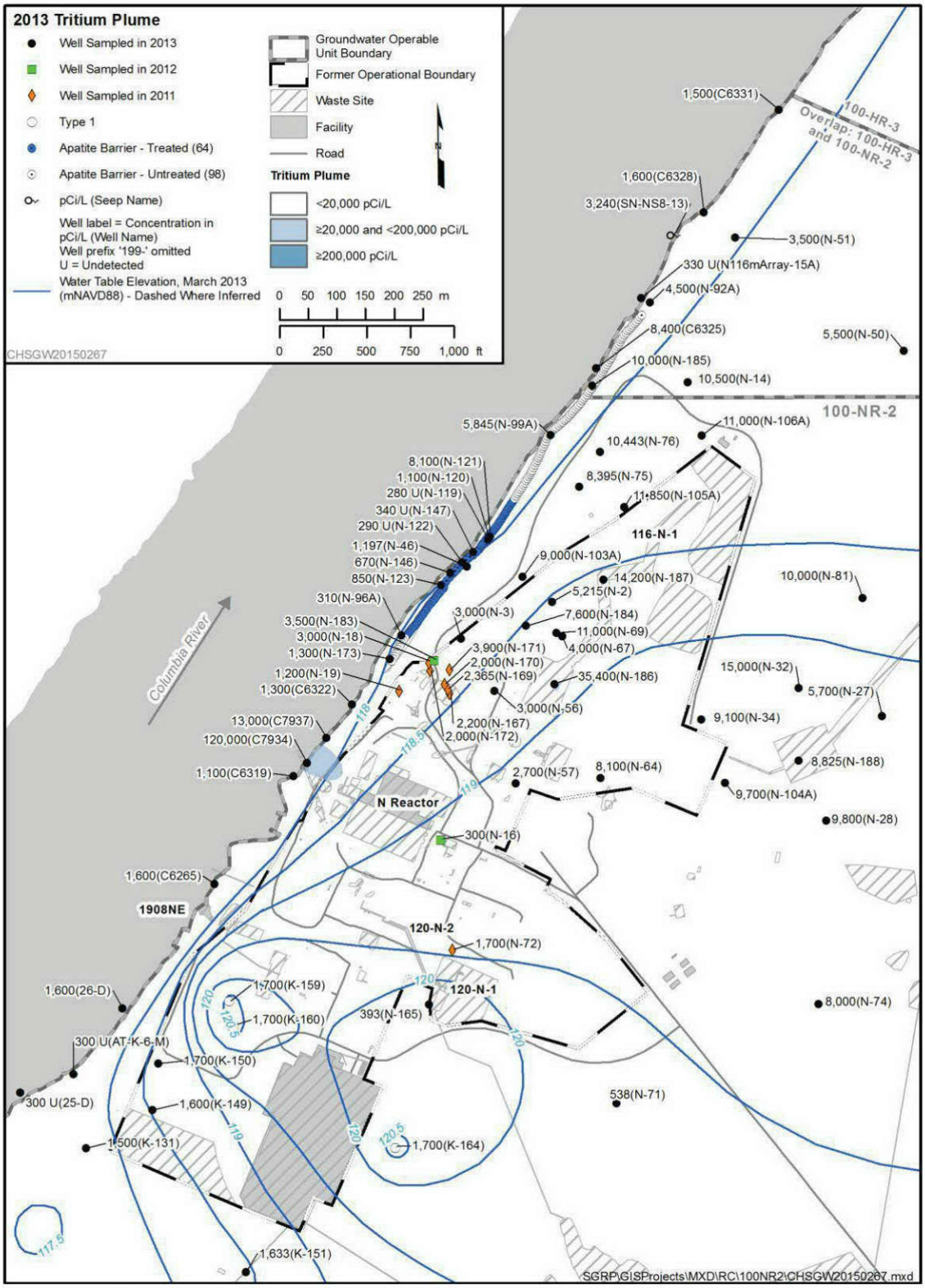
A1.4.2 Information Needs to Support the 100-NR-2 DQO Process

- Current monitoring well structure (adequate for monitoring purposes)
- New or replacement well and aquifer tube needs
- Identification of wells needed to characterize the above areas of interest
- Identification of groundwater field parameters for all wells (besides COC/COPC analytes)
- Performance monitoring criteria for the apatite barrier and TPH treatment
- Automated water level measurements (need to establish location and frequency)

A1.4.3 Sampling and Analysis Methods for Developing the Information

Current methods of sampling monitoring wells and aquifer tubes will be considered per the following documents that govern 100-NR-2 OU CERCLA monitoring well and aquifer tube sampling and analysis:

- DOE/RL-2000-59, *Sampling and Analysis Plan for Aquifer Sampling Tubes*
- DOE/RL-2009-42, *Sampling and Analysis Plan for the 100-NR-1 and 100-NR-2 Operable Units Remedial Investigation/Feasibility Study*
- DOE/RL-2001-27, Rev 1 *Remedial Design Report/Remedial Action Work Plan for the 100-NR-2 Operable Unit*, Appendix A, "100-NR-2 Groundwater Operable Unit Sampling and Analysis Plan for Interim Actions Associated with Saturated and Vadose Injection Projects, Long-Term/Routine Monitoring, Bioremediation, and Barrier Performance Monitoring"
- DOE/RL-2005-93, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, Appendix H, "Phase II Testing/Performance Monitoring Plan for the UPR-100-N-17 Bioremediation"



Note: Modified from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*.

Figure A1-11. 100-NR-2 OU 2013 Tritium Plume

Table A1-3. Summary of 100-NR-2 Long-Term Groundwater COCs, COPCs, Background, and Water Quality Criteria

COCs and COPCs	DOE/RL-96-61 Background Values (µg/L)	Drinking Water Standards (µg/L unless noted otherwise)	Ambient Water Quality Standards (µg/L unless noted otherwise)
Interim Action ROD Analytes			
Sr-90	1.03 pCi/L	8 pCi/L	278 pCi/L[a]
Tritium	119 pCi/L	20,000 pCi/L	No value
Total chromium (filtered)	2.4	100	65
Hexavalent chromium	No value	48	10
Manganese (filtered)	38.5	50 (secondary)	No value
Nitrate	26,871	10,000	10,000
Sulfate	47,014	250,000 (secondary)	No value
Total TPH	No value	500	No value
DOE/RL-2012-15 RI/FS COCs and COPCs			
Sr-90 (COC)	1.03 pCi/L	8.0 pCi/L	278 pCi/L[a]
Ethylbenzene (COC)	No value	700	No value
Nitrate (COC)	26,871	10,000	10,000
TPH-diesel (COC)	No value	500	No value
Tritium (COPC)	119 pCi/L	20,000 pCi/L	No value
Antimony (uncertain COPC)[b]	55.1	6	14
Cadmium (COPC)	0.916	5	0.25
Total chromium (COPC)	2.4	100	65
Hexavalent chromium (COPC)	No value	48	10
Cobalt (uncertain COPC)[b]	0.916	4.8	No value
TPH-gasoline (COPC)	No value	1,000	No value
DOE/RL-2005-93, Bioventing Performance Monitoring			
TPH-diesel	No value	500	No value
TPH-gasoline	No value	1,000	No value
TPH-motor oil	No value	No value	No value
Oil and grease	No value	No value	No value
BTEX	No value	Analyte-specific	Analyte-specific

Table A1-3. Summary of 100-NR-2 Long-Term Groundwater COCs, COPCs, Background, and Water Quality Criteria

COCs and COPCs	DOE/RL-96-61 Background Values (µg/L)	Drinking Water Standards (µg/L unless noted otherwise)	Ambient Water Quality Standards (µg/L unless noted otherwise)
PAH	No value	Analyte-specific	Analyte-specific
Arsenic	7.85	10	0.018
Barium	105	2,000	No value
Cadmium	0.916	5	0.25
Total chromium	2.4	100	65
Iron	570	300	No value
Lead	0.917	15	2.1
Magnesium	24,816	No value	No value
Manganese	38.5	50 (secondary)	No value
Selenium	10.5	50	5
Silver	5.28	100	2.6
Sodium	26,998	No value	No value
Nitrite	No value	1,000	1,000
Nitrate	26,871	10,000	10,000
Phosphate	162	No value	No value
Alkalinity	147,127	No value	No value
DOE/RL-2001-27, Apatite Barrier Performance Monitoring			
Sr-90	1.03 pCi/L	8.0 pCi/L	278 pCi/L[a]
Anions[c]	Analyte-specific	Analyte-specific	Analyte-specific
Chloride	15,630	250,000 (secondary)	No value
Nitrate	26,871	10,000	10,000
Sulfate	47,014	250,000 (secondary)	No value
Alpha (gross)	0	15 pCi/L	No value
Beta (gross)	3.1	4.0 mrem/yr	No value
Cadmium	0.916	5	0.25
Calcium	52,644	500	No value
Total chromium	2.4	100	65

Table A1-3. Summary of 100-NR-2 Long-Term Groundwater COCs, COPCs, Background, and Water Quality Criteria

COCs and COPCs	DOE/RL-96-61 Background Values (µg/L)	Drinking Water Standards (µg/L unless noted otherwise)	Ambient Water Quality Standards (µg/L unless noted otherwise)
Magnesium	24,816	No value	No value
Manganese	38.5	50 (secondary)	No value
Sodium	26,998	No value	No value
TPH-diesel	No value	500	No value

Reference: DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*.

a. Benchmark (not criteria). Based on preliminary remediation goal/exposure point concentration in DOE/RL-2012-15 Draft A, Table 8-5.

b. Analyte laboratory detection limit is less than the drinking water standard

c. Anions include, but are not limited, to chloride, nitrate, and sulfate.

BTEX = benzene, toluene, ethylbenzene, and xylene
COC = contaminant of concern
COPC = contaminant of potential concern
PAH = polycyclic aromatic hydrocarbons
RI/FS = remedial investigation/feasibility study
ROD = record of decision
TPH = total petroleum hydrocarbons

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Table A1-4. Summary of 100-NR-2 Groundwater OU Contaminant Evaluation (from DOE/RL-2012-15, Draft A)

Category	Constituent
Chromium Plume	
Retained as a COPC	
Contaminant of potential concern[a] (contaminants that warrant further evaluation in FS)	Total chromium, Cr(VI)
Retained for Monitoring	
Detected at levels above action level and background	Antimony, cadmium, cobalt
Not Retained as a COPC	
Detected in groundwater but below action level or background concentration	Gross alpha, gross beta, Sr-90, technetium-99, tritium, uranium-233/234, uranium-235, uranium-238, chloroform, toluene, bis (2-ethylhexyl) phthalate, fluoride, nitrate, nitrite, sulfate, aluminum, arsenic, copper, iron, lead, lithium, manganese, nickel, selenium, thallium, uranium, vanadium, zinc, aldrin[b]
Not detected in groundwater	Cobalt-60, plutonium-238, plutonium-239/240, 1,4-dichlorobenzene, benzene, carbon tetrachloride, ethylbenzene, methylene chloride, styrene, tetrachloroethene, trichloroethene, vinyl chloride, xylenes (total), dibenzofuran, n-nitrosodiethylamine, n-nitrosodimethylamine, pentachlorophenol, cyanide, mercury, TPH-diesel, TPH-gasoline, 4,4′-DDD, 4,4′-DDT, alpha-BHC, chlordane, dieldrin, endrin, heptachlor, heptachlor epoxide, methoxychlor

Table A1-4. Summary of 100-NR-2 Groundwater OU Contaminant Evaluation (from DOE/RL-2012-15, Draft A)

Category	Constituent
Diesel Plume	
Retained as a COPC	
Contaminant of potential concern[a] (contaminants that warrant further evaluation in feasibility study)	Strontium-90, nitrate, TPH-diesel, and TPH-gasoline
Retained for Monitoring	
Detected at levels above action level and background	Antimony, cadmium, chromium (total), cobalt, ethylbenzene
Not Retained as a COPC	
Detected above action level, but is the result of reducing conditions caused by the anaerobic decomposition of TPH	Iron, manganese, nickel
Detected above the action level only at Well 199-N-18	Aluminum, arsenic, benzene, carbon tetrachloride, copper, dieldrin, endosulfan II, endrin, Cr(VI), lead, mercury, selenium, sulfate, thallium, zinc
Detected in groundwater but below action level, estimated quantitation limit, or background concentrations	Gross alpha, gross beta, tritium, uranium-233/234, uranium-235, uranium-238, chloroform, styrene, tetrachloroethene, toluene, xylenes (total), bis (2-ethylhexyl) phthalate, dibenzofuran, fluoride, nitrite, lithium, uranium, vanadium, aldrin[b]
Not detected in groundwater	Cobalt-60, plutonium-238, plutonium-239/240, technetium-99, 1,4-dichlorobenzene, methylene chloride, trichloroethene, vinyl chloride, n-nitrosodiethylamine, n-nitrosodimethylamine, pentachlorophenol, cyanide, 4,4′-DDD, 4,4′-DDT, alpha-BHC, chlordane, heptachlor, heptachlor epoxide, methoxychlor
100-N Area	
Retained as a COPC	
Contaminant of potential concern[a] (contaminants that warrant further evaluation in feasibility study)	Strontium-90, tritium, trichloroethene[c], nitrate
Retained for Monitoring	
Detected at levels above action level and background	Antimony, cadmium, cobalt
Not Retained as a COPC	
Detected in groundwater but below action level, estimated quantitation limit, or background concentrations	Cobalt-60, gross alpha[b], gross beta[d], plutonium-239/240, technetium-99, uranium-233/234, uranium-235, uranium-238, 1,2-dichloroethane[b], chloroform, ethylbenzene, methylene chloride, styrene, tetrachloroethene, toluene, xylenes (total), bis(2-ethylhexyl) phthalate, fluoride, nitrite, sulfate[e], aluminum, arsenic[f], chromium (total)[g], Cr(VI)[b], copper[b], iron, lead[b], lithium[b], manganese[b], nickel[b], selenium, thallium[g], uranium, vanadium, zinc[b], TPH-gasoline, aldrin[b]

Table A1-4. Summary of 100-NR-2 Groundwater OU Contaminant Evaluation (from DOE/RL-2012-15, Draft A)

Category	Constituent
Not detected in groundwater	Plutonium-238, 1,4-dichlorobenzene, benzene, carbon tetrachloride, vinyl chloride, n-nitrosodiethylamine, n-nitrosodimethylamine, pentachlorophenol, cyanide, mercury, TPH-diesel, 4,4′-DDD, 4,4′-DDT, alpha-BHC, chlordane, dieldrin, endrin, heptachlor, heptachlor epoxide, methoxychlor

a. Based on evaluation of data collected from January 2006 through December 2011.

b. Concentrations above action level are due to laboratory contamination or are single nonrecurring detections.

c. Trichloroethene was reported at concentrations above the drinking water standard at well 699-77-54. Well 699-77-54 is located within the boundaries of the 100-IU-2/IU-6 Source Operable Unit; as such, this well is addressed in the remedial actions for DOE/RL-2010-98, *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*.

d. Gross beta is an indicator parameter that is consistent with the presence of Sr-90.

e. Infrequent detections above secondary drinking water standard.

f. Arsenic concentrations slightly above background.

g. Concentrations above action level are measured at Well 199-N-80, which is screened in a localized confined interval within the RUM unit.

COPC = contaminant of potential concern
RUM = Ringold upper mud (unit)
TPH = total petroleum hydrocarbons

A1.5 Step 4: Define the Boundaries of the Study

Summary: Define the specific spatial and temporal boundaries that are included in the decision.

A1.5.1 Spatial Boundaries

The monitoring program physical boundaries constrain the data collection in three dimensions. The areal limits include the 100-NR-2 OU (whose plume boundaries have generally been established with regard to DWS/AWQC) shown in Figures A1-4 through A1-6 and A1-8 through A1-11. The working hypothesis is that groundwater contaminant migration follows groundwater flow paths toward discharge boundaries. The study domain is shown in Figure A1-1 and includes groundwater that discharges to the Columbia River in areas where aquifer tubes are currently installed. The spatial boundary is also consistent with the exposure area in DOE/RL-93-81, *Limited Field Investigation Report for the 100-NR-2 Operable Unit, Hanford Site, Richland, Washington*, and DOE/RL-2012-15.

There are two distinct vertical aquifer boundaries. The uppermost unit is the unconfined aquifer, which extends from the water table to the surface of the RUM. The second unit, which is locally semiconfined, is a thin water bearing unit located near the top of RUM. The RUM lower confining interval extends to the top of the Ringold Formation lower mud unit. The 100-NR-2 OU monitoring plan is designed to gather data that will be used to continue evaluating contaminants within both the unconfined aquifer and the first water bearing unit of the RUM. Only one groundwater well (199-N-80) will be used to monitor the RUM unit as defined in this report.

Groundwater from the 100-NR-2 Groundwater OU discharges to the Columbia River. The interface of the groundwater and surface water (i.e., Columbia River) represents a boundary of the study area based on regulatory levels for groundwater discharge to surface water. The inland boundaries are defined by the

plumes originating in the 100-NR-2 OU. Upgradient source plumes (i.e., 100-KR-4 hexavalent chromium plumes) will be monitored by the 100-KR-4 project to track their movement within the 100-NR-2 OU.

The wells and aquifer tubes that will be considered for 100-NR-2 OU groundwater monitoring are listed in Table A1-16 (located at the end of this insert). The locations, screening depths, construction, or other factors may render some of these wells insufficient for 100-NR-2 OU long-term groundwater monitoring purposes.

Monitoring decisions will be made on a well-by-well basis and consider the extent of plumes where COC concentrations are greater than the DWSs identified in Table A1-3. Table A1-3 also includes COPCs identified in the RI/FS and other analytes of interest for the apatite barrier and bioventing performance monitoring.

A1.5.2 Temporal Boundaries

Temporal boundaries are related to physical characteristics and behaviors of the contaminants being monitored and the aquifer flow system (i.e., they are defined by the timing, frequency, and duration of measurements and observations). Timing is driven by river stage seasonal variation and the associated changes in groundwater flow direction and flow velocity. Frequency is the number of times per year a sample is collected from a monitoring location. Historical trends should be evaluated to identify changes in conditions that are related to seasonal changes in order to provide an understanding of how any particular measurement may be affected. The data generally show that the river stage begins to climb in April, while May through July it has historically remained above the annual mean river stage. Time-series plots of concentrations, groundwater elevations, and river stage are available for identifying relationships, with the purpose of developing measurement schedules to satisfy data needs. The Columbia River functions as a discharge boundary for the shallow unconfined aquifer beneath the 100-NR-2 OU with the following characteristics:

- During low river stage (mid-September through mid-November timeframe), groundwater flows toward the river and discharges into the river along the shore and riverbed.
- During periods of rising and high river stage (approximately mid-May through mid-July timeframe), the magnitude of the groundwater gradient is reduced and in portions of the shallow aquifer near the river, the gradient may reverse and river water may enter the unconfined aquifer.
  - As the river stage remains elevated, groundwater from upgradient inland regions continues to flow toward the river, backs up against the boundary head from the elevated river stage, and eventually causes groundwater elevations inland of the river shore to rise.
  - As the river stage declines, groundwater again flows toward the river, typically under a higher gradient.
  - Because of the time lag and attenuation that occurs between high river stage and maximum inland groundwater elevation, high river stage does not directly coincide with high groundwater elevation.

  Based on the above temporal information, groundwater monitoring for mobile plume migration tracking, radioactive decay, CSM verification, groundwater contaminant status (i.e., COC or COPC), and other general parameters should be conducted on a contaminant-by-contaminant basis. If it is to be conducted on an annual basis, it should be done based on geographic location with appropriate Columbia River stage.

- Monitoring for treatment performance (apatite barrier and bioventing) should be conducted twice per year:
  - Once during the low Columbia River stage period
  - Once during the high Columbia River stage period

  When practical, each sampling event should not exceed 4 weeks.
- Water levels should be incorporated into an AWLN for hourly measurements. Manual measurements will also be taken during routine sampling to verify the AWLN system. Water level data will be used to improve interpretations and models of groundwater flow in the 100-NR-2 OU.

A1.5.3 Practical Limitations and Constraints Regarding 100-NR-2 OU Monitoring

- DOE budget priorities and available funding, the number and type of new wells to be installed, sampling frequency, and the extent of testing to be conducted at new and existing wells
- Analytical detection limits
- Cultural and ecological constraints on new well locations, plus timing of installation
- Seasonal variability of river stage and water table could affect the quality and consistency of groundwater and aquifer tube samples among different sampling dates
- River stage conditions and temperatures (i.e., freezing conditions/snow/extreme heat) which could preclude access for aquifer tube and PRB sampling in the desired timeframe

A1.6 Step 5: Develop the Analytic Approach

Summary: Integrate the outputs from the previous steps into statements that describe the logical basis to select among the alternative actions. This includes specifying the population parameter (e.g., mean, percentile), determining the action level, and constructing the decision rule. A decision rule is determined for each PSQ. Keep in mind that at this point we pretend we will have perfect information with which to make our decisions.

A1.6.1 100-NR-2 Parameters of Interest

- Concentrations/trends for COCs and COPCs (expressed by statistical parameters [e.g., 95 percent upper confidence limit])
- Plume areas or masses for each COC (temporal changes [e.g., annual])
- Comparison of empirical observations to 100-NR-2 RI/FS modeled conditions

A1.6.2 Decision Rules (If/Then Statements)

	Principal Study Questions (from Step 2)	Decision Rules
1	Is the Sr-90 permeable reactive (apatite) barrier performing as intended?	If the weight of evidence from the apatite barrier monitoring wells and aquifer tubes indicates that Sr-90 levels have not declined downgradient from the barrier within 5 years of initial installation, then evaluate the need for apatite reinjection or alternative remedies; otherwise, continue barrier maintenance and monitoring.

	Principal Study Questions (from Step 2)	Decision Rules
2	Are TPH remedies contributing to groundwater quality improvement?	If the weight of evidence from the TPH treatment and monitoring wells and aquifer tubes (i.e., bioventing and/or TPH removal [Well 199-N-18]) indicates that TPH components (e.g., diesel, ethylbenzene, gasoline) are not declining toward drinking water standard, then reevaluate the appropriateness of continued groundwater monitoring ; otherwise, continue treatment and monitoring as a vadose zone remedy.
3	Is there evidence of IAROD COC plume, concentration, area, or location changes?	If monitoring well results indicate unexpected changes in IAROD COC plume concentrations (e.g., higher or lower), sizes (e.g., larger or smaller), or locations (e.g., evidence of migration), then reevaluate the COC monitoring plan (e.g., well addition/removal for plume tracking); otherwise, continue monitoring.
4	Are there continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?	If monitoring well results indicate COC/COPC concentrations are increasing in an unexpected manner, then continuing sources of contamination may be indicated and an evaluation is needed to further characterize and evaluate the CSM to determine whether additional remedies are required; otherwise, maintain their COC/COPC status and evaluate the need to continue monitoring.
5	Is there evidence that Columbia River water quality is being protected?	If near-river well and aquifer tube data for COCs are above action levels, then evaluate their potential effects and consider the need for remediation; otherwise, continue monitoring.
6	How do adjacent OUs influence 100-NR-2 OU remedies?	If 100-KR-4 OU originated and monitored hexavalent chromium groundwater/AWQS exceedances overlap with 100-NR-2 OU plumes, then evaluate their potential impact on 100-NR-2 OU remedies and coordinate the need for additional 100-KR-4 OU hexavalent chromium remediation; otherwise, advise 100-KR-4 continued tracking of 100-KR-4 hexavalent chromium areas across the 100-NR-2 OU.
7	Is there additional information needed for a final ROD?	If emerging groundwater monitoring data (e.g., TPH fraction identification, COPC or COC status changes) could influence future 100-NR-2 decision and/or implementation documents, then use the emerging information in formulating final 100-NR-2 OU remedy decisions; otherwise, evaluate monitoring.

AWQS	=	ambient water quality standard	IAROD	=	interim action record of decision
CSM	=	conceptual site model	OU	=	operable unit
COC	=	contaminant of concern	ROD	=	record of decision
COPC	=	contaminant of potential concern	TPH	=	total petroleum hydrocarbons

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A1.7 Step 6: Specify Performance or Acceptance Criteria

Summary: Define how much uncertainty can be tolerated when making the decision of interest and establish appropriate performance goals for limiting uncertainty in the data. The guidance document says this is where you "face the reality that you will not have perfect information from which to formulate your conclusions." Discuss severity of consequences of making wrong decisions.

Resolving the PSQs is dependent on evaluating historical and current analytical data plus field measurements. These data will be used for scientific calculations and (in some cases) statistical analyses. The limits on analytical data are specified within the analytical method quality assurance/quality control criteria, as identified in the quality assurance project plan in a SAP.

Traditional statistical sampling designs were not identified for 100-NR-2 groundwater monitoring. Thus, tables defining the null hypothesis, alpha and beta error, and width of the gray region have been excluded from this DQO process. However, statistical evaluations of the data collected to address PSQs 1, 2, 3, 4, 5, 6, and 7 may be used to support decisions associated with them (see Step 1 PSQs and subquestions). Although statistical sampling designs are not proposed, statistical evaluations of the data collected for these PSQs will be required to support future decisions associated with them (e.g., remedial action objective achievement or treatment performance).

The data collected will be used to support future decisions regarding apatite barrier performance, TPH treatment performance, groundwater quality criteria compliance (e.g., DWS and/or AWQC), groundwater CSM verification, groundwater contaminant status (e.g., COC or COPC), plume migration tracking, and Columbia River protection. The consequences of inadequate sampling design may affect the time it takes to achieve cleanup approval or affect the ability to convincingly demonstrate remedial action goal achievement. All of the monitoring wells are expected to be accessible for resampling, but resampling times will differ and may introduce data set variability. Table A1-5 summarizes potential data variability, uncertainty, and errors that could affect PSQ decisions and actions that could mitigate their effects.

Table A1-5. Data Variability, Uncertainty, or Error and Mitigating Measures

Source of Variability, Uncertainty, or Error	Mitigating Measures
Concentration variability causing inaccurate attenuation rate estimates (e.g., variability due to seasonal or longer term changes in water table)	Maintain consistent timing, frequency and sample event duration for sampling to increase comparability; more frequent monitoring in wells with variable concentrations.
Uncertainty in estimates of plume size (interpolation, extrapolation)	Robust monitoring network, including new monitoring wells to reduce uncertainty in plume interpretations. Use geostatistical methods to evaluate plume size.
New or unknown sources of contamination	Monitor near former source areas with greater density of wells objectively and consistently over time.
Analytical (laboratory) errors	Robust quality assurance/quality control program to minimize analytical uncertainties.

A1.8 Step 7: Develop the Plan for Obtaining Data

Summary: Using results from the previous six steps identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs.

A1.8.1 Inputs to Step 7

- All information and outputs generated in Steps 1 through 6.

A1.8.2 Outputs of Step 7

- Identify alternative sampling and analysis designs appropriate for the intended use
- Select and document a design that will best achieve the performance or acceptance criteria
  - Detail how the design should be implemented together with contingency plans for unexpected events
  - Consider quality assurance/quality control procedures that would be performed to detect and correct problems and so ensure defensible results (these would be documented in the 100-NR-2 OU SAP)
- Full documentation of the final sampling and analysis design, along with a discussion of the key assumptions underlying this design

A1.8.3 Monitoring Networks for 100-NR-2 OU Contaminants of Concern

The groundwater monitoring networks recommended for plume tracking and treatment performance monitoring, including network-specific assumptions and general monitoring well inclusion/exclusion criteria, follow.

A1.8.3.1 General Criteria for Monitoring Well Retention

- Define groundwater contaminant plumes and plume concentration variations over time.
- Monitor the apparent natural migration pathway of contaminant plumes.
- Monitor the 100-KR-4 OU to understand temporal aquifer effects and trends (groundwater head and direction changes) due to ongoing 100-KR-4 OU P&T systems. Coordinate evaluation of data with the 100-KR-4 OU.
- Define piezometric surface. Water level measurements will be performed in the wells identified in Table A1-6. Data will be collected from the AWLN wells throughout the year (typically hourly). Manual water level measurements will be performed in other wells in March of each year. Manual measurements will also be performed during each sampling event. The March 2013 water table map from DOE/RL-2014-32 is shown in Figure A1-1. A second March 2013 water table map based on the AWLN data is overlain over the 2013 water table map from DOE/RL-2014-32 in Figure A1-12.
- Monitor potential exposure locations (i.e., contaminated groundwater discharge to surface water near the PRB and associated aquifer tubes and wells within 100 m [328 ft] of the river shore).

Table A1-6. 100-NR-2 Water Level Monitoring Wells

199-N-2*	199-N-92A*
199-N-3*	199-N-96A
199-N-14*	199-N-99A*
199-N-18	199-N-105A
199-N-19	199-N-119
199-N-27	199-N-189
199-N-28	699-81-58
199-N-32	699-87-55
199-N-34*	199-K-129
199-N-41	199-K-130
199-N-50*	199-K-131
199-N-51	199-N-146*
199-N-52	199-N-147*
199-N-56	199-K-148
199-N-57	199-K-151
199-N-62	199-K-152
199-N-67	199-K-153
199-N-71*	199-K-159
199-N-72*	199-K-160
199-N-73	199-K-164
199-N-76*	199-K-182
199-N-81	

* Wells in the automated water level network.

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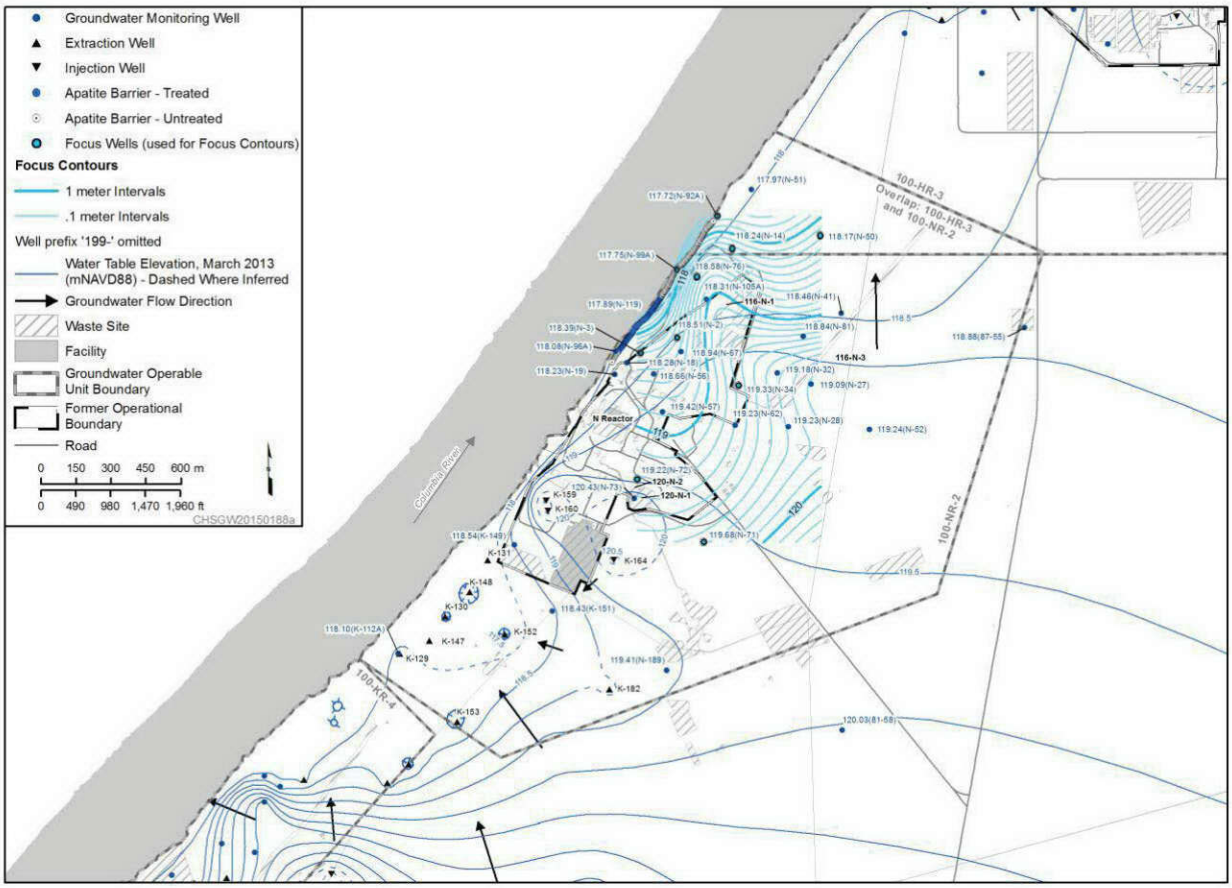

Figure A1-12. 100-NR-2 Automated Water Level Network

A1.8.3.2 General Criteria for Long-Term Monitoring Well Exclusion

- Locations that are redundant (i.e., within 100 m [328 ft] of another monitoring location [large plume area focus]) and do not provide supplemental or definitive input to a data need.
- Do not provide representative measurements (e.g., wells with poor seals or wells with undefined open intervals, nonconventional well constructions).
- Wells not necessary to define boundary conditions.

A1.8.3.3 Network-Specific Assumptions and Performance Monitoring/Plume Tracking Recommendations

A1.8.3.3.1 Apatite Barrier Performance

Note: Requirements for apatite barrier performance monitoring are provided in DOE/RL-2001-27, Rev. 1 (Appendix A, "100-NR-2 Groundwater Operable Unit Sampling and Analysis Plan for Interim Action Associated with Saturated and Vadose Injection Project, Long-Term/Routine Monitoring, and Barrier Performance Monitoring"). Appendix A will be updated to include changes to the following:

- Groundwater monitoring requirements identified in DOE/RL-2005-93, Appendix A
- Long-term groundwater monitoring requirements for Sr-90, nitrate, TPH, tritium, and hexavalent chromium

Requirements for the apatite barrier performance monitoring remain unchanged.

Apatite barrier performance monitoring in DOE/RL-2001-27 includes vadose zone (PRB sediment cores) and groundwater sampling and sample analysis. The objective of groundwater performance monitoring is to determine if the PRB is effective in reducing concentrations of Sr-90 in groundwater. This is determined by comparing Sr-90 or gross-beta concentrations from downgradient performance monitoring wells to baseline (pre-injection) values for those wells.

- The monitoring network includes 29 monitoring wells downgradient of the PRB (both existing and PRB and planned expansion to 762 m [2,500 ft]), 22 injection wells within the apatite barrier, and 18 aquifer tubes along the shoreline downgradient of the PRB. The 22 apatite barrier injection wells selected for sampling include adjacent shallow and deep screened injection wells with higher Sr-90 concentrations (either from baseline sampling or samples collected during drilling) spaced out along the length (762 m [2,500 ft]) of the PRB. Monitoring wells are listed in Table A1-7 and shown in Figure A1-13.
- The principal COC is Sr-90. Other constituents of interest includes metals, anions, TPH, and radiological indicators (e.g., gross alpha).
- TPH is also analyzed at locations downgradient of the former TPH burn trench to monitor for any migration of the TPH plume resulting from apatite injections.
- Ongoing monitoring will determine the continued effectiveness of the apatite treatment along the expanded barrier. Based on previous monitoring data, the PRB is expected to achieve a 90 percent reduction from baseline in Sr-90 concentrations in the monitoring wells.
- If Sr-90 concentration target reduction is observed in treated injection wells, then monitoring will continue and the need for additional injection will be reevaluated annually for the first 5 years and every 5 years for the next 25 years.
- Aquifer tubes will be sampled during high river stage (mid-May through mid-July) and low river stage (mid-September through mid-November) every year. During each sampling event, samples will be collected within a 4-week period (see Table A1-7 and Figure A1-13).

Table A1-7. 100-NR-2 OU Apatite Barrier Wells

Well Type	Monitoring Location (69)	Network*	Northing	Easting	PRB Network Addresses PSQs	Sample Frequency for PRB	WAC Compliant? (Yes or No)
Unconfined	199-N-92A	PRB-E, Sr-90, nitrate, metals	150383.53	571647.42	1, 3, 4, 5, and 7	SA after installation of upgradient PRB	Yes
Unconfined	199-N-96A	PRB, nitrate, Sr-90, BV, TPH, metals, Cr+6	149800.76	571213.47	1, 3, 4, 5, 6, and 7	SA	Yes
Unconfined	199-N-122	PRB, Sr-90	149928.81	571318.48	1, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-123	PRB, Sr-90	149889.37	571282.86	1, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-136	PRB, Sr-90	149940.73	571337.18	1, 3, 4, 5, and 7	B	Yes

Table A1-7. 100-NR-2 OU Apatite Barrier Wells

Well Type	Monitoring Location (69)	Network*	Northing	Easting	PRB Network Addresses PSQs	Sample Frequency for PRB	WAC Compliant? (Yes or No)
Unconfined	199-N-146	PRB, Sr-90, Metals	149909.74	571298.80	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-147	PRB, Sr-90	149946.51	571338.34	1, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-159	PRB	149942.84	571340.00	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-173	PRB, BV, nitrate, TPH, Sr-90, metals	149759.67	571193.02	1, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-200	PRB-E	149755.44	571196.16	1, 3, 4, 5, and 7	B after installation of PRB	Yes
Unconfined	199-N-201	PRB-E	149759.46	571198.46	1, 3, 4, 5, and 7	B after installation of PRB	Yes
Unconfined	199-N-210	PRB-E	149795.42	571218.71	1, 3, 4, 5, and 7	B after installation of PRB	Yes
Unconfined	199-N-211	PRB	149799.02	571221.25	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-229	PRB	149864.74	571271.28	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-230	PRB	149868.47	571274.06	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-247	PRB	149994.14	571381.44	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-248	PRB	149997.93	571383.91	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-268	PRB	150074.61	571433.49	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-269	PRB	150078.94	571436.02	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-280	PRB	150122.77	571457.93	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-281	PRB	150127.35	571459.57	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-297	PRB, Sr-90	150182.74	571504.78	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-298	PRB	150186.18	571508.01	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-315	PRB	150247.530	571555.86	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-316	PRB	150251.37	571558.24	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-332	PRB, Sr-90	150314.30	571595.38	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-333	PRB	150318.21	571597.44	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-342	PRB	150349.47	571623.93	1, 3, 4, 5, and 7	B	Yes
Unconfined	199-N-343	PRB	150353.33	571627.19	1, 3, 4, 5, and 7	B	Yes

Table A1-7. 100-NR-2 OU Apatite Barrier Wells

Well Type	Monitoring Location (69)	Network*	Northing	Easting	PRB Network Addresses PSQs	Sample Frequency for PRB	WAC Compliant? (Yes or No)
Unconfined	199-N-346	PRB-E, TPH	149780.23	571203.32	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-347	PRB-E, Sr-90, nitrate	149822.23	571231.25	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-348	PRB, Sr-90	149845.23	571248.28	1, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-349	PRB, nitrate	149866.13	571267.16	1, 3, 4, 5 and 7	SA	Yes
Unconfined	199-N-350	PRB	149966.26	571356.74	1, 3, 4, 5 and 7	SA	Yes
Unconfined	199-N-351	PRB	149987.11	571373.17	1, 3, 4, 5 and 7	SA	Yes
Unconfined	199-N-352	PRB, Sr-90	150009.03	571388.72	1, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-353	PRB, Sr-90 nitrate, metals	150031.62	571403.29	1, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-354	PRB-E	150055.09	571418.57	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-355	PRB-E	150077	571431.65	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-356	PRB-E	150101.5	571446.09	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-357	PRB-E	150125.44	571456.35	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-358	PRB-E	150148.67	571466.28	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-359	PRB-E	150168.77	571484.18	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-360	PRB-E	150186.77	571154.04	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-361	PRB-E	150206.98	571373.17	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-362	PRB-E	150228.08	571538.55	1, 3, 4, 5, and 7	SA after installation of PRB	Yes

Table A1-7. 100-NR-2 OU Apatite Barrier Wells

Well Type	Monitoring Location (69)	Network*	Northing	Easting	PRB Network Addresses PSQs	Sample Frequency for PRB	WAC Compliant? (Yes or No)
Unconfined	199-N-363	PRB-E	150249.9	571554.65	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-364	PRB-E	150273.49	571569.71	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-365	PRB-E	150296.66	571583.77	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-366	PRB-E	150317.84	571594.87	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Unconfined	199-N-367	PRB-E	150340.41	57161.38	1, 3, 4, 5, and 7	SA after installation of PRB	Yes
Aquifer tube	APT1	PRB	149897.48	571276.50	1, 3, 4, 5, and 7	SA	No
Aquifer tube	APT5	PRB	149957.20	571334.10	1, 3, 4, 5, and 7	SA	No
Aquifer tube	C6132	PRB, BV	149734.96	571165.27	1, 3, 4, 5, and 7	SA	No
Aquifer tube	C6136	PRB-E	149815.36	571195.69	1, 3, 4, 5, and 7	SA after installation of PRB	No
Aquifer tube	C6324	PRB-E	150268.72	571554.35	1, 3, 4, 5, and 7	SA after installation of PRB	No
Aquifer tube	C7881	PRB	149981.81	571346.96	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray-0A	PRB-E, BV	149776.00	571169.00	1, 3, 4, 5, and 7	SA after installation of PRB	No
Aquifer tube	N116mArray-2A	PRB	149888.37	571259.69	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray-3A	PRB	149911.86	571273.37	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray-4A	PRB	149925.23	571292.50	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray-6A	PRB	149955.73	571325.44	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray-8A	PRB	150029.75	571381.19	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray-9A	PRB	150124.98	571437.81	1, 3, 4, 5, and 7	SA	No

Table A1-7. 100-NR-2 OU Apatite Barrier Wells

Well Type	Monitoring Location (69)	Network*	Northing	Easting	PRB Network Addresses PSQs	Sample Frequency for PRB	WAC Compliant? (Yes or No)
Aquifer tube	N116mArray -10A	PRB	150158.65	571452.00	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray -11A	PRB-E	150184.45	571482.06	1, 3, 4, 5, and 7	SA after installation of PRB	No
Aquifer tube	N116mArray -13A	PRB	150264.01	571540.68	1, 3, 4, 5, and 7	SA	No
Aquifer tube	N116mArray -15A	PRB-E	150391.00	571632.00	1, 3, 4, 5, and 7	SA after installation of PRB	No
Aquifer tube	NVP2-116.0	PRB	149944.56	571313.31	1, 3, 4, 5, and 7	SA	No

* The bioventing, Sr-90, nitrate, TPH, tritium, and metals groundwater monitoring networks are shown in Tables A1-8 through A1-13.

Principal study questions (PSQs):

PSQ 1. Is the Sr-90 permeable reactive (apatite) barrier performing as intended?

PSQ 3. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 4. Are there continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

PSQ 5. Is there evidence that Columbia River water quality is being protected?

PSQ 7. Is additional information needed for a final record of decision?

A = Annual. Annual sampling targets low river stage (mid-September through mid-November timeframe). The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

B = Biennial. Biennial sampling targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every other year. Groundwater wells sampled biennially should be sample during the same year. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BV = Bioventing. This network will be sampled and analyzed for alkalinity, anions, unfiltered metals, TPH-D, TPH-G, TPH motor oil, oil and grease, PAH, and VOA (BTEX). Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, turbidity, sheen, and odor. Prior to purging the well, a transparent bailer will be used to collect a grab sample to evaluate the presence of sheen.

Nitrate = Equivalent to anions.

PRB = Existing permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Exception: Wells 199-N-268, 199-N-269, 199-N-280, 199-N-281, 199-N-297, 199-N-298, 199-N-315, 199-N-316, 199-N-332, 199-N-333, 199-N-342, and 199-N-343 are not sampled for TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

PRB-E = Planned extension of permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

SA = Semiannual. Semiannual sampling targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every year. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Table A1-7. 100-NR-2 OU Apatite Barrier Wells

Well Type	Monitoring Location (69)	Network*	Northing	Easting	PRB Network Addresses PSQs	Sample Frequency for PRB	WAC Compliant? (Yes or No)

Metal analysis should be performed on unfiltered and filtered samples.
BTEX = benzene, toluene, ethylbenzene, and xylene
PAH = polycyclic aromatic hydrocarbons
TPH-D = total petroleum hydrocarbons-diesel
TPH-G = total petroleum hydrocarbons-gasoline
VOA = volatile organic analysis
WAC = *Washington Administrative Code*

A1.8.3.3.2 Bioventing Performance Monitoring

Note: Bioventing performance monitoring is documented in DOE/RL-2005-93, Appendix H. Appendix H provides the technical direction for vadose zone (100-NR-1) and groundwater (100-NR-2) monitoring applicable to the bioremediation. The groundwater monitoring identified in Appendix H is justified in this 100-NR-2 DQO summary report and will be incorporated into DOE/RL-2001-27, *Remedial Design Report/Remedial Action Work Plan for the 100-NR-2 Operable Unit*, Rev. 2, Appendix A.

- The bioventing performance monitoring includes system and groundwater sampling and analysis. It also includes respirometry testing and monthly monitoring of well gases.
  - The groundwater monitoring well network includes one upgradient well (100-N-56), four bioventing wells (199-N-167, 199-N-169, 199-N-171, and 199-N-172), five groundwater monitoring wells (199-N-19, 199-N-183, 199-N-173, 199-N-96A, and 199-N-3), and three aquifer tubes (N 116-mArray-OA, C6132, and C6135). Monitoring wells and aquifer tubes are shown in Table A1-8 and Figure A1-14. Well 199-N-377 was added to this network during the DQO process to better define the TPH plume geometry.
  - Groundwater samples were collected for chemical analysis from the monitoring wells as a baseline prior to the bioventing system startup. They are sampled semiannually thereafter in the fall and spring to account for seasonal low and high groundwater table elevations. If irregular, decreasing, or increasing trends appear, the sampling frequency of a well may be adjusted accordingly. The groundwater sampling results are used to support demonstration of stability of the groundwater plume, performance of the bioremediation remedy, and that intrinsic biodegradation of petroleum is occurring across the PRZ. All laboratory analyses will be performed on nonfiltered groundwater samples. Prior to purging a well for sample collection, a transparent bailer and/or an electronic oil-water interface probe will be used to evaluate the presence of oil sheen and/or LNAPL.

  Given a concentration to be treated of 4,200 mg/kg and the observed biodegradation rate range, the vadose zone remedy may require 15 to 41 years to achieve remedial action goals.

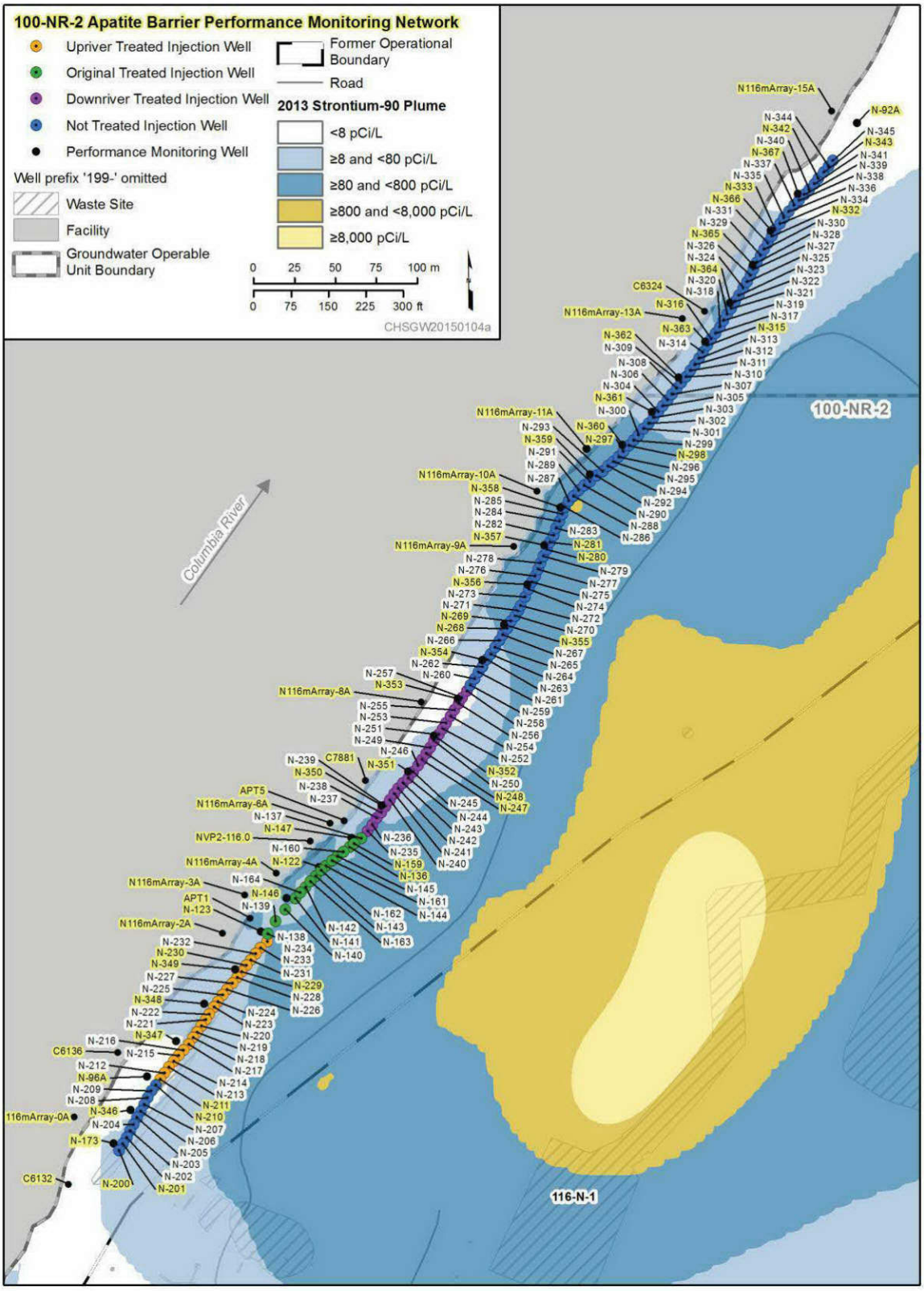

Figure A1-13. Apatite PRB Performance Monitoring Network

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Table A1-8. 100-NR-2 OU Bioventing Groundwater Monitoring Network

Well Type	Monitoring Location (14)	Network	Northing	Easting	BV Network Addresses PSQs	Sample Frequency for BV	WAC Compliant? (Yes or No)
Unconfined	199-N-3	BV, nitrate, TPH	149794.61	571317.38	2, 3, 4, 5, and 7	SA	No
Unconfined	199-N-19	BV, TPH, nitrate	149702.45	571209.05	2, 3, 4, 5, and 7	SA	No
Unconfined	199-N-56	BV, TPH, nitrate	149703.50	571375.87	2, 3, 4, 5, and 7	SA	No
Unconfined	199-N-96A	BV, nitrate, Sr-90, TPH, PRB, metals, Cr+6	149800.76	571213.47	2, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-167	BV, TPH, nitrate, metals	149698.29	571296.75	2, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-169	BV, TPH	149705.43	571293.97	2, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-171	BV, TPH	149740.08	571296.70	2, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-172	BV	149738.54	571263.29	2, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-173	BV, PRB, nitrate, TPH, Sr-90, metals	149759.67	571193.02	2, 3, 4, 5, and 7	SA	Yes
Unconfined	199-N-183	BV, nitrate, TPH, Sr-90, metals, Cr+6	149756.01	571269.69	2, 3, 4, 5, and 7	SA	Yes
Planned Unconfined	199-N-377	BV, TPH, nitrate, Sr-90	149678.00	571141.08	2, 3, 4, 5 and 7	SA	Yes
Aquifer Tube	C6132	BV, PRB,	149734.96	571165.27	2, 3, 4, 5, and 7	SA	No
Aquifer Tube	C6135	BV	149794.07	571181.41	2, 3, 4, 5, and 7	SA	No

Table A1-8. 100-NR-2 OU Bioventing Groundwater Monitoring Network

Well Type	Monitoring Location (14)	Network	Northing	Easting	BV Network Addresses PSQs	Sample Frequency for BV	WAC Compliant? (Yes or No)
Aquifer Tube	N116mArray-0A	BV, PRB-E	149776.00	571169.00	2, 3, 4, 5, and 7	SA	No

Principal study questions (PSQs):

PSQ 1. Is the Sr-90 permeable reactive (apatite) barrier performing as intended?

PSQ 2. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 3. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 4. Are there continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

PSQ 5. Is there evidence that Columbia River water quality is being protected?

PSQ 7. Is additional information needed for a final record of decision?

BV = Bioventing. This network will be sampled and analyzed for alkalinity, anions, unfiltered metals, TPH-D, TPH-G, TPH motor oil, oil and grease, PAH, and VOA (BTEX). Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, turbidity, sheen, and odor. Prior to purging the well, a transparent bailer and/or electronic oil water interface probe will be used to collect a grab sample to evaluate the presence of sheen.

Nitrate = Equivalent to anions

PRB = Existing permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Exception: Wells 199-N-268, 199-N-269, 199-N-280, 199-N-281, 199-N-297, 199-N-298, 199-N-315, 199-N-316, 199-N-332, 199-N-333, 199-N-342, and 199-N-343 are not sampled for TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

PRB-E = Planned extension of permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

SA = Semiannual. Semiannual sampling targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every year. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BTEX = benzene, toluene, ethylbenzene, and xylene

PAH = polycyclic aromatic hydrocarbons

TPH-D = total petroleum hydrocarbons-diesel

TPH-G = total petroleum hydrocarbons-gasoline

VOA = volatile organic analysis

WAC = *Washington Administrative Code*

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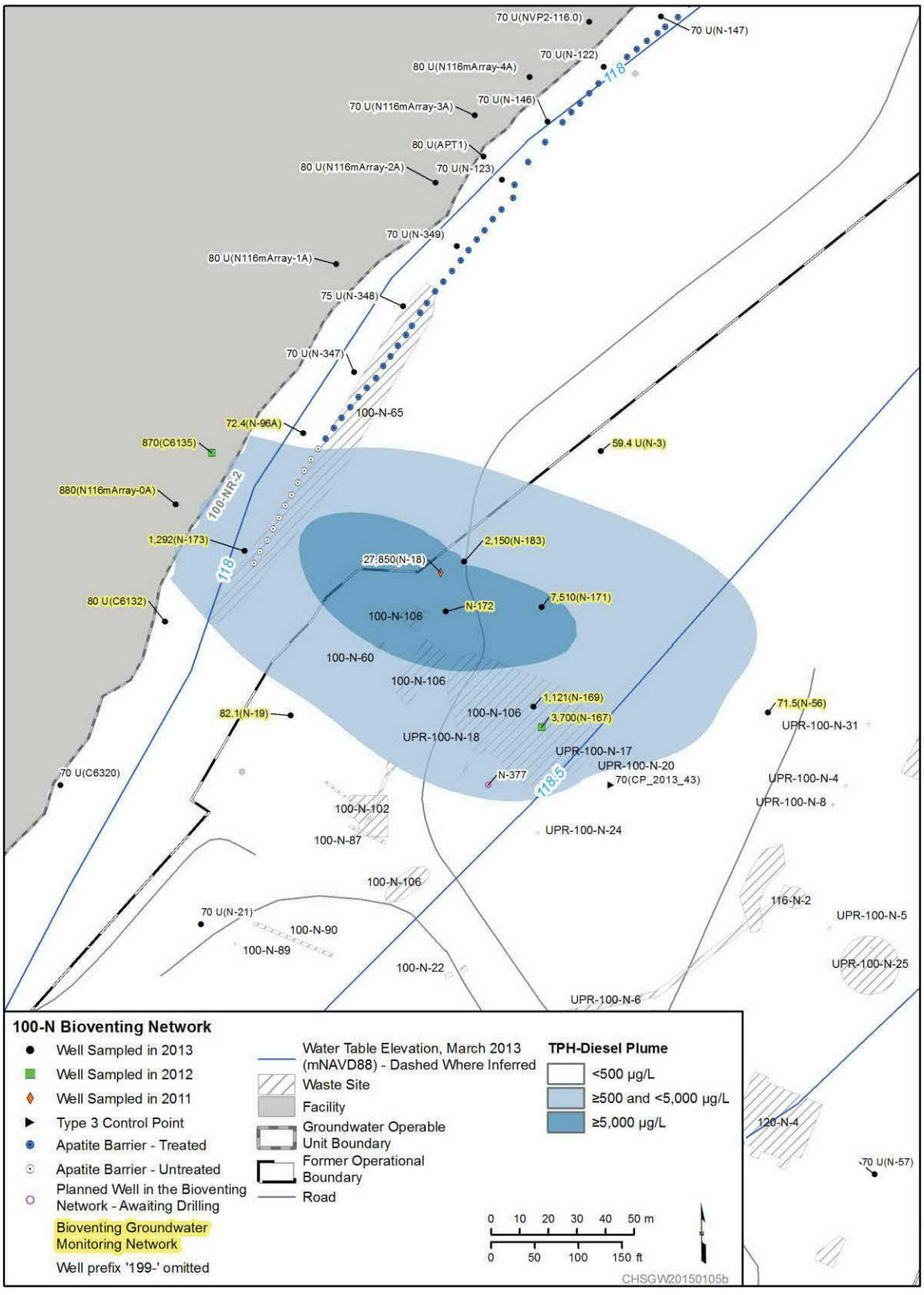

Figure A1-14. Bioventing Performance Groundwater Monitoring Network

A1.8.3.3.3 Sr-90 Plume Tracking

- Sr-90 Plume long-term monitoring assumptions
  - Long-term monitoring is based on 2013 Sr-90 plume extent.
  - Conditions will be monitored upgradient of the PRB.
  - Sampling will occur only during low river stage (mid-September through mid-November) to capture concentrations during time of groundwater flow towards the river.
  - High river stage does not significantly influence plume movement but may temporally change local concentrations.
  - The Sr-90 plume does not migrate significantly in groundwater.
  - The Sr-90 plume can be tracked using far fewer wells than were used in 2013.
- Monitoring wells (existing and new; see Table A1-9 and Figure A1-15)
  - Sampling frequency 1x/5 years at low river stage (mid-September through mid-November) within a 4-week period. Sampling will commence in 2015, 1 year before the 5-year review.
  - Three new monitoring wells (199-N-371, 199-N-372, and 199-N-374) will characterize the area near Aquifer Tube C7934. An additional new well (199-N-377) will be used to characterize concentrations within the main body of the Sr-90 plume.
    - As a general rule, newly installed long-term groundwater monitoring wells will be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).
    - The new wells will be analyzed for Sr-90.
- Aquifer tubes (existing; see Table A1-9 and Figure A1-15)
  - Sampling frequency 1x/5 years at low river stage (mid-September through mid-November) within a 4-week period.
  - Aquifer tubes in this network are outside of the main Sr-90 plume and upriver of the PRB.

Table A1-9. 100-NR-2 Strontium-90 Groundwater Monitoring Network

Well Type	Monitoring Location (53)	Network	Northing	Easting	Sr-90 Network Addresses PSQs	Sample Frequency for Sr-90	WAC Compliant? (Yes or No)
Unconfined	199-N-14	Sr-90, nitrate, metals	150243.37	571713.10	3, 4, 5, and 7	A5	No
Unconfined	199-N-21	Sr-90	149629.41	571177.78	3, 4, 5, and 7	A5	No

Table A1-9. 100-NR-2 Strontium-90 Groundwater Monitoring Network

Well Type	Monitoring Location (53)	Network	Northing	Easting	Sr-90 Network Addresses PSQs	Sample Frequency for Sr-90	WAC Compliant? (Yes or No)
Unconfined	199-N-27	Sr-90, nitrate	149659.79	572052.62	3, 4, 5, and 7	A5	No
Unconfined	199-N-28	Sr-90	149476.65	571955.27	3, 4, 5, and 7	A5	No
Unconfined	199-N-34	Sr-90, nitrate	149653.89	571737.41	3, 4, 5, and 7	A5	No
Unconfined	199-N-41	Sr-90, nitrate, metals	149965.26	572182.24	3, 4, 5, and 7	A5	No
Unconfined	199-N-46	Sr-90, nitrate	149921.35	571326.97	3, 4, 5, and 7	A5	No
Unconfined	199-N-50	Sr-90, nitrate	150298.79	572090.90	3, 4, 5, and 7	A5	No
Unconfined	199-N-51	Sr-90	150496.97	571796.10	3, 4, 5, and 7	A5	No
Unconfined	199-N-57	Sr-90, nitrate, metals	149830.32	571969.90	3, 4, 5, and 7	A5	
Unconfined	199-N-64	Sr-90, nitrate, metals	149551.18	571561.41	3, 4, 5, and 7	A5	No
Unconfined	199-N-67	Sr-90, nitrate, metals	149798.95	571494.16	3, 4, 5, and 7	A5	No
Unconfined	199-N-75	Sr-90, nitrate	150060.72	571523.58	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-76	Sr-90, nitrate	150122.12	571560.08	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-81	Sr-90, nitrate	149866.09	572019.16	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-92A	Sr-90, PRB-E, nitrate, metals	150383.53	571647.42	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-96A	Sr-90, BV, PRB, TPH, nitrate, metals, Cr+6	149800.76	571213.47	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-99A	Sr-90, nitrate	150151.41	571473.67	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-103A	Sr-90, nitrate	149903.68	571424.79	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-104A	Sr-90	149542.63	571778.32	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-105A	Sr-90, nitrate	150024.96	571602.30	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-122	Sr-90, PRB	149928.81	571318.48	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-123	Sr-90, PRB	149889.37	571282.86	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-136	Sr-90, PRB	149940.73	571337.18	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-146,	Sr-90, PRB, metals	149909.74	571298.80	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-147	Sr-90, PRB	149946.51	571338.34	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-173, metals	Sr-90, PRB, BV, nitrate, TPH, metals	149759.67	571193.02	3, 4, 5, and 7	A5	Yes

Table A1-9. 100-NR-2 Strontium-90 Groundwater Monitoring Network

Well Type	Monitoring Location (53)	Network	Northing	Easting	Sr-90 Network Addresses PSQs	Sample Frequency for Sr-90	WAC Compliant? (Yes or No)
Unconfined	199-N-183	Sr-90, BV, nitrate, TPH, metals, Cr+6	149756.01	571269.69	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-184	Sr-90, nitrate, tritium	149817.82	571430.74	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-185	Sr-90, nitrate	150237.98	571546.33	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-186	Sr-90, nitrate, tritium	149715.06	571480.87	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-187	Sr-90, nitrate	149897.96	571565.90	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-188	Sr-90, nitrate, metals	149581.53	571906.94	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-297	Sr-90, PRB	150182.74	571504.78	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-332	Sr-90, PRB	150314.30	571595.38	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-347	Sr-90, PRB-E, nitrate	149822.23	571231.25	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-348	Sr-90, PRB	149845.23	571248.28	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-352	Sr-90, PRB	150009.03	571388.72	3, 4, 5, and 7	A5	Yes
Unconfined	199-N-353	Sr-90, PRB, nitrate, metals	150031.62	571403.29	3, 4, 5, and 7	A5	Yes
Planned unconfined	199-N-371	Sr-90, tritium	149572.86	571130.67	3, 4, 5, and 7	Q/A5	Yes
Planned unconfined	199-N-372	Sr-90, nitrate, tritium	149502.95	571100.16	3, 4, 5, and 7	Q/A5	Yes
Planned unconfined	199-N-374	Sr-90, tritium	149533.74	571112.10	3, 4, 5, and 7	Q/A5	Yes
Planned unconfined	199-N-377	Sr-90, BV, nitrate, TPH	149678.00	571278.00	3, 4, 5, and 7	Q/A5	Yes
Aquifer tube cluster	C6317, C6318, C6319[a]	Sr-90, tritium	149554.40	571023.87	3, 4, 5, and 7	SA	No
Aquifer tube	C6320	Sr-90, nitrate	149677.99	571128.66	3, 4, 5, and 7	SA	No
Aquifer tube cluster	C7934, C7935, C7936*	Sr-90, tritium	149577.50	571048.23	3, 4, 5, and 7	SA	No
Aquifer tube cluster	C7937, C7938, C7939[a]	Sr-90, tritium	149621.34	571081.92	3, 4, 5, and 7	SA	No

* Sr-90 detected at these locations suggests there may be a continuing source associated with the 1908-N Outfall that is not a part of the larger stable plume. As such, these locations are sampled semiannually.

Principal study questions (PSQs):

Table A1-9. 100-NR-2 Strontium-90 Groundwater Monitoring Network

Well Type	Monitoring Location (53)	Network	Northing	Easting	Sr-90 Network Addresses PSQs	Sample Frequency for Sr-90	WAC Compliant? (Yes or No)

PSQ 2. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 4. Are there continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

PSQ 5. Is there evidence that Columbia River water quality is being protected?

PSQ 7. Is additional information needed for a final record of decision?

A5 = Annually every 5 years. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and every 5 years thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BV = Bioventing. This network will be sampled and analyzed for alkalinity, anions, unfiltered metals, TPH-D, TPH-G, TPH motor oil, oil and grease, PAH, and VOA (BTEX). Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, turbidity, sheen, and odor. Prior to purging the well, a transparent bailer and/or electronic oil water interface probe will be used to collect a grab sample to evaluate the presence of sheen.

PRB = Existing permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Exception: Wells 199-N-268, 199-N-269, 199-N-280, 199-N-281, 199-N-297, 199-N-298, 199-N-315, 199-N-316, 199-N-332, 199-N-333, 199-N-342, and 199-N-343 are not sampled for TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

PRB-E = Planned extension of permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Field methods include dissolved oxygen, oxidation reduction potential, pH, conductivity, temperature, and turbidity.

Q/A5 = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Otherwise, the well will be sample as defined by A5. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

SA = Semiannual. Semiannual sampling targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every year. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BTEX = benzene, toluene, ethylbenzene, and xylene

PAH = polycyclic aromatic hydrocarbons

PAH = polycyclic aromatic hydrocarbons

TPH-D = total petroleum hydrocarbons-diesel

TPH-G = total petroleum hydrocarbons-gasoline

WAC = *Washington Administrative Code*

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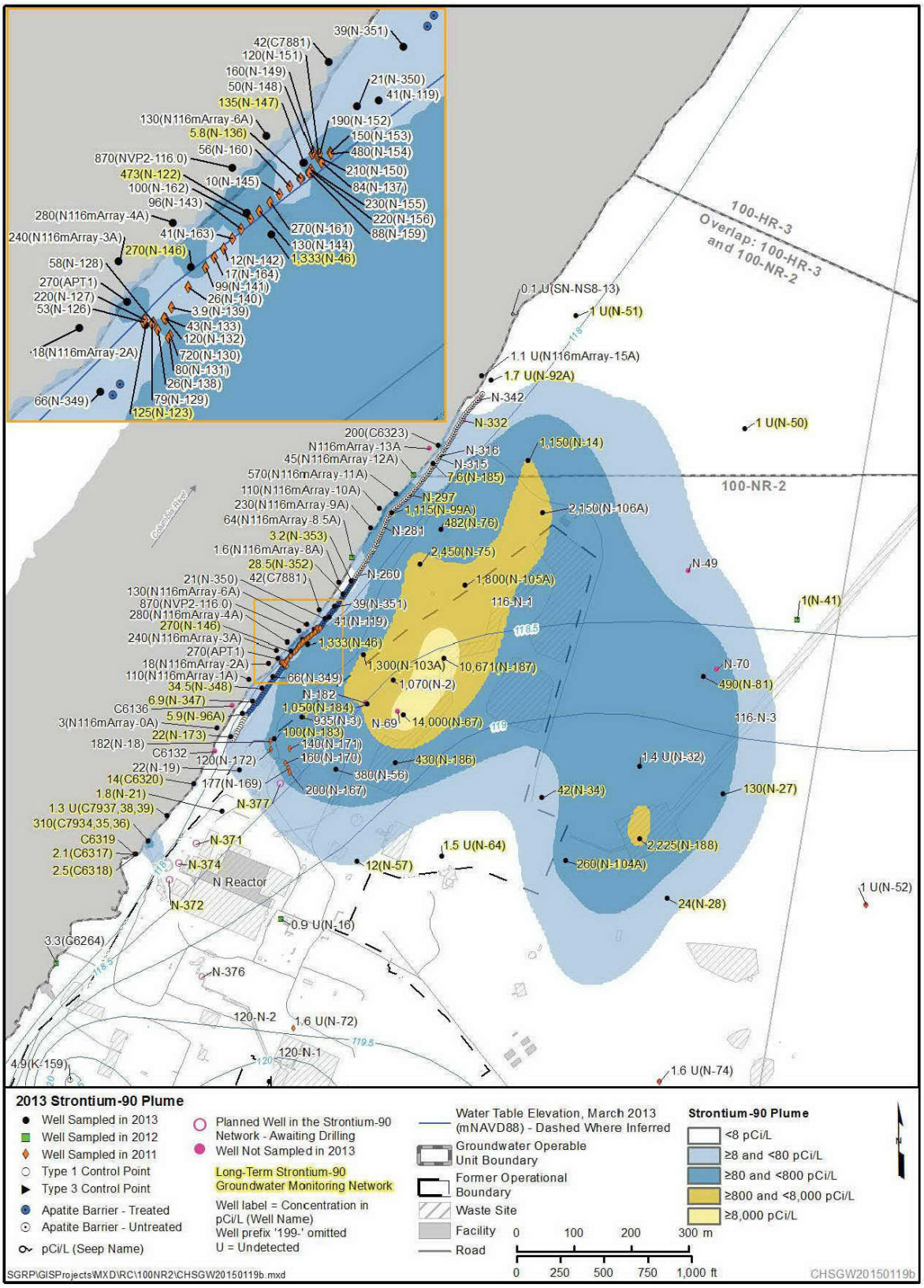

Figure A1-15. 100-NR-2 OU Sr-90 Groundwater Monitoring Network

A1.8.3.3.4 Nitrate Plume Tracking

- Nitrate long-term monitoring assumptions
  - Long-term monitoring is based on 2013 plume extent.
  - Sampling will occur annually during low river stage (mid-September through mid-November) within a 4-week period to capture conservative groundwater quality conditions.
  - High river stage influences plume movement and may temporally change local concentrations.
  - The nitrate plume is expected to continue to migrate toward the river in groundwater.
  - Residual vadose source contributions possible from the 116-N-1 Trench to groundwater.
  - The nitrate plume can be tracked using far fewer wells than were used in 2013.
- Monitoring wells (existing and new; see Table A1-10 and Figure A1-16)
  - Four new monitoring wells (199-N-372, 199-N-373, 199-N-376, and 199-N-377) will improve characterization of the nitrate plume.
  - As a general rule, newly installed long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).
  - The new wells will be analyzed for nitrate.
- Aquifer tubes (existing; see Table A1-10 and Figure A1-16)
  - Sampling frequency 1x/year at low river stage (mid-September through mid-November) within a 4-week period.

Table A1-10. 100-NR-2 Nitrate Groundwater Monitoring Network

Well Type	Monitoring Location (39)	Network	Northing	Easting	Nitrate Network Addresses PSQs	Sample Frequency for Nitrate	WAC Compliant? (Yes or No)
Unconfined	199-N-3	Nitrate, BV, TPH	149794.61	571317.38	3, 4, 5, and 7	A	No
Unconfined	199-N-14	Nitrate, Sr-90, metals	150243.37	571713.10	3, 4, 5, and 7	A	No
Unconfined	199-N-19	Nitrate, BV, TPH	149702.45	571209.05	3, 4, 5, and 7	A	No
Unconfined	199-N-27	Nitrate, Sr-90	149659.79	572052.62	3, 4, 5, and 7	A	No

Table A1-10. 100-NR-2 Nitrate Groundwater Monitoring Network

Well Type	Monitoring Location (39)	Network	Northing	Easting	Nitrate Network Addresses PSQs	Sample Frequency for Nitrate	WAC Compliant? (Yes or No)
Unconfined	199-N-34	Nitrate, Sr-90	149653.89	571737.41	3, 4, 5, and 7	A	No
Unconfined	199-N-41	Nitrate, Sr-90, metals	149965.26	572182.24	3, 4, 5, and 7	A	No
Unconfined	199-N-46	Nitrate, Sr-90	149921.35	571326.97	3, 4, 5, and 7	A	No
Unconfined	199-N-50	Nitrate, Sr-90	150298.79	572090.90	3, 4, 5, and 7	A	No
Unconfined	199-N-56	Nitrate, BV, TPH	149703.50	571375.87	3, 4, 5, and 7	A	No
Unconfined	199-N-57	Nitrate, Sr-90, metals	149830.32	571969.90	3, 4, 5, and 7	A	No
Unconfined	199-N-64	Nitrate, Sr-90, metals	149551.18	571561.41	3, 4, 5, and 7	A	No
Unconfined	199-N-67	Nitrate, Sr-90, metals	149798.95	571494.16	3, 4, 5, and 7	A	No
Unconfined	199-N-72	Nitrate	149249.65	571302.74	3, 4, 5, and 7	A	Yes
Unconfined	199-N-73	Nitrate	149168.99	571292.02	3, 4, 5, and 7	A	Yes
Unconfined	199-N-75	Nitrate, Sr-90	150060.72	571523.58	3, 4, 5, and 7	A	Yes
Deep Unconfined	199-N-77	Nitrate	149243.0	571309.8	3, 4, 5, and 7	A	Yes
Unconfined	199-N-76	Nitrate, Sr-90	150122.12	571560.08	3, 4, 5, and 7	A	Yes
Unconfined	199-N-81	Nitrate, Sr-90	149866.09	572019.16	3, 4, 5, and 7	A	Yes
Unconfined	199-N-92A	Nitrate, PRB-E, Sr-90, metals	150383.53	571647.42	3, 4, 5, and 7	A	Yes

Table A1-10. 100-NR-2 Nitrate Groundwater Monitoring Network

Well Type	Monitoring Location (39)	Network	Northing	Easting	Nitrate Network Addresses PSQs	Sample Frequency for Nitrate	WAC Compliant? (Yes or No)
Unconfined	199-N-96A	Nitrate, PRB, BV, Sr-90, TPH, metals, Cr+6	149800.76	571213.47	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-99A	Nitrate, Sr-90	150151.41	571473.67	3, 4, 5, and 7	A	Yes
Unconfined	199-N-103A	Nitrate, Sr-90	149903.68	571424.79	3, 4, 5, and 7	A	Yes
Unconfined	199-N-105A	Nitrate, Sr-90	150024.96	571602.30	3, 4, 5, and 7	A	Yes
Unconfined	199-N-167	Nitrate, BV, TPH, metals	149698.29	571296.75	3, 4, 5, and 7	A	Yes
Unconfined	199-N-173	Nitrate, PRB, BV, TPH, Sr-90, metals	149759.67	571193.02	3, 4, 5, and 7	A	Yes
Deep unconfined	199-N-182	Nitrate, tritium	149819.87	571428.71	3, 4, 5, and 7	A	Yes
Unconfined	199-N-183	Nitrate, BV, TPH, Sr-90, metals, Cr+6	149756.01	571269.69	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-184	Nitrate, tritium, Sr-90	149817.82	571430.74	3, 4, 5, and 7	A	Yes
Unconfined	199-N-185	Nitrate, Sr-90	150237.98	571546.33	3, 4, 5, and 7	A	Yes
Unconfined	199-N-186	Nitrate, Sr-90, tritium	149715.06	571480.87	3, 4, 5, and 7	A	Yes
Unconfined	199-N-187	Nitrate, Sr-90	149897.96	571565.90	3, 4, 5, and 7	A	Yes
Unconfined	199-N-188	Nitrate, Sr-90, metals	149581.53	571906.94	3, 4, 5, and 7	A	Yes
Unconfined	199-N-347	Nitrate, PRB-E, Sr-90	149822.23	571231.25	3, 4, 5, and 7	A	Yes
Unconfined	199-N-349	Nitrate, PRB	149866.13	571267.16	3, 4, 5, and 7	A	Yes

Table A1-10. 100-NR-2 Nitrate Groundwater Monitoring Network

Well Type	Monitoring Location (39)	Network	Northing	Easting	Nitrate Network Addresses PSQs	Sample Frequency for Nitrate	WAC Compliant? (Yes or No)
Unconfined	199-N-353	Nitrate, PRB, Sr-90, metals	150031.62	571403.29	3, 4, 5, and 7	A	Yes
Planned unconfined	199-N-372	Nitrate, Sr-90, tritium	149502.95	571100.16	3, 4, 5, and 7	Q/A	Yes
Planned unconfined	199-N-373	Nitrate, TPH	149442.00	571276.00	3, 4, 5, and 7	Q/A	Yes
Planned deep unconfined	199-N-376	Nitrate	149338.62	571141.08	3, 4, 5, and 7	Q/A	Yes
Planned unconfined	199-N-377	Nitrate, BV, TPH, Sr-90	149678.00	571278.00	3, 4, 5, and 7	Q/A	Yes

Principal study questions (PSQs):

PSQ 3. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 4. Are there increasing concentrations in groundwater indicating newly identified or continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

PSQ 5. Is there evidence that Columbia River water quality is being protected?

PSQ 7. Is additional information needed for a final record of decision?

A= Sample in 2015 at low river stage (mid-September through mid-November timeframe) and annually thereafter. The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BV = Bioventing. This network will be sampled and analyzed for alkalinity, anions, unfiltered metals, TPH-D, TPH-G, TPH motor oil, oil and grease, PAH, and VOA (BTEX). Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, turbidity, sheen, and odor. Prior to purging the well, a transparent bailer and/or electronic oil water interface probe will be used to collect a grab sample to evaluate the presence of sheen.

PRB = Existing permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Exception: Wells 199-N-268, 199-N-269, 199-N-280, 199-N-281, 199-N-297, 199-N-298, 199-N-315, 199-N-316, 199-N-332, 199-N-333, 199-N-342, and 199-N-343 are not sampled for TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

PRB-E = Planned extension of permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Field methods include dissolved oxygen, oxidation reduction potential, pH, conductivity, temperature, and turbidity.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Otherwise, the well will be sample as defined by A. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

BTEX = benzene, toluene, ethylbenzene, and xylene

PAH = polycyclic aromatic hydrocarbons

PAH = polycyclic aromatic hydrocarbons

TPH-D = total petroleum hydrocarbons-diesel

TPH-G = total petroleum hydrocarbons-gasoline

WAC = *Washington Administrative Code*

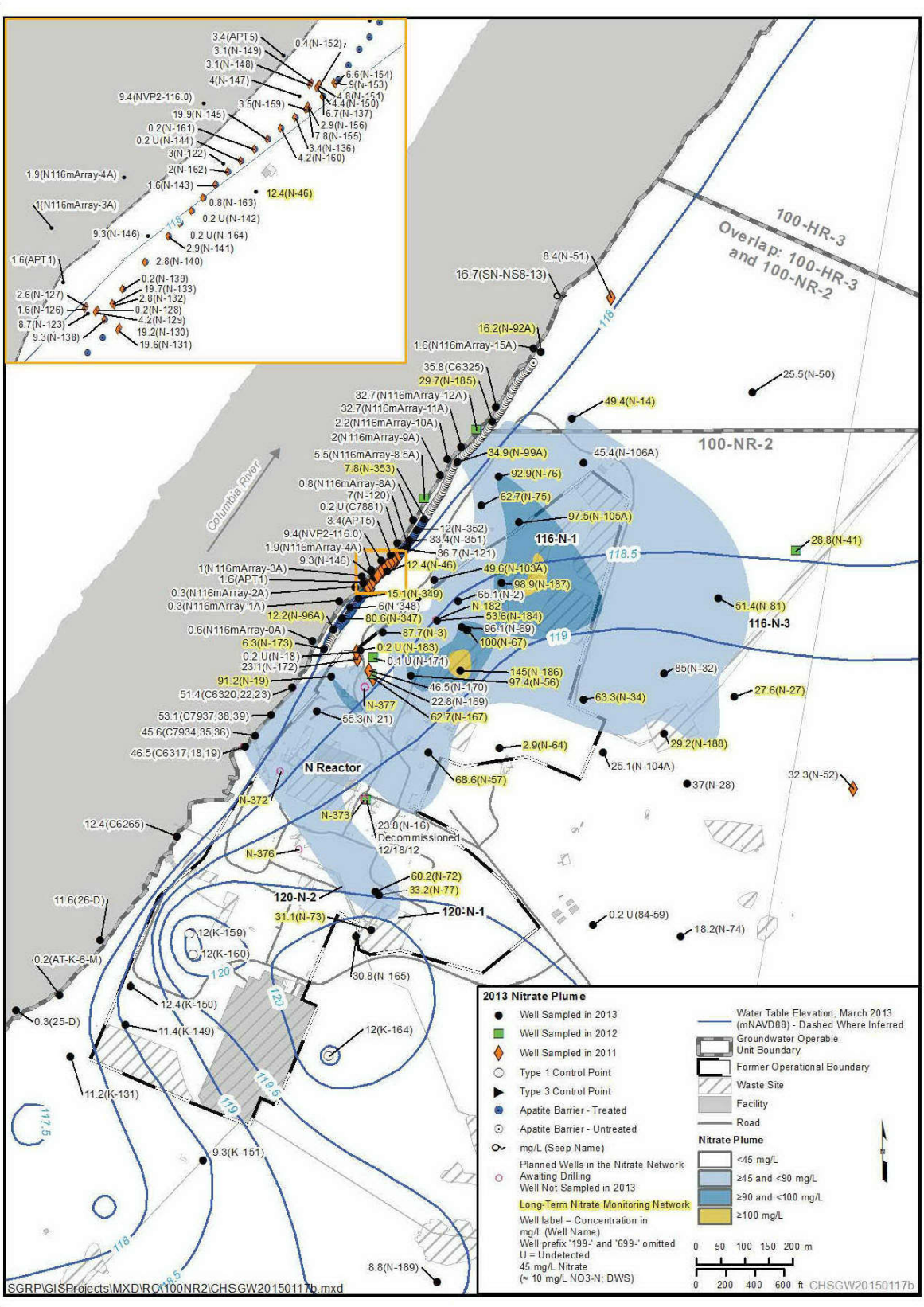

Figure A1-16. 100-NR-2 OU Nitrate Groundwater Monitoring Network

A1.8.3.3.5 TPH Plume Tracking

- TPH long-term monitoring assumptions
  - Long-term monitoring is based on 2013 plume extent.
  - The focus of the monitoring is downgradient. No significant inland (upgradient) spreading indicated.
  - Sampling will occur during low river stage (mid-September through mid-November) within a 4-week period to capture concentrations during time of groundwater flow towards the river.
  - High river stage influences plume movement and may temporally change local concentrations. Seasonal changes in plume concentrations will be monitored in the bioventing groundwater monitoring network
  - TPH-related contamination is expected to continue to migrate in groundwater to the river.
  - The plume extent is relatively stable; however, that stability was based on pre-bioventing operations. It is unclear how bioventing will affect the plume extent.
  - There is a residual vadose source from the TPH plume footprint area located within the PRZ.
- Monitoring wells (existing and new; see Table A1-11 and Figure A1-17)
- Aquifer tubes (existing see Table A1-11 and Figure A1-17)
  - Sampling frequency 1x/year at low river stage (mid-September through mid-November) within a 4-week period.

Table A1-11. 100-NR-2 TPH Groundwater Monitoring Network

Well Type	Monitoring Location (10)	Network	Northing	Easting	TPH Network Addresses PSQs	Sample Frequency for TPH	WAC Compliant? (Yes or No)
Unconfined	199-N-3	TPH, BV, nitrate	149794.61	571317.38	3, 4, 5, and 7	A	No
Unconfined	199-N-56	TPH, BV, nitrate	149703.50	571375.87	3, 4, 5, and 7	A	No
Unconfined	199-N-96A	TPH, Sr-90, PRB, BV, nitrate, metals, Cr+6	149800.76	571213.47	3, 4, 5, and 7	A	Yes
Unconfined	199-N-169	TPH, BV	149705.43	571293.97	3, 4, 5, and 7	A	Yes
Unconfined	199-N-171	TPH, BV	149740.08	571296.70	3, 4, 5, and 7	A	Yes
Unconfined	199-N-173	TPH, BV, PRB, nitrate, Sr-90, metals	149759.67	571193.02	3, 4, 5, and 7	A	Yes

Table A1-11. 100-NR-2 TPH Groundwater Monitoring Network

Well Type	Monitoring Location (10)	Network	Northing	Easting	TPH Network Addresses PSQs	Sample Frequency for TPH	WAC Compliant? (Yes or No)
Unconfined	199-N-183	TPH, Sr-90, BV, nitrate, metals, Cr+6	149756.01	571269.69	3, 4, 5, and 7	A	Yes
Unconfined	199-N-346	TPH, PRB-E	149780.23	571203.32	3, 4, 5, and 7	A	Yes
Planned unconfined	199-N-373	TPH, nitrate	149442.00	571276.00	3, 4, 5, and 7	Q/A	Yes*
Planned unconfined	199-N-377	TPH, BV, nitrate, Sr-90	149678.00	571278.00	3, 4, 5, and 7	Q/A	Yes

* If TPH is not detected during the initial sampling event, sampling for TPH will be discontinued.

Principal study questions (PSQs):

PSQ 3. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 4. Are there increasing concentrations in groundwater indicating newly identified or continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

PSQ 5. Is there evidence that Columbia River water quality is being protected?

PSQ 7. Is additional information needed for a final record of decision?

A = Annual. Annual sampling targets low river stage (mid-September through mid-November timeframe). The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BV = Bioventing. This network will be sampled and analyzed for alkalinity, anions, unfiltered metals, TPH-D, TPH-G, TPH motor oil, oil and grease, PAH, and VOA (BTEX). Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, turbidity, sheen, and odor. Prior to purging the well, a transparent bailer and/or electronic oil water interface probe will be used to collect a grab sample to evaluate the presence of sheen.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

PRB = Existing permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Exception: Wells 199-N-268, 199-N-269, 199-N-280, 199-N-281, 199-N-297, 199-N-298, 199-N-315, 199-N-316, 199-N-332, 199-N-333, 199-N-342, and 199-N-343 are not sampled for TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

PRB-E = Planned extension of permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Field methods include dissolved oxygen, oxidation reduction potential, pH, conductivity, temperature, and turbidity.

BTEX = benzene, toluene, ethylbenzene, and xylene

PAH = polycyclic aromatic hydrocarbons

TPH-D = total petroleum hydrocarbons-diesel

TPH-G = total petroleum hydrocarbons-gasoline

WAC = *Washington Administrative Code*

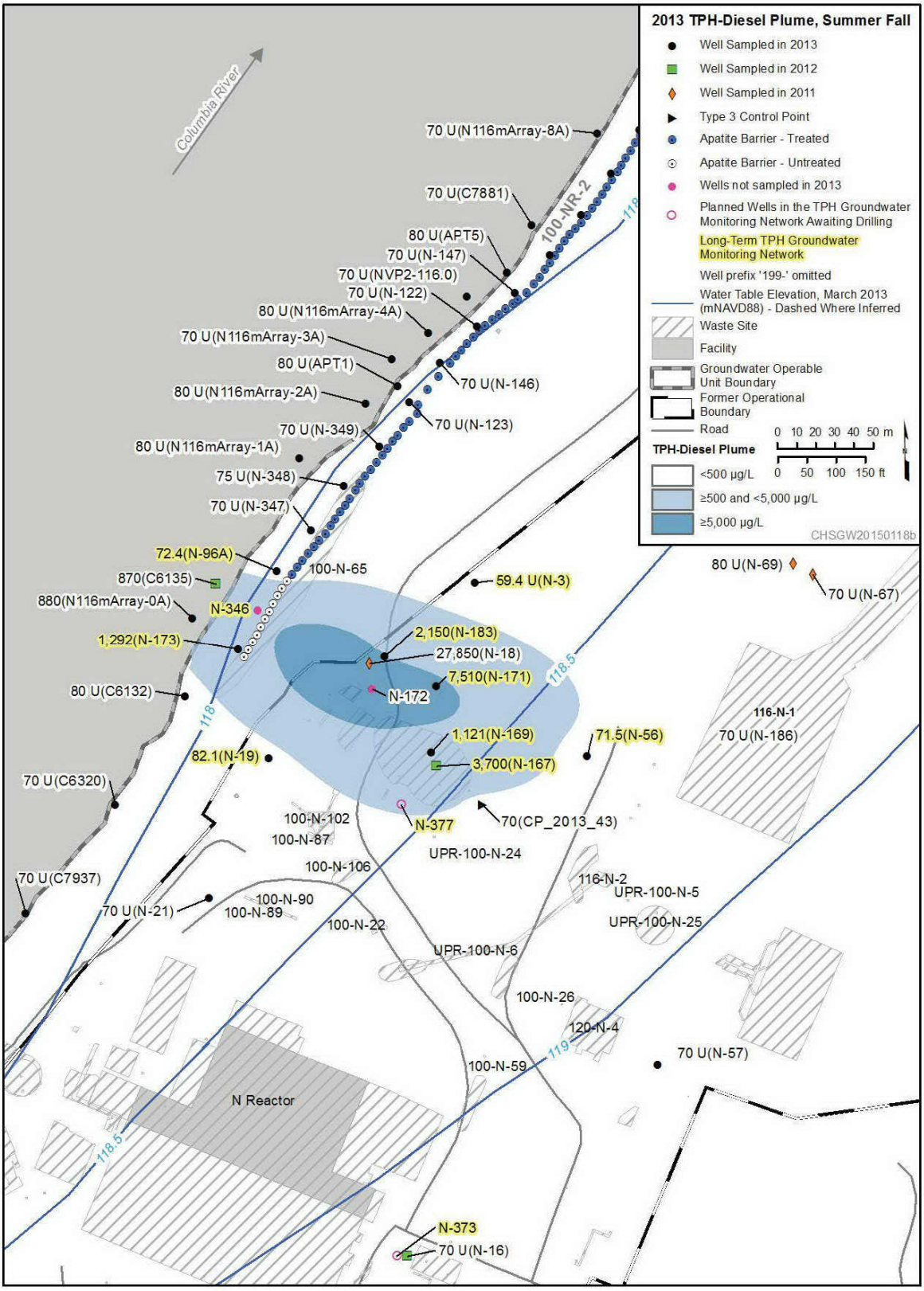

Figure A1-17. 100-NR-2 OU TPH Groundwater Monitoring Network

A1.8.3.3.6 Tritium Concentration Verification

- Tritium long-term monitoring assumptions
  - Historical primary tritium plume for the 100-NR-2 OU
    - Long-term monitoring is based on 2013 data (defined tritium plume that is below the DWS; there is currently only 1 well >DWS).
    - Monitoring will be focused on Well 199-N-186.
    - High river stage influences plume movement and would be expected to temporally change local concentrations.
    - Sampling will occur annually during low river stage (mid-September through mid-November) within a 4-week period to capture concentrations during time of groundwater flow towards the river.
  - Emerging tritium plume for the 100-NR-2 OU
    - Residual vadose source contribution is possible from the 100-N fuel storage basin and 100-N-66.
    - Based on one aquifer tube cluster >DWS.
    - Preferential pathway is assumed to be related to construction of the outfall.
- Monitoring wells (existing and new; see Table A1-12 and Figure A1-18)
  - Three new monitoring wells (199-N-371, 199-N-372, and 199-N-374) will characterize the area near Aquifer Tube C7934.
  - As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter)
  - The new wells will be analyzed for Sr-90, tritium, and nitrate.
- Aquifer tubes (see Table A1-12 and Figure A1-18)
  - Sampling frequency 1x/year at low river stage (mid-September through mid-November) within a 4-week period.

Table A1-12. 100-NR-2 Tritium Groundwater Monitoring Network

Well Type	Monitoring Location (15)	Network	Northing	Easting	Tritium Network Addresses PSQs	Sample Frequency for Tritium	WAC Compliant? (Yes or No)
Deep unconfined	199-N-182	Tritium, nitrate	149819.87	571428.71	3, 4, 5 and 7	A	Yes
Unconfined	199-N-184	Tritium, nitrate, Sr-90	149817.82	571430.74	3, 4, 5 and 7	A	Yes
Unconfined	199-N-186	Tritium, nitrate, Sr-90	149715.06	571480.87	3, 4, 5 and 7	A	Yes
Planned unconfined	199-N-371	Tritium, Sr-90	149572.86	571130.67	3, 4, 5 and 7	Q/A	Yes
Planned unconfined	199-N-372	Tritium, Sr-90, nitrate	149502.95	571100.16	3, 4, 5 and 7	Q/A	Yes
Planned unconfined	199-N-374	Tritium, Sr-90	149533.74	571112.10	3, 4, 5 and 7	Q/A	Yes
Aquifer tube	C6317, C6318, C6319[a]	Tritium, Sr-90	149554.40	571023.87	3, 4, 5 and 7	SA	No
Aquifer tube	C7934, C7935, C7936[a]	Tritium, Sr-90	149577.50	571048.23	3, 4, 5 and 7	SA	No
Aquifer tube	C7937, C7938, C7939[a]	Tritium, Sr-90	149621.34	571081.92	3, 4, 5 and 7	SA	No

a. Tritium detected at these locations may be indicative of a continuing source associated with the 1908-N Outfall. As such, these locations are sampled semiannually

Principal study questions (PSQs):

PSQ 3. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 4. Are there increasing concentrations in groundwater indicating newly identified or continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

PSQ 5. Is there evidence that Columbia River water quality is being protected?

PSQ 7. Is additional information needed for a final record of decision?

A = Annual. Annual sampling targets low river stage (mid-September through mid-November timeframe). The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

SA = Semiannual. Semiannual targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe). The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

TPH = total petroleum hydrocarbons WAC = *Washington Administrative Code*

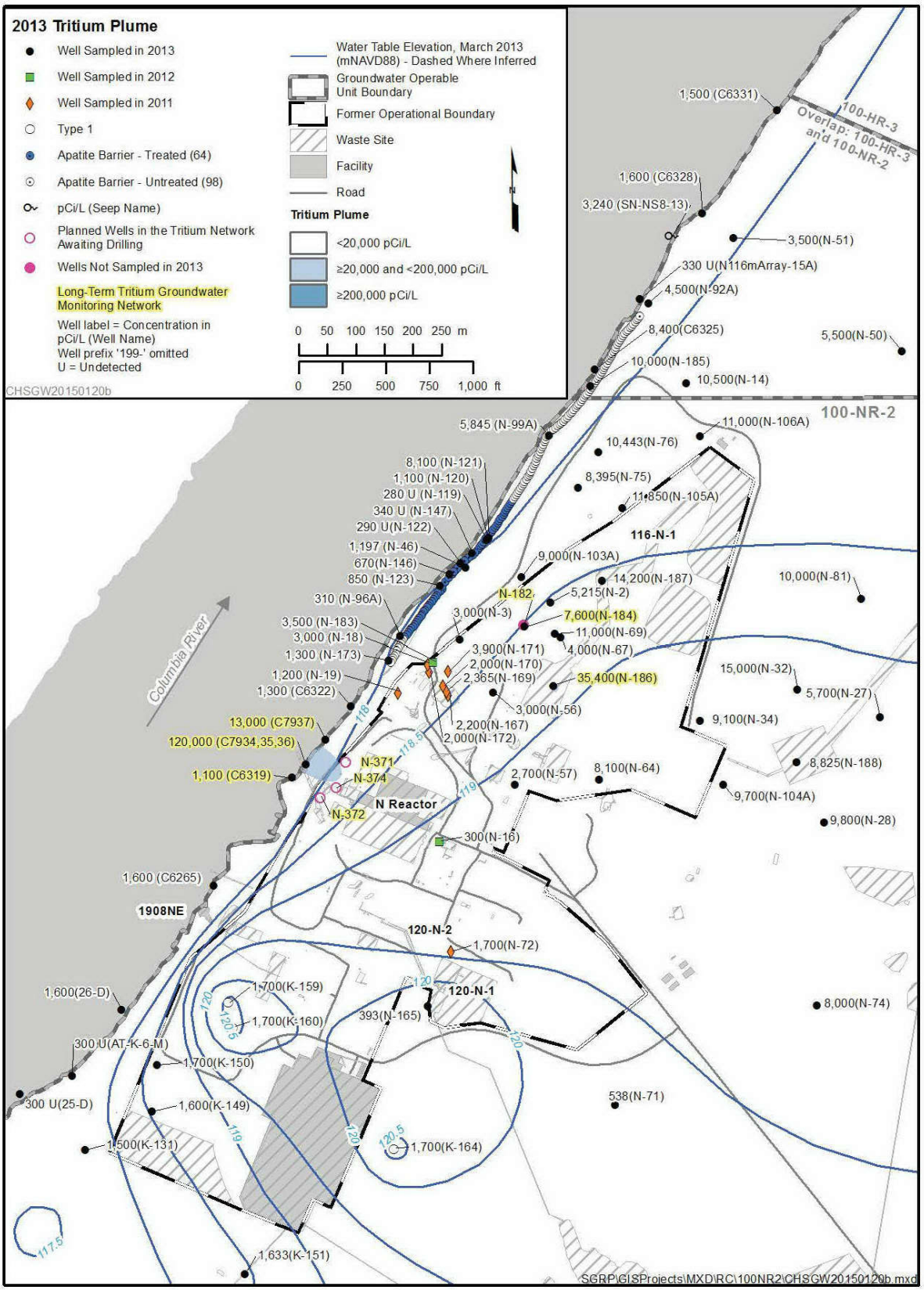

Figure A1-18. 100-NR-2 OU Tritium Groundwater Monitoring Network

A1.8.3.3.7 Hexavalent Chromium and Metals

- Hexavalent chromium and metals long-term monitoring assumptions
  - The 100-K Area is the principal source of the hexavalent chromium within the 100-NR-2 OU. Except as noted below, the 100-KR-4 SAP shall address hexavalent chromium contamination.
  - The 100-NR-2 OU SAP will address hexavalent chromium contamination in the vicinity of Well 199-N-96A and in Well 199-N-80 (RUM well).
  - The occurrence of antimony, cadmium, and cobalt in groundwater is uncertain because these analytes historically have been detected in groundwater at concentrations above their respective action level; however, their presence was not associated with a specific location or a trend and the analytical methods used were not of sufficient accuracy for risk characterization purposes. Therefore, antimony, cadmium, and cobalt are retained as COPCs (DOE/RL-2012-15, Draft A, Chapter 6.)
- Monitoring wells (existing and new; see Table A1-13 and Figure A1-19)

Sampling frequency 1x/year at low river stage (mid-September through mid-November) within a 4-week period.

Table A1-13. 100-NR-2 Hexavalent Chromium and Metals Groundwater Monitoring Network of 12 Wells

Well Type	Monitoring Location	Network	Northing	Easting	Cr(VI)/Metals Network Addresses PSQs	Sample Frequency for Metals	WAC Compliant? (Yes or No)
Unconfined	199-N-14	Metals, nitrate, Sr-90	150243.37	571713.10	3, 4, 5, 6, and 7	A	No
Unconfined	199-N-41	Metals, nitrate, Sr-90	149965.26	572182.24	3, 4, 5, 6, and 7	A	No
Unconfined	199-N-57	Metals, nitrate Sr-90	149830.32	571969.90	3, 4, 5, 6, and 7	A	No
Unconfined	199-N-67	Metals, nitrate, Sr-90,	149798.95	571494.16	3, 4, 5, 6, and 7	A	No
Deep confined	199-N-80	Cr(VI), Cr, metals	149950.85	571477.58	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-96A	Cr(VI), metals, PRB, BV, TPH, Sr-90, nitrate	149800.76	571213.47	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-146	Metals, PRB, Sr-90	149909.74	571298.80	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-167	Metals, BV, TPH, nitrate	149698.29	571296.75	3, 4, 5, 6, and 7	A	Yes

Table A1-13. 100-NR-2 Hexavalent Chromium and Metals Groundwater Monitoring Network of 12 Wells

Well Type	Monitoring Location	Network	Northing	Easting	Cr(VI)/Metals Network Addresses PSQs	Sample Frequency for Metals	WAC Compliant? (Yes or No)
Unconfined	199-N-173	Metals, PRB, BV, nitrate, TPH, Sr-90	149759.67	571193.02	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-183	Cr(VI), metals, BV, nitrate, TPH, Sr-90	149756.01	571269.69	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-188	Metals, nitrate, Sr-90	149581.53	571906.94	3, 4, 5, 6, and 7	A	Yes
Unconfined	199-N-353	Metals, PRB, Sr-90, nitrate	150031.62	571403.29	3, 4, 5, 6, and 7	A	Yes

Principal study questions (PSQs):

PSQ 3. Is there evidence of Interim Action Record of Decision contaminant of concern plume, concentration, area, or location changes?

PSQ 4. Are there increasing concentrations in groundwater indicating newly identified or continuing sources of contamination to groundwater (e.g., Sr-90 and tritium near the 1908-N Outfall)?

PSQ 5. Is there evidence that Columbia River water quality is being protected?

PSQ 6. How do adjacent operable units influence 100-NR-2 Operable Unit remedies?

PSQ 7. Is additional information needed for a final record of decision?

A = Annual. Annual sampling targets low river stage (mid-September through mid-November timeframe). The low river stage sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BV = Bioventing. This network will be sampled and analyzed for alkalinity, anions, unfiltered metals, TPH-D, TPH-G, TPH motor oil, oil and grease, PAH, and VOA (BTEX). Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, turbidity, sheen, and odor. Prior to purging the well, a transparent bailer and/or electronic oil water interface probe will be used to collect a grab sample to evaluate the presence of sheen.

PRB = Existing permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Exception: Wells 199-N-268, 199-N-269, 199-N-280, 199-N-281, 199-N-297, 199-N-298, 199-N-315, 199-N-316, 199-N-332, 199-N-333, 199-N-342, and 199-N-343 are not sampled for TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

BTEX = benzene, toluene, ethylbenzene, and xylene

PAH = polycyclic aromatic hydrocarbons

PRB = permeable reactive barrier

TPH-D = total petroleum hydrocarbons-diesel

TPH-G = total petroleum hydrocarbons-gasoline

WAC = *Washington Administrative Code*

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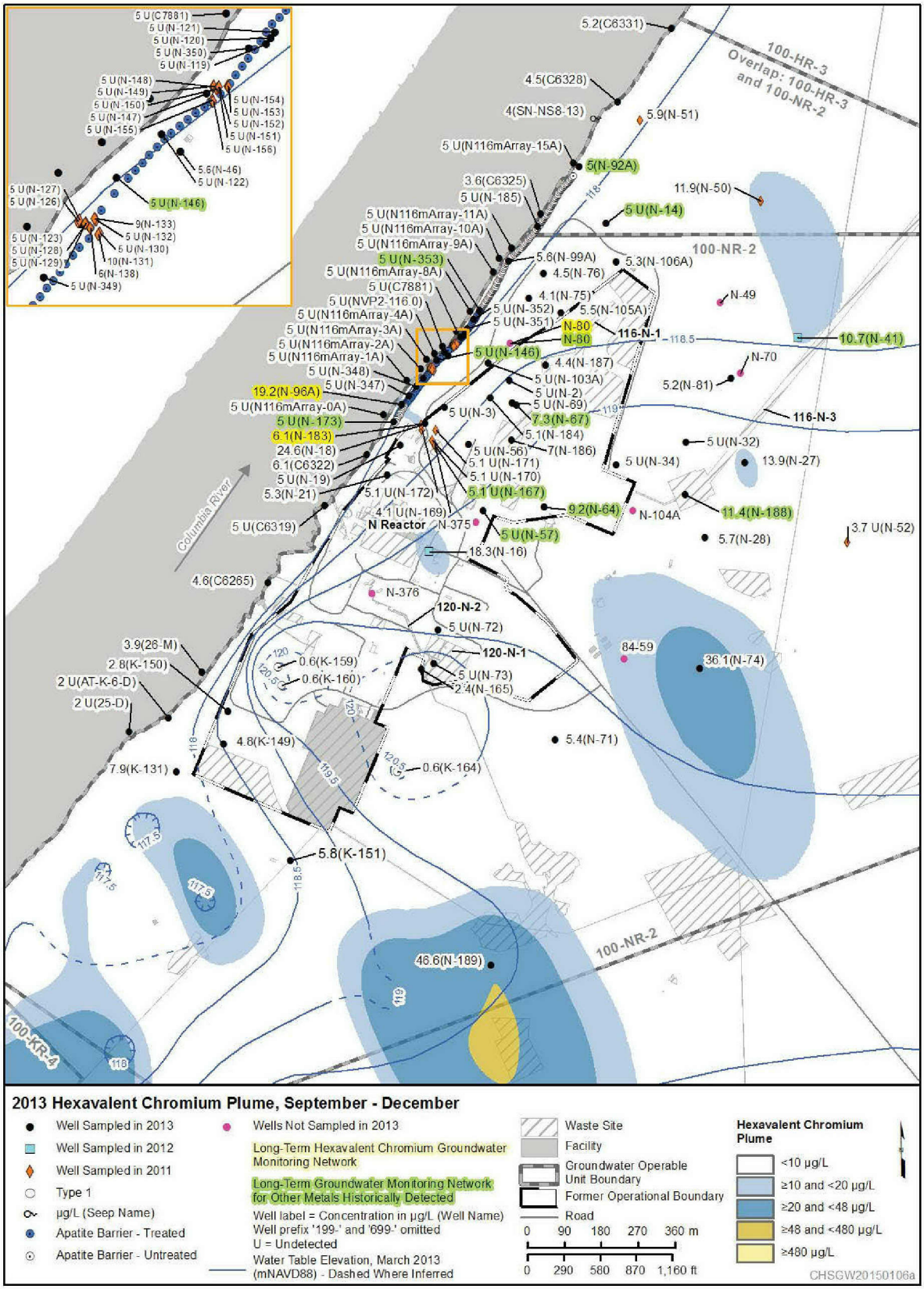

Figure A1-19. 100-NR-2 OU Hexavalent Chromium and Metals Network

A1.8.3.3.8 Water Level Monitoring

- Assumptions
  - Automated water level, river gauge and manual measurements will be collected within the 100-NR-2 OU.
  - Water level monitoring will be performed in the wells identified in Table A1-6.
  - Water level monitoring will also be performed during the sampling event at each monitoring well.
  - Monitoring will be performed once in March for certain wells identified in SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*.

A1.8.3.4 Additional Data from New Wells

- Geologic samples
- Sediment (soil) samples for analytical evaluation of COPCs
- Aquifer properties (slug tests)
- Other data as defined by new well drilling sampling plan.

A1.8.3.5 Use of Old Wells

- Evaluate pre-WAC wells for suitability (e.g., review documentation where available, perform camera surveys, borehole geophysics, field inspections) as needed.

Rehabilitate wells as appropriate (e.g., routine maintenance)

A1.8.3.6 Analytes (include in matrix summaries above)

- COCs specific to each location (see Tables A1-7 through A1-13)
- COPCs in wells that had detections in the past (information in the Groundwater Annual Report)
- Field parameters (specific conductance, pH, turbidity, temperature, dissolved oxygen, oxidation-reduction potential, sheen/odor)

A1.8.3.7 Sampling Frequency

Sample frequency defines the number of sampling events planned over a given time period. The sample frequencies identified for the 100-NR-2 OU are as follows: annual (once a year), semiannual (two times per year), quarterly (four times a year), and annually every 5 years (once every 5 years). On the Hanford Site, the groundwater sampling frequency has historically been defined as semiannual along the river to account for seasonal changes in the water table due to Columbia River stage.

Determination of sample frequency is guided by the goals of the monitoring program, quality and quantity of the available data, the hydrology of the aquifer system, and the CSM. These considerations are discussed briefly in this section. Justification for the selected sample frequency is also provided at the end of this section for the 100-NR-2 OU groundwater monitoring networks.

The basic goals of the 100-NR-2 OU groundwater monitoring program are threefold:

1. Determine the effectiveness of two remedial alternatives (i.e., performance monitoring systems) to reduce Sr-90 and TPH concentrations.

2. Collect data to monitor changes relative to the documented concentrations and the extent of Sr-90, tritium, nitrate, TPH, and hexavalent chromium contamination.

3. Collect data to reduce uncertainty about concentrations of antimony, cadmium, and cobalt in groundwater

Groundwater data have been collected in the 100-NR-2 OU for more than 30 years. In most cases sufficient data are available to evaluate the nature and extent of contamination. However, due to historical sampling using analytical methods with practical quantitation limits above current action levels for some metals, uncertainty remains concerning whether concentrations of antimony, cadmium, and cobalt are above action levels and need further evaluation. Data are also needed to support performance monitoring. For the two performance monitoring systems, data are periodically needed to verify the effectiveness of the cleanup remedy. Groundwater data quality applicable to other analytes is considered acceptable for use. Currently data are lacking where no existing wells are present in the area. In this case, quarterly sampling is applicable once the new wells are installed.

The Columbia River forms the northwest boundary of the 100-NR-2 OU and is a discharge boundary for the unconfined aquifer. Changes in the elevation of the river can guide sample frequency because groundwater flow direction changes seasonally in the 100-NR-2 OU. The elevation of the Columbia River generally varies seasonally in response to water released upriver at Priest Rapids Dam. The rise and fall of the river creates zones of surface water and groundwater interaction. When the elevation of the river is high (i.e., high river stage), river water moves into bank storage. When river stage is low (i.e., low river stage), groundwater flows from areas of higher elevation and discharges to the river. Changes in river stage are most evident along the river. It has been reported that river stage influences groundwater elevations over 1 km inland from the river (Section 3.6 of DOE/RL-2012-15).

The CSM for the 100-NR-2 OU indicates that the groundwater is contaminated and will remain so for an extended period (~300 years). Sr-90 is the main COC and risk driver in groundwater. The Sr-90 plume is shown in Figure A1-6. Its shape and size have not changed much since effluent discharges to the soil column from N Reactor were terminated. Other contaminants in groundwater include TPH, nitrate, tritium, hexavalent chromium, and chromium. Additional information on these contaminants is provided in Section A1.4.

In practice, sample frequencies are typically larger when little data are available, sample quality is poor, and when seasonal variations in the groundwater flow system are impacted. Greater sample frequencies may also be required when data are required to determine the effectiveness of an operating remedy or to verify that groundwater is no longer contaminated. A reduced sample frequency may be applicable when plume concentrations are based on years of data, the plume geometry is relatively stable, or the groundwater system is not impacted by seasonal variation.

A1.8.3.7.1 100-NR-2 OU Sample Frequency, Sample Event Duration, and River Stage Guidelines

The guidelines and definitions in this subsection are established to assist in obtaining samples that meet the specific objectives (e.g. “low river stage sample”) and increase the comparability of sample event results from year to year.

Sampling Event Duration

To improve year-to-year comparability and obtain a better concurrent evaluation of conditions throughout the contaminant plume, sampling events should be completed within the narrowest timeframe practical. For the purposes of the 100-NR-2 SAP, the goal for the event duration should be no longer than 1 month. This is not anticipated to be difficult to achieve in most years, with the possible exception of the event that occurs at low river stage every 5 years (when most sample points at the 100-N Area will be sampled). Special arrangements or an exception to the goal may be required for those sampling events.

River Stage Definitions

Based on a review of river stage data for the period from 1992 through 2013, “low river” stage generally occurs in the September through January timeframe; however, there is generally a gradual increase in

river stage from about October throughout the remainder of that period. The most consistently low period is from September through October. Based on this and to avoid the start of the low river stage, "low river" stage for sampling purposes will be assumed to occur from mid-September through mid-November. The start of the low river stage is avoided both because it may not be actual low river stage in certain years and because data from 100-B/C Area sampling have indicated that effects of river stage changes are most evident after extended periods at the new stage. Based on the same 1992 to 2013 data set, the most consistent high river period is from mid-May through mid-July. Based on this, "high river" stage for sampling purposes will be assumed to occur from mid-May through mid-July. In this case the period is not shifted 2 weeks later because in a significant number of years there is substantial reduction in river stage during the July period.

As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling may continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

Apatite Barrier Network. Wells and aquifer tubes in this network are located along the river. Sampling of performance monitoring wells/aquifer tubes will be conducted two times per year to account for seasonal changes in the groundwater flow regime and performance data needs. The sampling events will be conducted during high (mid-May through mid-July) and low (mid-September through mid-November) river stage. All sample collection for the high river stage event should be planned to be collected within a 4-week sampling event window. All sample collection for the low river stage should be planned to be collected within a 4-week sampling event window. High and low river stage sampling events, respectively, in the other 100-NR-2 OU networks (e.g., TPH, metals, hexavalent chromium) should also be coordinated and completed in the same timeframe.

Bioventing Network. Wells and aquifer tubes in this network are located along the river and inland. Sampling of performance monitoring wells/aquifer tubes will be conducted two times per year to account for seasonal changes in the groundwater flow regime and performance data needs. The sampling events will be conducted during high (mid-May through mid-July) and low (mid-September through mid-November) river stage. All sample collection for the high river stage event should be planned to be collected within a 4-week sampling event window. All sample collection for the low river stage event should be planned to be collected within a 4-week sampling event window. High and low river stage sampling events, respectively, in the other 100-NR-2 OU networks (e.g., TPH, metals, hexavalent chromium) should be coordinated and completed in the same timeframe.

Strontium-90 Network. Wells in this network should be sampled in 2015 at low river stage (mid-September through mid-November) and every 5 years thereafter. A decreased monitoring frequency is selected for this network because the plume geometry has not changed in years and attenuation of contamination is anticipated to take place over an extended period of time (~300 years). All sample collection for the low river stage event should be planned to be collected within a 4-week sampling event window. Additionally, low river stage sampling in the other 100-NR-2 OU networks should be coordinated and completed within the same 4-week timeframe. It was proposed to change the sampling event to high river stage because high concentrations are sometimes observed during this time. A review of the data shows that high concentration can be observed during high and low river stage. Although some concentrations in some locations may be higher at high river stage due to continuing source from the PRZ, the goal is to monitor the overall long-term trend in attenuation of Sr-90 contamination. Monitoring at only low river stage will be adequate for monitoring the trends. In the future, when the goal changes to

attainment monitoring, the SAP will need to be revised to address the timing of the highest anticipated concentrations for evaluation of attainment on a well-by-well basis.

Tritium, Nitrate, TPH, Hexavalent Chromium, and Metals Groundwater Monitoring Network. Wells in these networks should be sampled at low river stage (mid-September through mid-November). All sample collection for the low river stage event should be planned to be collected within a 4-week sampling event window. Additionally, low river stage sampling in the other 100-NR-2 OU networks should be coordinated and completed within the same 4-week timeframe. A reduced sampling frequency is selected for these networks because the subject contaminants are not the main OU risk drivers and the groundwater will not be usable in the near term because of the Sr-90 contamination. Collection of data one time per year is deemed sufficient for monitoring the nature and extent of these contaminant concentrations. Furthermore, because some of these contaminants are also sampled in the performance monitoring networks, additional seasonal data will be available.

A1.8.3.8 Quality Assurance and Quality Control Program

Quality assurance/quality control will be integrated with the Groundwater Remediation Project; documented in the SAP.

A1.8.3.9 Rationale for New Well Locations (see Table A1-14 and Figure A1-20 for well coordinates and locations)

1. Well 199-N-371 (C9400). This well location is positioned as one of three new wells downgradient of the 105-N Reactor building. It is slightly downriver and upgradient of the aquifer tube cluster C7934-C7936 where an isolated pocket of Sr-90 and tritium groundwater contamination has been detected. This well location is just above the river bench and is located in an area near previously remediated waste sites. This location is also downgradient of the large volume UPR sites UPR-100-N-3 and UPR-100-N-12 and the deep contamination zone associated with the 100-N-66 waste site.

    a. This well provides new groundwater monitoring location upgradient of detected Sr-90 hot spot and downgradient of UPR sites. Currently, there is no active groundwater monitoring downgradient of the reactor building.

    b. This well provides groundwater characterization data between reactor and river.

    c. This well supports assessment of vadose zone waste site remediation and evaluation of Sr-90 hot spot extent.

    d. This well will characterize the entire unconfined aquifer interval to the lower boundary (RUM).

2. Well 199-N-372 (C9401). This well location is positioned as one of three wells downgradient of the 105-N Reactor building. It is nearest to the 100-N-79 Spillway that discharged from the 1908-N Outfall structure and upgradient from the aquifer tube cluster C7934-C7936 where an isolated pocket of Sr-90 and tritium contamination is being detected. Nitrate should also be present at this location. This well location is just above the river bench within the area of previously remediated waste sites and downgradient of the large-volume UPR-100-N-7 UPR and the 100-N-66 waste site near the main reactor building (fuel storage building).

    a. This well provides new groundwater monitoring location upgradient of detected Sr-90 and tritium hot spot and near the outfall structure preferential pathway potential source area. This location will also provide downgradient monitoring near the UPR and the reactor fuel storage basin

(currently no active groundwater monitoring occurs downgradient of the reactor building). This well will also be used to better define the nature and extent of the nitrate plume.

b. This well provides groundwater characterization data between the reactor and the river.

c. This well supports assessment of waste site remediation and determination of likely Sr-90 and tritium pathway/source (i.e., 1908-N).

d. This well will characterize the entire unconfined aquifer interval to the lower boundary (RUM).

3. Well 199-N-373 (C9402). This well location is positioned upgradient of the main reactor building and downgradient from the decommissioned 184-N Powerhouse and associated fuel oil day tanks.

   a. This well provides new groundwater monitoring location upgradient of nitrate groundwater plume. Currently no active groundwater monitoring occurs in this area upgradient of the reactor building.

   b. This well provides groundwater monitoring data for assessment of the nitrate plume and confirmation that petroleum is not present in the groundwater.

   c. This well will characterize the entire unconfined aquifer interval to the lower boundary (RUM).

   d. This well provides additional impact assessment capability during the 100-KR-4 P&T operations.

4. Well 199-N-374 (C9403). This well location is positioned as one of three wells downgradient of the 105-N Reactor building. It is upgradient of the Sr-90 and tritium hot spot near the boundary of the 100-N-66 waste site (which includes the partially remediated footprint of the fuel storage basin). Washington Closure Hanford has indicated (CCN 177341, "100-N-66, 105-N/109-N Reactor Building Complex for Remedial Action") that the 100-N-66 waste site (including the fuel storage basin) will be remediated (RTD) after the disposition of the 105-N Reactor safe storage enclosure. The proposed new well location will provide groundwater monitoring downgradient of the 100-N-66 waste group until remediation is complete.

   a. This well provides groundwater characterization data that will fill data gaps related to tritium and Sr-90 extent within the deep vadose zone, and unconfined aquifer near the fuel storage basin.

   b. This well provides new groundwater monitoring location in the potential groundwater pathway between the aquifer tube hot spot and potential deep vadose zone residual Sr-90/tritium contamination waste sources.

   c. This well provides data to define concentration boundaries for the tritium/Sr-90 groundwater hot spot.

5. Well 199-N-376 (C9425). This well location is positioned on the upriver side of the 105-N Reactor building and downgradient of suspected nitrate plume sources (several large septic systems in the area around 120-N-1).

   a. This well provides groundwater characterization data that will fill data gaps related to nitrate extent and delineation of potential sources within the unconfined aquifer.

   b. This well provides characterization and determination of potential contaminant pathway (nitrate).

   c. This well will characterize the entire unconfined aquifer interval to the lower boundary (RUM).

6. Well 199-N-377 (C9429). This well location is positioned on the upriver and upgradient edge of the TPH petroleum plume and downgradient of the remediated 116-N-1 waste site. The well provides a new groundwater monitoring location to define a lateral upriver boundary of the TPH plume. This location would also characterize residual petroleum contamination remaining in the deep vadose zone beneath the remediated 100-N-84:2 pipeline excavation at test pit 4 (Appendix C of "Remaining Sites Verification Package for the 100-N-84:2, 100-N Area Fuel and Foam Pipelines Subsite" [attachment to WSRF 2014-088, *Waste Site Reclassification Form*, Operable Unit 100-NR-1, Waste Site Code 100-N-84:2]). Additionally, this location supports delineation of the main Sr-90 plume and the separate hot spot located upriver.

    a. This well provides groundwater characterization data that will fill data gaps related to nitrate and TPH groundwater plume extent and delineation of potential residual source within the deep vadose zone associated with the 100-N-84:2 waste site.

    b. This well provides characterization and determination of potential contaminant pathway (TPH, Sr-90).

    c. This well will characterize the entire unconfined aquifer interval to the lower boundary (RUM).

The proposed locations may need to be moved based on accessibility or results of ecological/cultural reviews. If locations are moved more than ~20 m (66 ft), DOE and Ecology will be consulted for concurrence.

Table A1-14. Proposed New 100-NR-2 Monitoring Well IDs and Coordinates

Well Name	Well ID	Northing	Easting
199-N-371	C9400	149572.86	571130.67
199-N-372	C9401	149502.95	571100.16
199-N-373	C9402	149442.00	571276.00
199-N-374	C9403	149533.74	571112.10
199-N-376	C9425	149338.62	571141.08
199-N-377	C9429	149678.00	571278.00

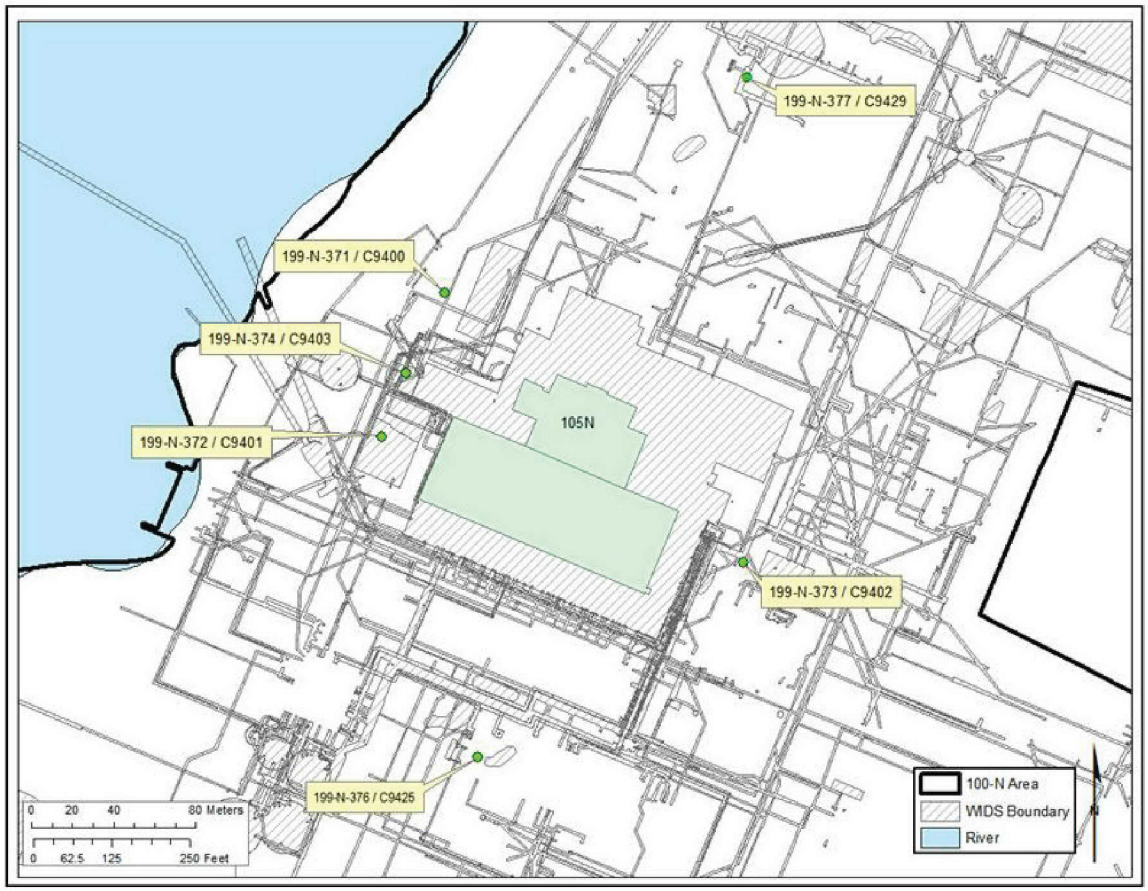

Figure A1-20. New 100-NR-2 OU Monitoring Well Locations

A1.8.3.10 Additional New Wells

Locations of any future additional wells will be determined based on the results of sampling the new wells listed above. For example, if COC concentrations in new wells intended to delimit plumes are greater than the DWS, installation of additional wells to delineate the extent of contamination should be considered. The results from the installation and monitoring of the three wells downgradient of the reactor will provide information to evaluate the potential need and urgency of an additional soil boring/well through the footprint of the fuel storage basin.

A1.8.4 Interpretation of Groundwater Data

Groundwater data will be used to evaluate hydrologic and contaminant impacts on the aquifer. Water level data will be used mainly to evaluate hydraulic changes within the aquifer. These data can be used to determine groundwater flow direction, gradients, and river stage. Contaminant data will be used to evaluate the nature (type and concentration) and extent of contamination. Interpretive tools commonly used to evaluate hydrologic and contaminant impacts may include the following:

- Hydrographs: Graphs of water table elevations versus time. These graphs show seasonal and man-made fluctuations in groundwater levels.
- Water table maps: Water table elevations from multiple wells are used to construct contour maps of the water surface and estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential on the maps.

- Trend plots: Graphs of contaminant concentrations in groundwater versus time. This tool is used to determine if contaminant concentrations are increasing or decreasing overtime. Trend plots may be used in tandem with hydrographs and/or water table maps to determine if concentrations are related to changes in water level or groundwater flow directions.

- Plume maps: Plume maps show the distributions of chemical constituent concentrations in the aquifer to determine the extent of contamination. Changes in plume distribution over time assist in determining plume movement and direction of groundwater flow.

Statistical tests can also be used to show population changes in groundwater quality. These tests can be used to evaluate the normality of the data, nondetects, and outliers, and determine if contaminant concentrations in groundwater are statistically increasing or decreasing. Increasing contaminant concentration may be indicative of a continuing source of contamination from the vadose zone. Decreasing concentrations are an indicator of improved groundwater quality. Potential statistical tests are shown in Table A1-15.

Table A1-15. Statistical Test

Test	Description	Reference
Normality Test		
Shapiro-Wilk Test	Shapiro-Wilk test is used to test for normality when the number of data points is less than or equal to 50. Tests the correlation of the ordered values to the quantiles taken based on a normal distribution.	Shapiro and Wilk, 1965; EM 1110-1-4014, Appendix I; EPA 530-R-09-007
Shapiro-Francia	Shapiro-Francia test is used to test for normality when the number of data points is greater than 50. Tests the correlation of the ordered values to the quantiles taken based on a normal distribution.	Shapiro and Francia, 1972; EM 1110-1-4014, Appendix I; EPA 530-R-09-007
Handling Nondetect Data		
Cohen's Adjustment	Cohen's adjustment is useful when more than 15% to 50% of the data are below the reporting limit. The adjustment alters the calculated mean and standard deviation based on the reporting limit. This method is recommended by the Washington State Department of Ecology.	Cohen, 1959; EPA 530-R-09-007; WAC 173-340-720
Robust Regression on Order Statistics (ROS)	ROS is useful when more than 15% to 50% of the data are below the reporting limit. Estimates values for the censored data based on the statistical distribution of the uncensored data.	Helsel, 2005; EPA 530-R-09-007
Kaplan-Meier	Kaplan-Meier is useful when more than 15% to 50% of the data are below the reporting limit and the ROS method is	Kaplan and Meier, 1958; EPA 530-R-09-007

Table A1-15. Statistical Test

Test	Description	Reference
Univariate Statistical Test*		
Fourth Spread	The test identifies outliers using a box-and-whisker plot. A value that is less than the difference of the 25th percentile and 3 times the inter-quartile range (IQR), or any result greater than the sum of the 75th percentile and 3 × IQR is identified as an "extreme" outlier. A result that is less than the difference of the 25th percentile and 1.5 times the inter-quartile range (IQR), or any result greater than the sum of the 75th percentile and 1.5 × IQR is identified as a "mild" outlier.	EM 1110-1-4014, Appendix I
Dixon's Test	Tests one value, either the highest or lowest value in the data set, and determines if it is a potential outlier. Used for datasets with more than 8 but less than 50 values.	EM 1110-1-4014, Appendix I; EPA 530-R-09-007
Discordance Test	Tests one value, either the highest or lowest value in the data set, and determines if it is a potential outlier. Used for datasets with more than 50 values.	EM 1110-1-4014, Appendix I
Trend Analysis		
Theil-Sen 0.95 UCL test	Calculates the trajectory of recently sampled results and calculates confidence intervals about the linear trend. The newly collected sample is compared to the confidence intervals to see if the sample result lies outside the confidence interval.	EPA 530-R-09-007
Lowess smoother: Change in Slope and Change in Datum	The lowess smoother algorithm, available in R statistical software, is used to fit a locally weighted polynomial regression to the data. The change in slopes and datum shifts calculated from the LOWESS smoother is used to detect changes in the trajectory of sampled results. This can be useful in identifying wells where contaminant concentrations are beginning to increase where they were previously decreasing. A change in datum can indicate an error in collection procedures or instrumentation. The lowess smoother was also used to detrend the data for application of univariate statistical analysis.	Cleveland, 1981; R Core Team, 2012

Table A1-15. Statistical Test

Test	Description	Reference
Cleveland, 1981, "LOWESS: A Program for Smoothing Scatterplots by Robust Locally Weighted Regression."		
Cohen, 1959, "Simplified Estimators for the Normal Distribution When Samples are Singly Censored or Truncated."		
EM 1110-1-4014, *Environmental Quality: Environmental Statistics*.		
EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities; Unified Guidance*.		
Helsel, 2005, *Nondetects and Data Analysis*.		
Kaplan and Meier, 1958, "Nonparametric Estimation from Incomplete Observations."		
R Core Team, 2012, *R: A Language and Environment for Statistical Computing*.		
Shapiro and Francía, 1972, "An Approximate Analysis of Variance Test for Normality."		
Shapiro and Wilk, 1965, "An Analysis of Variance Test For Normality (Complete Samples)."		
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A1.8.4.1 Smart Sponge Metrics

Smart sponges are weighed before placing into Well 199-N-18 and then again when removed to determine the mass of hydrocarbon product removed. Trending these data will be used to determine if smart sponge is effectively removing product and/or adjust frequency of smart sponge change out. Smart sponges should be capable of removing at least their own weight in hydrocarbon product.

Interface probe measurements and visual observation for sheen from groundwater samples during TPH bioremediation groundwater sampling will be used to determine the presence of floating hydrocarbon product in wells for effective removal with smart sponges.

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Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-3	BV, Nitrate, TPH	149794.61	571317.38	SA	N	Data from this well are needed to define the lateral extent of TPH contamination and provides evidence of biodegradation and migration adjacent to the existing plume; it also delineates nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within and adjacent to plumes.
Unconfined	199-N-14	Nitrate, Sr-90, Metals	150243.37	571713.10	A: Nitrate and Metals; A5: Sr-90	N	[a]Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm); it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within plumes.
Unconfined	199-N-19	BV, TPH, Nitrate	149702.45	571209.05	SA	N	Data from this well are needed to define the lateral extent of TPH contamination and provides evidence of biodegradation and migration adjacent to the existing plume; it also delineates nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within and adjacent to plumes.
Unconfined	199-N-21	Sr-90	149629.41	571177.78	A5	N	Data from this well are needed to define the lateral extent of Sr-90 contamination; it also monitors plume migration.
Unconfined	199-N-27	Nitrate, Sr-90	149659.79	572052.62	A: Nitrate; A5: Sr-90	N	Data from this well are needed to define the lateral extent of nitrate contamination; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within and adjacent to the plumes.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-28	Sr-90	149476.65	571955.27	A5	N	Data from this well are needed to define Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-34	Nitrate, Sr-90	149653.89	571737.41	A: Nitrate; A5: Sr-90	N	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm); it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within plumes.
Unconfined	199-N-41	Nitrate, Sr-90, Metals	149965.26	572182.24	A: Nitrate and Metals; A5: Sr-90	N	[a]Data from this well are needed to define the lateral extent of nitrate and Sr-90 contamination.
Unconfined	199-N-46	Nitrate, Sr-90	149921.35	571326.97	A: Nitrate; A5: Sr-90	N	[a]Data from this well are needed to define Sr-90 concentrations greater than or equal to the DWS (8 pCi/L); it also delineates nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within plumes.
Unconfined	199-N-50	Nitrate, Sr-90	150298.79	572090.90	A: Nitrate; A5: Sr-90	N	Data from this well are needed to define the lateral extent of nitrate and Sr-90 contamination.
Unconfined	199-N-51	Sr-90	150496.97	571796.10	A5	N	Data from this well are needed to define the lateral extent of Sr-90 contamination.
Unconfined	199-N-56	BV, TPH, Nitrate	149703.50	571375.87	SA	N	Data from this well are needed to define the upgradient extent of TPH contamination and provides evidence of biodegradation and migration adjacent to the existing plume; it also monitors plume migration and delineates nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within and adjacent to plumes.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-57	Sr-90, Nitrate, Metals	149830.32	571969.90	A: Nitrate and Metals; A5: Sr-90	N	[a]Data from this well are needed to define Sr-90 concentrations greater than or equal to the DWS (8 pCi/L); it also delineates nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within plumes.
Unconfined	199-N-64	Nitrate, Sr-90, metals	149551.18	571561.41	A: Nitrate and metals; A5: Sr-90	N	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm); it also delineates the lateral extent of Sr-90 contamination and will be used to monitor plume changes.
Unconfined	199-N-67	Nitrate, Sr-90, Metals	149798.95	571494.16	A: Nitrate, and Metals; A5: Sr-90	N	[a]Data from this well are needed to define the nature and extent of metal contamination; it also monitors plume migration and delineates nitrate concentrations greater than or equal to the DWS (45 ppm). The maximum Sr-90 concentration is detected in this well. As such, it delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L).
Unconfined	199-N-72	Nitrate	149249.65	571302.74	A	Y	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within the plume.
Unconfined	199-N-73	Nitrate	149168.99	571292.02	A	Y	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within the plumes.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-75	Nitrate, Sr-90	150060.72	571523.58	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm); it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plumes.
Unconfined	199-N-76	Nitrate, Sr-90	150122.12	571560.08	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm); it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plumes.
Deep Unconfined	199-N-77	Nitrate	149243.0	571309.8	A: Nitrate	Y	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm) within the plume at the base of the unconfined aquifer
Deep Confined	199-N-80	Cr(VI), Cr, and Metals	149950.85	571477.58	A	Y	[a]Defines Cr(VI) and total chromium concentrations greater than or equal to the cleanup level (48 ppb) and the safe DWS (100 ppb), respectively within the Ringold Formation Upper Mud. The maximum concentrations are detected in this well.
Unconfined	199-N-81	Nitrate, Sr-90	149866.09	572019.16	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm); it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plumes.
Unconfined	199-N-92A	PRB-E, Sr-90, Nitrate, metals	150383.53	571647.42	SA after upgradient well treatment; PRB. A5: Sr-90; A: Nitrate and metals	Y	This well is located down river of the PRB and will be sampled SA in the performance network after treatment of upstream wells with apatite. This well monitors changes adjacent to the barrier and downgradient of the Sr-90 plume. This well also defines the lateral extent of nitrate

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
							(A) and Sr-90 (A5) contamination and will be used to monitor changes adjacent to the plumes.
Unconfined	199-N-96A	Nitrate, Sr-90, BV, TPH, PRB, Cr+6, metals	149800.76	571213.47	SA: PRB and BV; A: Nitrate, Metals, TPH, and Tritium; A5: Sr-90	Y	Data from this location will be used to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates the lateral extent of Sr-90, nitrate, and TPH contamination; provides evidence of TPH biodegradation; and will be used to monitor changes adjacent to plumes. It also defines Cr+6 concentrations greater than or equal to AWQC (10 ppb) and will be used to assess the nature and extent of possible metal contamination.
Unconfined	199-N-99A	Sr-90, Nitrate	150151.41	571473.67	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to define Sr-90 concentrations greater than or equal to the DWS (8 pCi/L); it also delineates the lateral extent of nitrate contamination and will be used to monitor changes within and adjacent to the plume.
Unconfined	199-N-103A	Sr-90, Nitrate	149903.68	571424.79	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to define nitrate concentrations greater than or equal to the DWS (45 ppm); it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plumes.
Unconfined	199-N-104A	Sr-90	149542.63	571778.32	A5	Y	Data from this well are needed to define Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within plumes.
Unconfined	199-N-105A	Sr-90, Nitrate	150024.96	571602.30	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to define Sr-90 concentrations greater than or equal to the DWS (8 pCi/L); it also delineates nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within plumes.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-122	PRB, Sr-90	149928.81	571318.48	SA: PRB; A5: Sr-90	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-123	PRB, Sr-90	149889.37	571282.86	SA: PRB; A5: Sr-90	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-136	PRB, Sr-90	149940.73	571337.18	B: PRB; A5: Sr-90	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-146	PRB, Sr-90, Metals	149909.74	571298.80	B: PRB. A5: Sr-90; A: Metals	Y	[a]Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-147	PRB, Sr-90	149946.51	571338.34	SA: PRB; A5: Sr-90	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-159	PRB	149942.84	571340.00	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-167	BV, Nitrate, TPH, Metals	149698.29	571296.75	SA: BV; A: Nitrate, TPH, and Metals	Y	[a]Data from this well are needed to determine TPH plume concentrations greater than or equal to (500 ppb) and provides evidence of biodegradation within the plume. It is also used for BV baseline and injection, delineates nitrate plume concentrations greater than or equal to 45 ppm, and will be used to monitor changes within the plumes.
Unconfined	199-N-169	BV, TPH	149705.43	571293.97	SA: BV; A: TPH	Y	Data from this well are needed to evaluate TPH plume concentrations greater than or equal to (500 ppb) and provides evidence of biodegradation within the plume. Also used for BV baseline and injection.
Unconfined	199-N-171	BV, TPH	149740.08	571296.70	SA: BV; A: TPH	Y	Data from this well are needed to evaluate TPH plume concentrations greater than or equal to (500 ppb) and provides evidence of biodegradation within the plume. The maximum TPH concentration is detected in this well. Also used for BV baseline and injection.
Unconfined	199-N-172	BV	149738.54	571263.29	SA	Y	Data from this well are needed to determine TPH plume concentrations greater than or equal to (500 ppb) and provides evidence of biodegradation within the plume. Also used for BV baseline and injection.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-173	BV, PRB, Nitrate, TPH, Sr-90, Metals	149759.67	571193.02	SA: PRB and BV; A: Nitrate, Metals, TPH; A5: Sr-90	Y	[a]Data from this well are used to determine the effectiveness of PRB to reduce Sr-90. It also delineates TPH plume concentrations greater than or equal to (500 ppb) and provides evidence of biodegradation within the plume, delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L), defines the lateral extent of nitrate contamination, and will be used to monitor changes within and adjacent to plumes. This well will also be used to define the nature and extent of potential metal contamination.
Deep Unconfined	199-N-182	Nitrate, Tritium	149819.87	571428.71	A	Y	Data from this well define vertical extent of nitrate and tritium contamination.
Unconfined	199-N-183	BV, Nitrate, TPH, Sr-90, metals, Cr+6	149756.01	571269.69	SA: BV; A: Nitrate, TPH, and Cr+6; A5: Sr-90	Y	Data from this well delineate TPH plume concentrations greater than or equal to (500 ppb) and provide evidence of biodegradation within the plume. It also delineates the lateral extent of nitrate and Cr+6 contamination and Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within and adjacent to plumes. This well will also be used to define the nature and extent of potential metal contamination
Unconfined	199-N-184	Nitrate, Tritium, Sr-90	149817.82	571430.74	A: Nitrate and Tritium; A5: Sr-90	Y	Data from this well delineate nitrate concentrations greater than or equal to the DWS (45 ppm) and Sr-90 concentrations greater than or equal to the DWS (8 pCi/L). It also defines the lateral extent of tritium contamination and will be used to monitor changes within and adjacent to plumes.
Unconfined	199-N-185	Nitrate, Sr-90	150237.98	571546.33	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to evaluate the lateral extent of nitrate and Sr-90 contamination; also monitors plume migration.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-186	Nitrate, Sr-90, Tritium	149715.06	571480.87	A: Nitrate and Tritium; A5: Sr-90	Y	Data from this well are needed to evaluate tritium plume concentrations greater than or equal to the DWS (20,000 pCi/L). It also defines nitrate concentrations greater than or equal to the DWS (45 ppm) and will be used to monitor changes within the plume. The maximum nitrate concentration is detected in this well.
Unconfined	199-N-187	Nitrate, Sr-90	149897.96	571565.90	A: Nitrate; A5: Sr-90	Y	Data from this well are needed to evaluate nitrate concentrations greater than or equal to the DWS (45 ppm). It also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plumes.
Unconfined	199-N-188	Nitrate, Sr-90, Metals	149581.53	571906.94	A: Nitrate and Metals; A5: Sr-90	Y	[a]Data from this well are needed to evaluate the lateral extent of nitrate contamination; it also and delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within and adjacent to plumes.
Unconfined	199-N-200	PRB-E	149755.44	571196.16	B after installation of barrier	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-201	PRB-E	149759.46	571198.46	B after installation of barrier.	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-210	PRB-E	149795.42	571218.71	B after installation of barrier	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes adjacent to the plume.
Unconfined	199-N-211	PRB	149799.02	571221.25	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes adjacent to the plume.
Unconfined	199-N-229	PRB	149864.74	571271.28	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-230	PRB	149868.47	571274.06	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-247	PRB	149994.14	571381.44	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-248	PRB	149997.93	571383.91	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-268	PRB	150074.61	571433.49	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-269	PRB	150078.94	571436.02	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-280	PRB	150122.77	571457.93	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-281	PRB	150127.35	571459.57	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-297	PRB, Sr-90	150182.74	571504.78	B: PRB; A5: Sr-90	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-298	PRB	150186.18	571508.01	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-315	PRB	150247.530	571555.86	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-316	PRB	150251.37	571558.24	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-332	PRB, Sr-90	150314.30	571595.38	B: PRB; A5: Sr-90.	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-333	PRB	150318.21	571597.44	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-342	PRB	150349.47	571623.93	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes adjacent to the plume.
Unconfined	199-N-343	PRB	150353.33	571627.19	B	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes adjacent to the plume.
Unconfined	199-N-346	PRB-E, TPH	149780.23	571203.32	SA after installation of PRB; A: TPH	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L), TPH plume concentrations greater than or equal to (500 ppb) and will be used to monitor changes adjacent to the plume.
Unconfined	199-N-347	Sr-90, PRB-E, Nitrate	149822.23	571231.25	SA after installation of PRB; A: Nitrate, A5: Sr-90	Y	Data from this location are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river. It also delineates nitrate concentrations greater than or equal to the DWS (45 ppm), the lateral extent of Sr-90 contamination, and will be used to monitor changes within and adjacent to the plumes.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-348	PRB, Sr-90	149845.23	571248.28	SA: PRB; A5: Sr-90	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-349	PRB, Nitrate	149866.13	571267.16	SA: PRB; A: Nitrate	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-350	PRB	149966.26	571356.74	SA	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-351	PRB	149987.11	571373.17	SA	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-352	PRB, Sr-90	150009.03	571388.72	SA: PRB; A5: Sr-90	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-353	PRB, Sr-90 Nitrate, Metals	150031.62	571403.29	SA: PRB; A: Nitrate and Metals; A5: Sr-90	Y	[a]Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates the lateral extent of Sr-90 and nitrate contamination and monitors changes adjacent to plumes.
Unconfined	199-N-354	PRB-E	150055.09	571418.57	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-355	PRB-E	150077	571431.65	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-356	PRB-E	150101.5	571446.09	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-357	PRB-E	150125.44	571456.35	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-358	PRB-E	150148.67	571466.28	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-359	PRB-E	150168.77	571484.18	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-360	PRB-E	150186.77	571154.04	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-361	PRB-E	150206.98	571373.17	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-362	PRB-E	150228.08	571538.55	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Unconfined	199-N-363	PRB-E	150249.9	571554.65	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-364	PRB-E	150273.49	571569.71	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-365	PRB-E	150296.66	571583.77	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-366	PRB-E	150317.84	571594.87	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Unconfined	199-N-367	PRB-E	150340.41	57161.38	SA after installation of PRB	Y	Data from this well are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates the lateral extent of Sr-90 contamination and will be used to monitor changes adjacent to and downgradient of the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Planned Unconfined	199-N-371	Sr-90, Tritium	149572.86	571130.67	Q during year 1 for groundwater COPCs (Sr-90, tritium, nitrate, hexavalent chromium, total chromium, gross beta, TPH, and ethylbenzene) followed by A for tritium. A5 for Sr-90. If the remaining COPCs are above cleanup levels, monitoring shall be performed at least annually.	Y	Data from this new well are needed to evaluate the nature and extent of Sr-90 and tritium contamination between N Reactor and the river. See details in Step 7. All "planned wells" in this report are sampled for 100-NR-2 COPCs to evaluate concentrations and the extent of contamination.
Planned Unconfined	199-N-372	Nitrate, Sr-90, Tritium	149502.95	571100.16	Q during year 1 for groundwater COPCs (Sr-90, tritium, nitrate, hexavalent chromium, total chromium, gross beta, TPH, and ethylbenzene) followed by A for tritium and nitrate; A5 for Sr-90. If the remaining COPCs are above cleanup levels, monitoring shall be performed at least annually.	Y	Data from this new well are needed to evaluate the nature and extent of nitrate, Sr-90, and tritium contamination between the reactor and the river. See details in Step 7. All "planned wells" in this report are sampled for 100-NR-2 COPCs to evaluate concentrations and the extent of contamination.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Planned Unconfined	199-N-373	Nitrate, TPH	149442.00	571276.00	Q during year 1 for groundwater COPCs (Sr-90, tritium, nitrate, hexavalent chromium, total chromium, gross beta, TPH, and ethylbenzene) followed by A for TPH and nitrate. If the remaining COPCs are above cleanup levels, monitoring shall be performed at least annually.	Y	Data from this new well are needed to evaluate the nature and extent of TPH and nitrate contamination. See details in Step 7. All "planned wells" in this report are sampled for 100-NR-2 COPCs to evaluate concentrations and the extent of contamination.
Planned Unconfined	199-N-374	Sr-90, Tritium	149533.74	571112.10	Q during year 1 for groundwater COPCs (Sr-90, tritium, nitrate, hexavalent chromium, total chromium, gross beta, TPH, and ethylbenzene) followed by A for tritium. A5 for Sr-90. If the remaining COPCs are above cleanup levels, monitoring shall be performed at least annually.	Y	Data from this new well are needed to evaluate the nature and extent of Sr-90 and tritium contamination. See details in Step 7. All "planned wells" in this report are sampled for 100-NR-2 COPCs to evaluate concentrations and the extent of contamination.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Planned Deep Unconfined	199-N-376	Nitrate	149338.62	571141.08	Q during year 1 for groundwater COPCs (Sr-90, tritium, nitrate, hexavalent chromium, total chromium, gross beta, TPH, and ethylbenzene) followed by A for nitrate. If the remaining COPCs are above cleanup levels, monitoring shall be performed at least annually.	Y	Data from this new well are needed to evaluate the nature and extent of nitrate contamination. See details in Step 7. All "planned wells" in this report are sampled for 100-NR-2 COPCs to evaluate concentrations and the extent of contamination.
Planned Unconfined	199-N-377	BV, Nitrate, TPH, Sr-90	149678.00	571278.00	Q during year 1 for groundwater COPCs (Sr-90, tritium, nitrate, hexavalent chromium, total chromium, gross beta, TPH, and ethylbenzene) followed by A for tritium nitrate, hexavalent chromium, total chromium, gross beta and ethylbenzene; SA for BV; A5 for Sr-90.	Y	Data from this new well are needed to evaluate Sr-90 concentrations greater than or equal to the DWS (8 pCi/L). It also delineates nitrate concentrations greater than or equal to the DWS (45 ppm) and TPH plume concentrations greater than or equal to (500 ppb). See details in Step 7. Also provides evidence of biodegradation within the plume. All "planned wells" in this report are sampled for 100-NR-2 COPCs to evaluate concentrations and the extent of contamination.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Aquifer Tube	APT1	PRB	149897.48	571276.50	SA	N	Data from this location are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	APT5	PRB	149957.20	571334.10	SA	N	Data from this location are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also delineates Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	C6132	PRB, BV	149734.96	571165.27	SA after installation of PRB SA: BV	Y	This aquifer tube is located upriver of the PRB and will be sampled SA in the performance network after treatment of upstream wells with apatite. Data from this location are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river This well monitors changes upgradient of the main Sr-90 plume and defines the lateral extent of Sr-90 contamination. It is also needed to define the lateral extent of TPH contamination and provides evidence of biodegradation adjacent to the plume.
Aquifer Tube	C6135	BV	149794.07	571181.41	SA	N	Data from this location are needed to define TPH plume concentrations greater than or equal to (500 ppb) and provides evidence of biodegradation within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Aquifer Tube	C6136	PRB-E	149815.36	571195.69	SA after installation of PRB	N	Data from this location are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines the lateral extent of Sr-90 contamination and will be used to monitor changes adjacent to the plume.
Aquifer Tube	C6317, C6318, C6319	Sr-90, Tritium	149554.40	571023.87	SA: Tritium; SA: Sr-90	N	Data from this location are needed to define the lateral extent of tritium and Sr-90 contamination. The data are also used to monitor changes/plume migration adjacent to the plume.
Aquifer Tube	C6320	Sr-90	149677.99	571128.66	SA: Sr-90	N	Data from this location are needed to define Sr-90 concentration greater than DWS (8 pCi/L) within an isolated area of contamination.
Aquifer Tube	C6324	PRB-E	150268.72	571554.35	SA after installation of PRB	N	Data from this location are needed to determine the effectiveness of the PRB to reduce the flux of Sr-90 into the river. It also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within he plume.
Aquifer Tube	C7934, C7935, C7936	Tritium, Sr-90	149577.50	571048.23	SA: Tritium, SA: Sr-90	N	Data from this location are needed to evaluate tritium plume concentrations greater than or equal to the DWS (20,000 pCi/L). The maximum tritium concentration is detected in this aquifer tube. It also defines Sr-90 concentration greater than or equal to the DWS (8 pCi/L) in an isolated area of Sr-90 contamination. This location will monitor changes within the plumes.
Aquifer Tube	C7937, C7938 C7939	Tritium, Sr-90	149621.34	571081.92	SA: Tritium, SA: Sr-90	N	Data from this location are needed to evaluate the lateral extent of tritium and Sr-90 contamination. This location is also used to monitor changes adjacent to the plumes.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Aquifer Tube	C7881	PRB	149981.81	571346.96	SA	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river. It also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will monitor changes within the plume.
Aquifer Tube	N116mArray-0 A	BV, PRB-E,	149776.00	571169.00	SA after installation of PRB. SA: BV	N	Data from this location are needed to evaluate TPH plume concentrations greater than or equal to (500 ppb) and provide evidence of biodegradation within the plume. The data is also used to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river.
Aquifer Tube	N116mArray-2 A	PRB	149888.37	571259.69	SA	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	N116mArray-3 A	PRB	149911.86	571273.37	SA	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Aquifer Tube	N116mArray-4 A	PRB	149925.23	571292.50	SA	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	N116mArray-6 A	PRB	149955.73	571325.44	SA	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	N116mArray-8 A	PRB	150029.75	571381.19	SA	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; they are also needed to evaluate the lateral extent of Sr-90 contamination and changes/migration adjacent to the plume.
Aquifer Tube	N116mArray-9 A	PRB-E	150124.98	571437.81	SA after installation of PRB	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	N116mArray-1 0A	PRB-E	150158.65	571452.00	SA after installation of PRB	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification
Aquifer Tube	N116mArray-1 1A	PRB-E	150184.45	571482.06	SA after installation of PRB	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	N116mArray-1 3A	PRB-E	150264.01	571540.68	SA after installation of PRB	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.
Aquifer Tube	N116mArray-1 5A	PRB-E	150391.00	571632.00	SA after upgradient well apatite treatment	N	This location is downriver of the PRB and will be sampled SA in the performance network after treatment of upstream wells with apatite. Data from this location are needed to evaluate the lateral extent of contamination adjacent to the barrier and downgradient of the Sr-90 plume. The data are also needed to evaluate contaminant migration adjacent to the plume.
Aquifer Tube	NVP2-116.0	PRB	149944.56	571313.31	SA	N	Data from this location are needed to evaluate the effectiveness of the PRB to reduce the flux of Sr-90 into the river; it also defines Sr-90 concentrations greater than or equal to the DWS (8 pCi/L) and will be used to monitor changes within the plume.

a. The occurrence of antimony, cadmium, and cobalt in groundwater is uncertain because these analytes historically have been detected in groundwater at concentrations above their respective action level; however, their presence was not associated with a specific location or a trend and the analytical methods used were not of sufficient accuracy for risk characterization purposes. Therefore, antimony, cadmium, and cobalt are retained as COPCs (DOE/RL-2012-15, Draft A, Chapter 6).

A = Annual. Annual sampling targets low river stage (mid-September through mid-November timeframe). The 100-NR-2 OU low river sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

A5 = Annually every 5 years. Sample in 2015 at low river stage (mid-September through mid-November timeframe) and every 5 years thereafter. The 100-NR-2 OU low river sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Table A1-16. Groundwater Monitoring Wells and Aquifer Tubes in the 100-NR-2 Network

Well Type	123 Monitoring Locations	Network	Northing	Easting	Sample Frequency	WAC Compliant? (Yes or No)	Justification

B = Biennial. Biennial sampling targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every other year. Groundwater wells sampled biennially should be sampled during the same year. The 100-NR-2 OU sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

BV = Bioventing. This network will be sampled and analyzed for alkalinity, anions, unfiltered metals, TPH-D, TPH-G, TPH motor oil, oil and grease, PAH, and VOA (BTEX). Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, turbidity, and sheen and odor. Prior to purging the well, a transparent bailer will be used to collect a grab sample to evaluate the presence of sheen.

PRB = Existing permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH-D. Exception: 199-N-268, 199-N-269, 199-N-280, 199-N-281, 199-N-297, 199-N-298, 199-N-315, 199-N-316, 199-N-332, 199-N-333, 199-N-342 and 199-N-343 are not sampled for TPH-D. Field methods include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, and turbidity.

PRB-E = Planned extension of permeable reactive barrier. This network is sampled and analyzed for anions, gross alpha, gross beta, unfiltered and filtered metals, Sr-90, and TPH D. Field methods include dissolved oxygen, oxidation reduction potential, pH, conductivity, temperature, and turbidity.

Q/A = As a general rule, new long-term groundwater monitoring wells should be sampled quarterly for the first year and annually thereafter. If after the first year contaminant trends indicate concentrations are increasing, quarterly sampling will continue until the contaminant trends remain steady or decrease over four quarters of sampling. Quarterly sampling should also be performed during the same timeframe as other sampling events (low-high river stage) as applicable, but should not be performed back to back (i.e., last day of the first quarter and first day of the second quarter).

SA= Semiannual. Semiannual sampling targets high river stage (mid-May through mid-July timeframe) and low river stage (mid-September through mid-November timeframe) every year. The sample event duration for all networks (apatite barrier, bioventing, Sr-90, nitrate, TPH, tritium, metals) should not exceed 4 weeks.

Metal analysis should be performed on unfiltered and filtered samples.

BTEX = benzene, toluene, ethylbenzene, and xylene

DWS = drinking water standard

Nitrate = equivalent to anions

PAH = polycyclic aromatic hydrocarbons

PSQ = principal study question

TPH-D = total petroleum hydrocarbons-diesel

TPH-G = total petroleum hydrocarbons-gasoline

VOA = volatile organic analysis

WAC = *Washington Administrative Code*

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Insert A2

Saturated Zone Aquifer and Vadose Zone Jet Injection Projects

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A2.1 Purpose and Scope

This insert describes the sampling locations, parameters, and the sample schedule for the saturated zone aquifer injection project and vadose zone jet injection project. It also includes additional background information on the performance monitoring of the apatite permeable reactive barrier (PRB) and addresses selected activities and tasks described in the main text of the remedial design/remedial action work plan (RD/RAWP). This insert addresses the following:

- Extension of the existing apatite PRB in the saturated zone from 90 m (300 ft) to approximately 760 m (2,500 ft).
- Implementation of a 305 m (1,000 ft) apatite barrier to enhance the attenuation of strontium-90 (Sr-90) in the vadose zone, emplaced via jet injection above and within the groundwater PRB along the shoreline.
- First year of remedy performance monitoring for the combined saturated zone and vadose zone PRB following injections. Performance monitoring after the first year will be conducted in accordance with the SAP (Appendix A).

A2.2 Background

Efforts to reduce the flux of Sr-90 from 100-N Area groundwater to the Columbia River have been underway since the early 1990s. The termination of all liquid discharges to the 100-N Area liquid waste disposal facilities by 1993 was a major step toward meeting this goal. However, Sr-90 desorption from contaminated strata within the aquifer represents a continuing source to groundwater and the river.

The interim remedial action specified in EPA/ROD/R10-99/112, *Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County* (hereafter referred to as the Interim Action Record of Decision [ROD]), included operation of a groundwater pump-and-treat (P&T) system, as well as a requirement to evaluate alternative Sr-90 treatment technologies. Because the P&T system had limited success in removing Sr-90 from the aquifer as a result of strontium's strong affinity for adhering to aquifer sediments, the system was placed in standby mode in March 2006 based on the Tri-Party Agreement (Ecology et. al., 1989a, *Hanford Federal Facility Agreement and Consent Order*) Change Request M-16-06-01, "Establish Interim Milestone M-016-14, Complete Construction of a Permeable Reactive Barrier at 100-N," which was approved by DOE, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) (also known as the Tri-Parties).

As required by the Interim Action ROD (EPA/ROD/R10-99/112), DOE conducted a comprehensive review of Sr-90 treatment technologies. The findings of this evaluation were presented to the public in a meeting on December 8, 2004 (FH-0403540, "Transmittal of the Draft Letter Report, Evaluation of Strontium-90 Treatment Technologies for the 100-NR-2 Groundwater Operable Unit"). Following this presentation, the Tri-Parties agreed that apatite sequestration, followed by polishing (if necessary), should be tested. In accordance with Tri-Party Agreement Change Request M-16-06-01, and an approved test plan (DOE/RL-2005-96, *Strontium-90 Treatability Test Plan for 100-NR-2 Groundwater Operable Unit*), field-scale testing was implemented in 2006. Apatite-forming minerals were injected into 10 wells along the Columbia River shoreline to create a 90 m (300 ft) long PRB. The data from this testing indicated that apatite sequestration is effective for immobilizing Sr-90 in situ.

Following an evaluation of potential Sr-90 treatment technologies and their applicability under 100-NR-2 OU hydrogeologic conditions, the Tri-Parties agreed that the long-term strategy for

groundwater remediation at the 100-N Area should include apatite sequestration as the primary treatment technology (DOE/RL-2006-20, *The Second CERCLA Five-Year Review Report for the Hanford Site*). This agreement was based on results of an evaluation of remedial alternatives that identified the apatite PRB technology as the approach showing the greatest promise for reducing Sr-90 flux to the Columbia River at a reasonable cost. The Interim Action ROD, as amended (EPA, 2010, *U.S. Department of Energy, 100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*), replaces the Sr-90 groundwater P&T system with a subsurface PRB comprising apatite injected into both the saturated zone and the vadose zone.

Based on the information and experience gained from treatability studies and the installation of an effective 90 m (300 ft) PRB, a design optimization study (DOE/RL-2010-29, *Design Optimization Study for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit*) was developed for the expansion of the saturated zone PRB. Forty-eight multipurpose wells were injected with high-concentration calcium-citrate-phosphate (Ca-citrate-PO_4) solution in 2010 and 2011, and subsequent monitoring indicates that the barrier appears to be working as designed (DOE/RL-2013-13, *Calendar Year 2012 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*). The basic optimization study injection design, with additional specifications to ensure target apatite emplacement (as learned from the 2011 barrier expansion), will be used for the final completion of a 760 m (2,500 ft) PRB along the shoreline.

Based on the results from the treatability tests (SGW-47062, *Treatability Test Report for Field-Scale Apatite Jet Injection Demonstration for the 100-NR-2 Operable Unit*), DOE/RL-2010-68, *Jet Injection Design Optimization Study for 100-NR-2 Groundwater Operable Unit*, was developed. DOE/RL-2010-68 includes the detailed design for the vertical extension of the PRB into the unsaturated vadose zone.

Figure A2-1 shows the location for the apatite PRB installation, and Figure A2-2 provides the apatite injection well locations. The effectiveness of the apatite PRB will be assessed based on its ability to reduce Sr-90 concentrations in groundwater as measured in samples collected from monitoring wells downgradient of the PRB. Strontium-90 concentrations in groundwater downgradient of the apatite PRB are expected to decrease over time as Sr-90 is incorporated from groundwater into the apatite structure. The apatite PRB technology is expected to be an important component of the final remedy to address Sr-90 in groundwater at the 100-N Area.

A2.2.1 Saturated Zone Permeable Reactive Barrier Design

Under the Interim Action ROD, as amended (EPA, 2010), the apatite PRB will be extended from 274 m (900 ft) to approximately 760 m (2,500 ft). Two injection skids were designed and constructed for injecting the high-concentration Ca-citrate-PO_4 solution into multipurpose wells. Each skid is capable of injecting chemicals into six wells simultaneously and pumping the chemicals from tanker trucks or tanks and river water to form an injection solution for distribution to the wellheads.

Flow meters and sample ports are provided on each injection skid to monitor and collect samples of pre-mixed chemical solution. Submersible pumps in the Columbia River will extract and transfer river water to the injection skid, where it will be filtered before being mixed with the chemical in a static inline mixing chamber. The injection skids will be used to mix concentrated calcium citrate and phosphate solutions with river water to dilute the chemicals to the high-concentration formulation values. Following mixing, a 10 cm (4 in.) pipe will convey the dilute chemical solution to a manifold for distribution to up to six individual wells. A sample port is located ahead of the manifold for collecting samples of the dilute chemical.

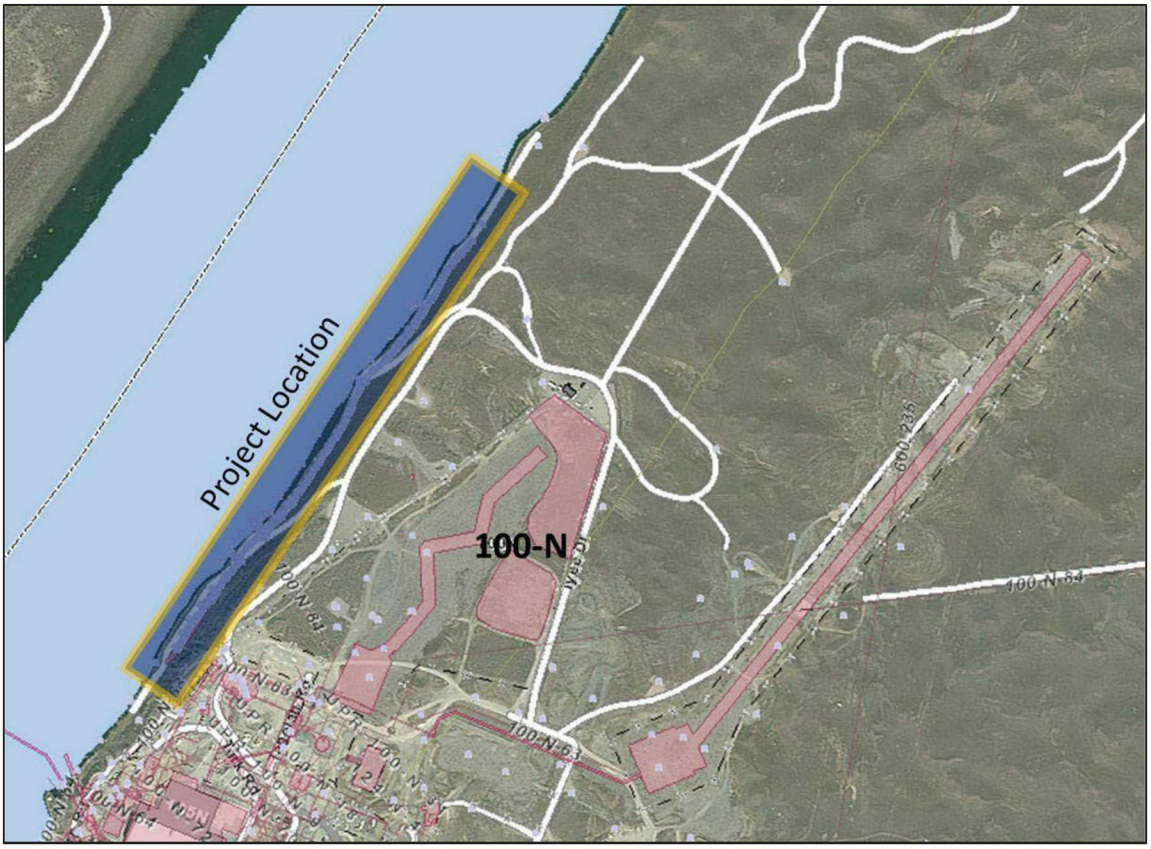
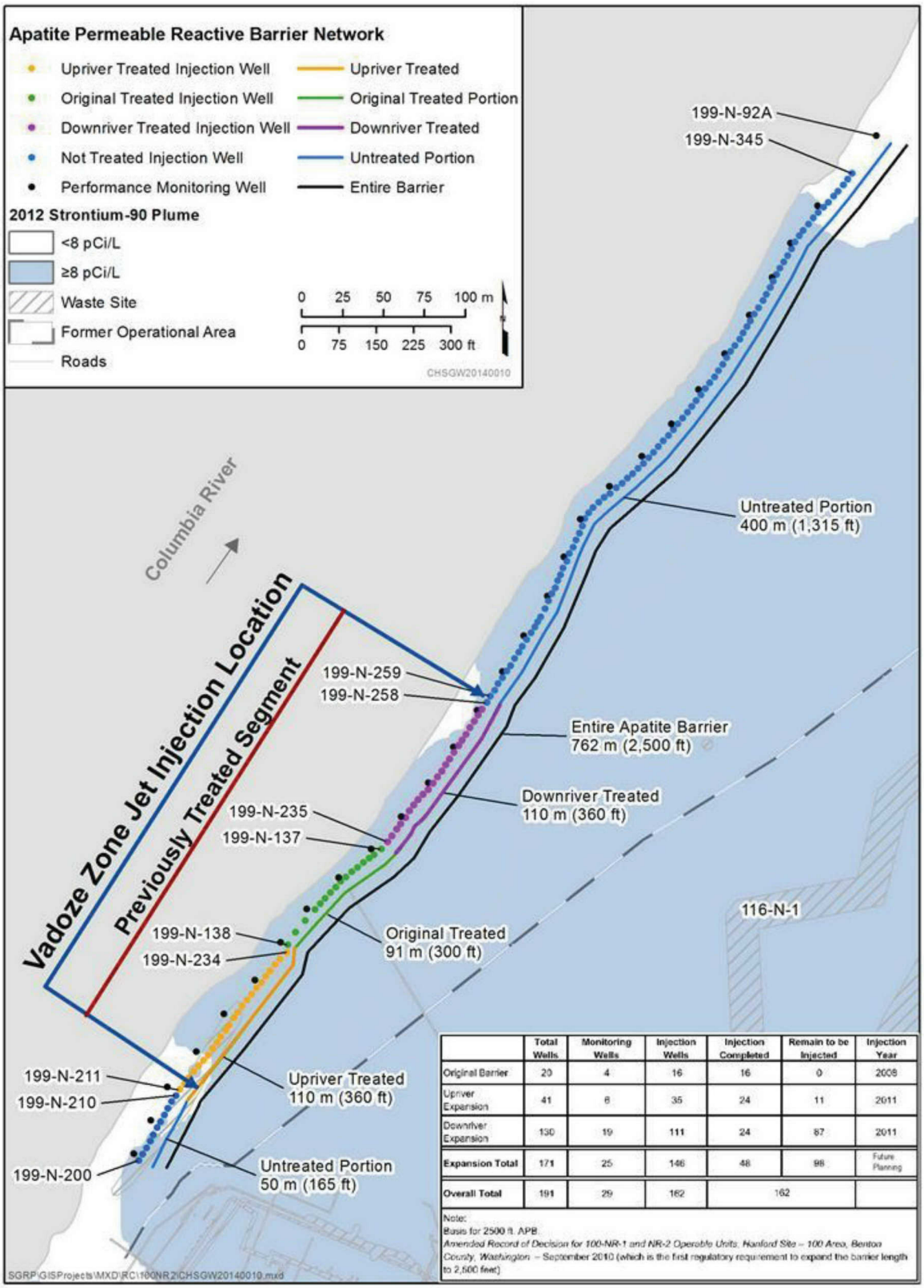


Figure A2-1. Location of Apatite Barrier Installation

The volume of dilute chemical for injection will likely range from 944,607 to 4,540,000 L (25,000 to 120,000 gal) per well, with a targeted average volume of 227,000 L (60,000 gal) injected per well. The injection system is capable of injecting chemical solution at a flow rate from 37 to 189 L/min (10 to 50 gal/min) per well, with a total capacity for each injection skid of up to 1,135 L/min (300 gal/min). Based on an average injection rate of 114 L/min (30 gal/min), it will take approximately 33 hours to inject 227,125 L (60,000 gal) of solution. Actual injection volumes delivered will be recorded for each well.

The target radial lateral distribution of injected chemical is 4.6 m (15 ft) from the injection wells. Lateral distribution of injected solution will be measured by specific conductance and water-level field measurements in adjacent injection wells and downgradient monitoring wells (near the wells that are being injected).

The saturated zone PRB has been designed to emplace sufficient apatite within the PRB footprint to sequester Sr-90 for the next 300 years and reduce Sr-90 flux to the Columbia River (DOE/RL-2010-29). One additional round of apatite injections at well locations that do not show adequate flux reduction (as outlined in Section 3.1.1.4 of the RD/RAWP) will be implemented within 5 years of all first-round apatite injections. Monitoring of the treated 274 m (900 ft) portion of the PRB (reported in DOE/RL-2013-13) indicates that target reduction of Sr-90 concentrations is being achieved in groundwater samples collected at the PRB monitoring wells. Barrier performance will be reported each year in the annual summary report and will be summarized every 5 years in the CERCLA 5-year review. The monitoring results indicate that reinjection of the treated portion is not required at this time; however, the 5-year monitoring period is still ongoing for the portion of the PRB that was completed in 2011.



	Total Wells	Monitoring Wells	Injection Wells	Injection Completed	Remain to be Injected	Injection Year
Original Barrier	20	4	16	16	0	2008
Upriver Expansion	41	6	35	24	11	2011
Downriver Expansion	130	19	111	24	87	2011
Expansion Total	171	25	146	48	98	Future Planning
Overall Total	191	29	162	162		

Note:
Basis for 2500 ft. APB
Amended Record of Decision for 100-NR-1 and NR-2 Operable Units, Hanford Site – 100 Area, Benton County, Washington – September 2010 (which is the first regulatory requirement to expand the barrier length to 2,500 feet)

Figure A2-2. 100-NR-2 Apatite PRB Well Locations

A2.2.2 Vadose Zone Permeable Reactive Barrier Design

As described in DOE/RL-2011-25, *Calendar Year 2010 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations and 100-NR-2 Groundwater Remediation*, when the water table rises, Sr-90 from the vadose zone is mobilized and concentrations in groundwater increase. Concentration peaks from 2006 through 2010 were correlated with periods when the water table was high. Apatite jet injections into the vadose zone will target areas of the highest Sr-90 vadose zone contamination along the shoreline for approximately 305 m (1,000 ft). The injections will emplace apatite from near the ground surface to approximately 7.6 m (25 ft) below ground surface (bgs), including the vadose zone and the periodically rewetted zone, mitigating these potential hazards.

Installation of a 305 m (1,000 ft) vadose zone PRB will extend the existing 274 m (900 ft) long section of the saturated zone into the overlying vadose zone where the majority of the Sr-90 present along the river shoreline occurs. The vadose zone application will use a direct jet injection method to emplace pre-formed apatite to immobilize Sr-90 and to reduce or eliminate its transport from the vadose zone to groundwater, and ultimately the Columbia River.

In 2009, a jet injection pilot test was conducted following the design optimization study (DOE/RL-2010-68), and the results of the test are presented in PNNL-19524, *Hanford 100-N Area In Situ Apatite and Phosphate Emplacement by Groundwater and Jet Injection: Geochemical and Physical Core Analysis*, and SGW-47062. Based on the favorable results observed during the 2009 jet injection pilot test, approximately 400 borings will be drilled using a phosphate drilling fluid to a depth of 7.6 m (25 ft), followed by jet injection with a phosphate solution containing pre-formed apatite slurry. In general, this methodology will achieve a semi-uniform distribution of pre-formed apatite and phosphate that will potentially precipitate with adsorbed calcium on sediment to form amorphous apatite, creating a PRB that is 305 m (1,000 ft) long by 3 m (10 ft) wide.

The vadose zone apatite PRB location is shown in Figure A2-2. It will be installed over the saturated zone apatite PRB on the downgradient (north) side of the existing PRB injection wells to provide greater certainty for overlap of the vadose zone and saturated zone apatite PRB treatment zones.

Drilling and injections will be conducted inside an excavated trench. In general, the trench will be approximately 3 m (10 ft) wide by 0.5 m (1.5 ft) deep, extending the length of the planned vadose zone apatite PRB. Excavated soil will be used to create a berm around the trench to contain drill cuttings and fluids that may rise to the surface during drilling and jet injection. Once the injections are completed within the trench, the boreholes and the trench will be backfilled with excavated soil.

The jet injection solution will consist of pre-formed apatite mixed with phosphate solution. The volume of phosphate solution used for injection must be sufficient to saturate the treatment zone: 3 m (10 ft) wide by 305 m (1,000 ft) long by 7.2 m (23.5 ft) deep (25 ft minus 1.5 ft trench).

The temporary borings will be drilled using a hydraulic drill rig equipped with jet grout injection capabilities. The borings will be advanced from the bottom of the trench to total depth (TD), using the phosphate solution as a drilling fluid. Trenches will serve as infiltration galleries, containing the excess phosphate solution and allowing it to seep into the ground to treat the shallow subsurface.

The actual TD of each boring will vary, depending on the geologic conditions encountered. The target TD is 7.6 m (25 ft) bgs, and successful injections to this depth will provide a 3 m (10 ft) wide barrier of pre-formed apatite that protects the vadose zone and reinforces the saturated zone PRB. Geologic conditions may result in refusal at shallower depths for some borings. A minimum depth of 4.6 m (15 ft) bgs is necessary to ensure treatment of the vadose zone; achieving this depth will be considered a priority.

A2.3 Barrier Treatability Test Data Quality Objectives Summary

Treatability tests were completed to define the sampling and DQOs to test chemical formulations for apatite-forming chemical injections into the aquifer for sequestration of Sr-90 contamination in the groundwater (DOE/RL-2005-96). The DQOs from DOE/RL-2005-96 included determining impacts to groundwater quality. Sampling to be conducted during the saturated zone and vadose zone injections is designed to meet this objective.

A2.4 Project Schedule

This section identifies the schedule for the saturated zone aquifer injection project and the vadose zone jet injection project.

The anticipated project schedule is as follows:

- Saturated zone aquifer injection in 2017 to 2018 (during high river stage)
- Vadose zone jet injection in 2017 (during low river stage)
- Post-PRB injection performance monitoring (ongoing)
- Final action ROD in mid-2016 (spring to summer time frame) submitted to regulatory agency for review
- RD/RAWP for final action ROD (180 days from ROD signing)

The work involved in completion of the barrier will be conducted within a traditional cultural property boundary. Performance of the work activities is dependent upon completion of the *National Historic Preservation Act of 1966*, Section 106 reviews and is subject to schedule delays pending establishment of a memorandum of understanding to conduct the project activities deemed to have an adverse effect on the traditional cultural property

A2.5 Saturated Zone Injection Monitoring

River-stage fluctuations along the 100-N Area shoreline influence Sr-90 flux to the river. These fluctuations, which result from hydroelectric dam operating schedules and natural seasonal variations, create groundwater elevation changes in the shoreline environment. High river stage generally falls between late April and early August, with peak stages most commonly occurring in June. The river stage typically transitions to low-stage period by late August, with low river occurring as late as early October. Saturated zone injections for the PRB expansion are planned to be conducted during high river stage (when groundwater elevations are above the screened intervals) to treat the full saturated thickness.

Sampling and analysis requirements for the high-concentration Ca-citrate-PO_4 solution injections include chemical makeup sampling, injection flow rate and volume monitoring, monitoring well and aquifer tube sampling, and some potential soil sampling after injections are complete. The monitoring and sampling requirements specified in this SAP are incorporated into the field instructions (SGW-57140, *Field Instruction for 100-NR-2 Operable Unit Saturated Zone Apatite Permeable Reactive Barrier Extension*) for performing the injections. Data sheets for recording field parameters and injection flow rates and pressures will be included in the field instructions. Table A2-1 provides information and frequency that data will be recorded on the data sheets.

Table A2-1. Saturated Zone Injection Data Sheet Information Logging and Frequency

Data to Record	Reading Locations	Frequency
River water pump flow rate and totalizer readings	Injection skid	Hourly
Calcium-citrate solution pump flow rate and totalizer readings	Injection skid	Hourly
Phosphate solution pump flow rate and totalizer readings	Injection skid	Hourly
Combined flow rate and totalizer readings	Injection skid	Hourly
Flow rate and totalizer readings to individual injection wells	Injection skid	Hourly
Injection pressure	Injection wells	Hourly
Specific conductance	Installed field instruments for continuous monitoring in monitoring and injection wells	Every 4 hours
Field parameters*	Samples from injection skid	Every 4 hours

* Field parameters include specific conductance, temperature, pH, oxidation-reduction potential, and dissolved oxygen.

Sampling will occur in a number of monitoring wells and aquifer tubes located within the potential area of injection influence along the 100-N Area shoreline before, during, and after treatment. The wells and aquifer tubes that will be sampled are listed in Table A2-2. The sampling frequency for the saturated zone injection monitoring is provided in Table A2-3.

Specific information regarding which wells and aquifer tubes will be sampled as the injections proceed will be provided in project field instructions. Field observations, including observations of potential contamination (e.g., odor and sheen), will be recorded in logbooks or on data sheets during injection and sampling activities. Field instrument readings, including industrial health measurements obtained as part of well access, will be recorded.

The objectives of the saturated zone injection monitoring are to determine the following information:

- Pre-injection baseline concentrations of Sr-90 for evaluating PRB performance
- Extent of the apatite precursor travel within the aquifer and effective PRB installation
- Reduction in Sr-90 concentrations in response to the PRB installation
- General or specific locations where a second injection of apatite precursors may be needed

Sampling protocols are designed to determine these conditions.

Table A2-2. Saturated Zone Injection Monitoring Points

Well Name	Well Type	Well Name	Well Type
199-N-173	MW	199-N-277	IW[a]
199-N-346	MW	199-N-278	IW[a]

Table A2-2. Saturated Zone Injection Monitoring Points

Well Name	Well Type	Well Name	Well Type
199-N-96A	MW	199-N-281	IW[a]
199-N-99A	MW	199-N-282	IW[a]
199-N-185	MW	199-N-283	IW[a]
199-N-354	MW	199-N-284	IW[a]
199-N-355	MW	199-N-287	IW[a]
199-N-356	MW	199-N-288	IW[a]
199-N-357	MW	199-N-289	IW[a]
199-N-358	MW	199-N-290	IW[a]
199-N-359	MW	199-N-293	IW[a]
199-N-360	MW	199-N-294	IW[a]
199-N-361	MW	199-N-295	IW[a]
199-N-362	MW	199-N-296	IW[a]
199-N-363	MW	199-N-299	IW[a]
199-N-364	MW	199-N-300	IW[a]
199-N-365	MW	199-N-301	IW[a]
199-N-366	MW	199-N-302	IW[a]
199-N-367	MW	199-N-305	IW[a]
199-N-200	IW[a]	199-N-306	IW[a]
199-N-201	IW[a]	199-N-307	IW[a]
199-N-202	IW[a]	199-N-308	IW[a]
199-N-203	IW[a]	199-N-311	IW[a]
199-N-208	IW[a]	199-N-312	IW[a]
199-N-209	IW[a]	199-N-313	IW[a]
199-N-210	IW[a]	199-N-314	IW[a]
199-N-211	IW[a]	199-N-317	IW[a]
199-N-212	IW[a]	199-N-318	IW[a]
199-N-257	IW[a]	N116mArray-0A	AT
199-N-258	IW[a]	N116mArray-8.5A	AT
199-N-263	IW[a]	N116mArray-9A	AT
199-N-264	IW[a]	N116mArray-10A	AT

Table A2-2. Saturated Zone Injection Monitoring Points

Well Name	Well Type	Well Name	Well Type
199-N-265	IW[a]	N116mArray-11A	AT
199-N-266	IW[a]	N116mArray-12A[b]	AT
199-N-269	IW[a]	N116mArray-13A[b]	AT
199-N-270	IW[a]	C6324	AT
199-N-271	IW[a]	N116mArray-15A	AT
199-N-272	IW[a]	N116mArray-16A	AT
199-N-275	IW[a]	N116mArray-16A	AT
199-N-276	IW[a]	N116mArray-16A	AT

a. Identified IW for monitoring may be adjusted based on injection sequence to ensure that IWs adjacent to wells being injected are monitored.

b. Records indicate these aquifer tubes may be missing or broken. Replacements, if available, may need to be identified or repairs may need to be completed.

AT = aquifer tube

IW = injection well

MW = monitoring well

1

Table A2-3. Approximate Saturated Zone Injection Sampling Locations and Frequency

Sample Purpose	Sampling Locations	Approximate Sampling Frequency	Analytes
Baseline sampling	Monitoring wells and aquifer tubes downgradient of wells to be injected	One time prior to injections. Available sample results may be used if well/aquifer tube has previously been sampled as part of PRB monitoring.	Cations, anions, Sr-90, gross beta, TPH-diesel,[b] and field parameters[c]
Injection monitoring	Injection stream from injection skid	Field parameters every 4 hours, aqueous samples daily.	Cations, anions, and field parameters[c]
Injection arrival monitoring[a]	Downgradient monitoring wells/ aquifer tubes	Field parameters continuously in situ from wells, aqueous samples at the end of each injection series from both wells and aquifer tubes (upriver and downriver).	Cations, anions, Sr-90, gross beta, TPH-diesel,[b] and field parameters[c]
Short-term performance monitoring	Nearby monitoring wells/aquifer tubes	Two and 4 weeks after the end of each injection series (upriver and downriver) and then quarterly for the first year after injections.	Cations, anions, Sr-90, gross beta, TPH-diesel,[b] and field parameters[c]

Table A2-3. Approximate Saturated Zone Injection Sampling Locations and Frequency

Sample Purpose	Sampling Locations	Approximate Sampling Frequency	Analytes

a. For injection arrival monitoring, probes will be placed in two upriver wells during upriver injection and two downriver wells during downriver injection. Probes will be placed in one upriver and one downriver well to monitor performance.

b. TPH-diesel range organic analysis conducted on samples collected from upriver monitoring wells/aquifer tubes only.

c. Field parameters include specific conductance, temperature, pH, oxidation-reduction potential, and dissolved oxygen.

PRB = permeable reactive barrier

TPH = total petroleum hydrocarbons

The majority of the monitoring wells identified in Table A2-2 that are located downgradient of untreated portions of the PRB have not been routinely sampled since completion of the wells in 2010. Routine sampling of the monitoring wells was initiated in spring 2014 along with the aquifer tubes listed in Table A2-2 to establish baseline strontium-90 concentrations for evaluating barrier performance following treatment with apatite forming chemicals. Table A2-4 identifies the sampling that will be conducted for the PRB monitoring wells, and aquifer tubes, prior to chemical injection if not already treated, during injection, and for the first year following injections. Table A2-4 includes the injection wells listed in Table A2-2 initially identified for monitoring of arrival of chemicals in wells adjacent to those be treated. Wells used for injection chemical arrival monitoring may be adjusted based on injection sequence to ensure that injection wells adjacent to wells being injected are monitored.

The sample results from the pre-injection sampling will be used to establish baseline Sr-90 concentrations for comparison and evaluation of PRB performance following injections in the untreated portions of the PRB. Table A2-5 provides a summary of the gross-beta and Sr-90 results from available sample data. The monitoring well and aquifer tube locations are identified in Figures A2-4 through A2-8. Complete sample results for the monitoring wells and aquifer tubes listed in Table A2-2 are provided in Table A2-12 at the end of this insert.

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]
199-N-122	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-123	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-146	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-147	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-173	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-136	Injection well[d]	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B
199-N-159	Injection well[d]	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B
199-N-200	Injection well	B	-	B	B	O[f]	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	O	B
199-N-201	Injection well	B	-	B	B	O[f]	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	O	B
199-N-202	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-203	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-208	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-209	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-210	Injection well	B	-	B	B	O[f]	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	O	B
199-N-211	Injection well[d]	-	-	B	-	O[f]	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	O	B
199-N-212	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-229	Injection well[d]	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]
199-N-230	Injection well[d]	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B
199-N-247	Injection well[d]	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B
199-N-248	Injection well[d]	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B	-	-	B
199-N-257	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-258	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-263	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-264	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-265	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-266	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-268	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-269	Injection well	B	-	B	B	O[f]	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	O	B
199-N-270	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-271	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-272	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-275	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-276	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-277	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]
199-N-278	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-280	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-281	Injection well	B	-	B	B	O[f]	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	O	B
199-N-282	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-283	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-284	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-287	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-288	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-289	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-290	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-293	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-294	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-295	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-296	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-297	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-298	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-299	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]
199-N-300	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-301	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-302	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-305	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-306	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-307	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-308	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-311	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-312	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-313	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-314	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-315	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-316	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-317	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-318	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-332	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-333	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]
199-N-342	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-343	Injection well	B	-	B	B	-	B	-	-	-	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B	B	-	B
199-N-344	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-345	Injection well[g]	-	-	-	-	O[f]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O	-
199-N-346	Monitoring well	A	O	Q	A	O[f]	Q	A	O	SA	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-347	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-348	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-349	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-350	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-351	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-352	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-353	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-354	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-355	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-356	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-357	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-358	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]
199-N-359	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-360	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-361	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-362	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-363	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-364	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-365	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-366	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-367	Monitoring well	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
199-N-92A	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
199-N-96A	Monitoring well[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
APT1	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
APT5	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
C6132	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
C6136	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	O	SA	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
C6324	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
C7881	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]
N116m Array-0A	Aquifer tube	A	O	Q	A	O[f]	Q	A	O	SA	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
N116m Array-10A	Aquifer tube	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
N116m Array-11A	Aquifer tube	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
N116m Array-15A	Aquifer tube	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
N116m Array-2A	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
N116m Array-3A	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
N116m Array-4A	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
N116m Array-6A	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
N116m Array-8A	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q
N116m Array-9A	Aquifer tube	A	O	Q	A	O[f]	Q	-	-	-	A	O	SA	SA	O	Q	SA	O	SA	SA	O	Q	SA	O	Q	SA	O	Q
NVP2-116.0	Aquifer tube[d]	-	O	Q	-	O[f]	Q	-	-	-	-	O	SA	-	O	Q	-	O	SA	-	O	Q	-	O	Q	-	O	Q

Table A2-4. Apatite Barrier Pre-Injection, Injection, and First Year Post-Injection Sampling Schedule and Constituents

Well	Purpose	ICP Metals[a]			Anions[b]			TPH-Diesel			Gross Alpha			Gross Beta			Sr-90			Field DO			Field ORP			Other Field Parameters[c]		
		Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]	Pre-Injection	Injection	First Year Post-Injection[e]

Note: B = biennial, O = once only after chemical injections, Q = quarterly, SA = semiannual; biennial and semiannual targets high river stage (June timeframe) and low river stage (September timeframe).

a. Metals include, but are not limited to, cadmium, calcium, chromium, magnesium, manganese, and sodium. Both filtered and unfiltered samples are collected for metals analyses.

b. Anions include, but are not limited to, chloride, nitrate, and sulfate.

c. Field parameters include pH, specific conductance, temperature, and turbidity.

d. Currently under routine performance monitoring for treated portion of the PRB. Sampling identified in this table only applies to the treated portion of the PRB.

e. The frequency shown only applies to the first year after injection. Sampling frequency after 1 year will be as described for routine performance monitoring in the SAP (Appendix A).

f. Include phosphate analysis in sample collected after injection.

g. Injection well used only for injection arrival monitoring during apatite chemical injections. Samples analyzed only for phosphate and field parameters.

DO = dissolved oxygen
ORP = oxidation-reduction potential
PRB = permeable reactive barrier
TPH = total petroleum hydrocarbons

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
199-N-173	MW	44	6	51	19	65	26
2/3/2009	MW	—	20	—	21	—	23
2/4/2009	MW	—	6	—	6	—	6
2/9/2009	MW	—	16	—	16	—	16
8/19/2009	MW	—	26	—	26	—	26
9/16/2009	MW	—	16	—	16	—	16
9/15/2010	MW	55	18	60	21	65	23
12/15/2011	MW	45	19	45	19	45	19
8/27/2012	MW	44	14	46	15	48	15
11/11/2013	MW	57	22	57	22	57	22
3/31/2014	MW	45	23	48	24	51	25
199-N-346	MW	8	1	12	3	16	5
4/6/2010	MW	16	1	16	1	16	1
3/31/2014	MW	8	5	8	5	8	5
199-N-354	MW	20	8	22	10	24	12
8/5/2010	MW	24	12	24	12	24	12
3/31/2014	MW	20	8	20	8	20	8
199-N-355	MW	2,200	1,200	2,400	1,300	2,600	1,400
8/5/2010	MW	2,200	1,400	2,200	1,400	2,200	1,400
3/31/2014	MW	2,600	1,200	2,600	1,200	2,600	1,200
199-N-356	MW	550	300	650	390	750	480
8/4/2010	MW	550	300	550	300	550	300
3/27/2014	MW	750	480	750	480	750	480

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
199-N-357	MW	2,400	1,300	2,867	1,567	3,500	2,000
8/4/2010	MW	2,400	1,300	2,550	1,350	2,700	1,400
3/27/2014	MW	3,500	2000	3,500	2,000	3,500	2,000
199-N-358	MW	1,400	920	1,650	1,010	1,900	1,100
8/4/2010	MW	1,400	920	1,400	920	1,400	920
3/27/2014	MW	1,900	1,100	1,900	1,100	1,900	1,100
199-N-359	MW	450	210	465	215	480	220
8/29/2010	MW	450	210	450	210	450	210
3/27/2014	MW	480	220	480	220	480	220
199-N-360	MW	800	400	1,150	550	1,500	700
8/29/2010	MW	1,500	700	1,500	700	1,500	700
3/27/2014	MW	800	400	800	400	800	400
199-N-361	MW	68	29	109	56	150	82
8/29/2010	MW	68	29	68	29	68	29
3/26/2014	MW	150	82	150	82	150	82
199-N-362	MW	840	410	930	480	1,100	580
8/29/2010	MW	840	410	845	430	850	450
3/26/2014	MW	1,100	580	1,100	580	1,100	580
199-N-363	MW	890	470	935	475	980	480
9/12/2010	MW	980	470	980	470	980	470
3/26/2014	MW	890	480	890	480	890	480
199-N-364	MW	460	200	700	385	940	570
9/12/2010	MW	460	200	460	200	460	200
3/26/2014	MW	940	570	940	570	940	570

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
199-N-365	MW	400	180	430	195	460	210
9/12/2010	MW	400	180	400	180	400	180
3/26/2014	MW	460	210	460	210	460	210
199-N-366	MW	310	190	365	205	420	220
9/12/2010	MW	420	220	420	220	420	220
3/26/2014	MW	310	190	310	190	310	190
199-N-367	MW	42	20	49	23	57	28
9/12/2010	MW	42	20	45	21	48	21
3/26/2014	MW	57	28	57	28	57	28
199-N-96A	MW	-1	-6	16	4	100	38
4/27/1995	MW	—	0	—	3	—	5
8/2/1995	MW	—	8	—	8	—	8
9/6/1995	MW	—	5	—	5	—	5
10/3/1995	MW	—	5	—	5	—	5
11/3/1995	MW	—	4	—	4	—	4
12/6/1995	MW	—	38	—	38	—	38
1/5/1996	MW	—	6	—	6	—	6
2/16/1996	MW	—	3	—	3	—	3
3/7/1996	MW	—	5	—	5	—	5
4/5/1996	MW	—	6	—	6	—	6
5/8/1996	MW	—	2	—	3	—	3
6/5/1996	MW	—	6	—	6	—	6
9/25/1996	MW	27	11	27	11	27	11
3/10/1997	MW	—	9	—	9	—	9
9/24/1997	MW	25	9	25	9	25	9

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
9/14/1998	MW	28	9	28	9	28	9
9/9/1999	MW	18	6	19	6	20	6
9/26/2000	MW	32	10	32	10	32	10
9/10/2001	MW	11	3	11	3	11	3
9/23/2002	MW	17	6	17	6	17	6
9/25/2003	MW	15	5	16	5	16	5
3/15/2004	MW	—	5	—	5	—	5
6/15/2004	MW	8	4	8	4	8	4
7/9/2004	MW	6	—	6	—	6	—
8/17/2004	MW	30	—	30	—	30	—
9/20/2004	MW	15	4	15	5	16	5
10/19/2004	MW	10	—	10	—	10	—
11/16/2004	MW	9	—	9	—	9	—
1/3/2005	MW	9	3	9	3	9	3
1/28/2005	MW	14	—	14	—	14	—
2/25/2005	MW	76	—	76	—	76	—
3/7/2005	MW	10	6	10	6	10	6
4/19/2005	MW	15	—	15	—	15	—
5/17/2005	MW	10	—	10	—	10	—
6/14/2005	MW	7	3	7	3	7	3
7/18/2005	MW	7	—	7	—	7	—
8/19/2005	MW	30	—	30	—	30	—
9/7/2005	MW	17	6	17	6	17	6
10/7/2005	MW	12	—	12	—	12	—
11/1/2005	MW	12	3	12	3	12	3

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
12/19/2005	MW	0	4	0	4	0	4
1/24/2006	MW	8	—	8	—	8	—
2/7/2006	MW	13	—	13	—	13	—
3/2/2006	MW	31	4	31	4	31	4
4/12/2006	MW	15	—	15	—	15	—
5/8/2006	MW	7	—	7	—	7	—
6/13/2006	MW	5	2	5	2	5	2
7/19/2006	MW	12	—	12	—	12	—
10/23/2006	MW	12	4	12	4	12	4
11/13/2006	MW	85	—	85	—	85	—
12/27/2006	MW	14	5	14	5	14	5
1/16/2007	MW	9	—	10	—	11	—
2/14/2007	MW	15	—	15	—	15	—
4/18/2007	MW	-1	2	-1	2	-1	2
5/30/2007	MW	7	—	7	—	7	—
6/22/2007	MW	6	2	6	2	6	2
7/6/2007	MW	8	—	8	—	8	—
8/30/2007	MW	13	—	13	—	13	—
9/7/2007	MW	16	5	16	5	16	5
10/9/2007	MW	13	—	13	—	13	—
11/7/2007	MW	19	—	19	—	19	—
12/18/2007	MW	18	6	18	6	18	6
1/23/2008	MW	10	—	10	—	10	—
2/20/2008	MW	13	—	13	—	13	—
3/30/2008	MW	30	6	30	6	30	6

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
4/10/2008	MW	24	—	24	—	24	—
5/27/2008	MW	6	—	6	—	6	—
6/25/2008	MW	4	-1	4	-1	4	-1
10/7/2008	MW	8	2	8	2	8	2
12/8/2008	MW	16	4	16	4	16	4
3/25/2009	MW	10	2	10	2	10	2
6/18/2009	MW	4	-6	4	-6	4	-6
9/15/2009	MW	13	-1	13	-1	13	-1
6/24/2010	MW	—	-3	—	-3	—	-3
11/14/2010	MW	6	-2	14	1	18	4
1/18/2011	MW	14	-5	14	-5	14	-5
9/16/2011	MW	100	—	100	—	100	—
9/20/2011	MW	16	10	16	10	16	10
9/28/2011	MW	33	—	33	—	33	—
10/13/2011	MW	14	—	14	—	14	—
5/6/2012	MW	2	1	2	1	2	1
8/27/2012	MW	5	5	5	5	5	5
9/27/2012	MW	2	1	2	1	2	1
5/6/2013	MW	1	2	1	2	1	2
9/6/2013	MW	5	6	5	6	5	6
3/31/2014	MW	-1	2	-1	2	-1	2
C6324	AT	45	3	45	8	45	17
1/12/2009	AT	—	3	—	3	—	3
2/8/2011	AT	—	4	—	4	—	4
1/17/2012	AT	—	7	—	7	—	7

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
1/8/2013	AT	—	8	—	8	—	8
9/20/2013	AT	—	7	—	7	—	7
3/28/2014	AT	45	17	45	17	45	17
N116mArray-0A	AT	1	-8	4	0	17	3
1/10/2007	AT	4	—	4	—	4	—
12/17/2007	AT	1	—	1	—	1	—
3/24/2008	AT	4	—	4	—	4	—
6/23/2008	AT	2	—	2	—	2	—
8/22/2008	AT	7	—	7	—	7	—
1/8/2009	AT	2	—	2	—	2	—
4/1/2009	AT	3	1	3	1	3	1
6/17/2009	AT	2	-8	2	-8	2	-8
9/17/2009	AT	3	-6	3	-6	3	-6
12/17/2009	AT	5	-2	5	-2	5	-2
3/8/2010	AT	3	1	3	1	3	1
6/28/2010	AT	3	-2	3	-2	3	-2
9/16/2010	AT	3	-6	3	-6	3	-6
2/8/2011	AT	3	1	3	1	3	1
3/15/2011	AT	5	0	5	0	5	0
6/1/2011	AT	3	1	3	1	3	1
9/2/2011	AT	4	1	4	1	4	1
2/1/2012	AT	2	1	2	1	2	1
3/27/2012	AT	3	1	3	1	3	1
6/22/2012	AT	3	1	3	1	3	1
9/17/2012	AT	3	1	3	1	3	1

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
1/14/2013	AT	7	0	7	0	7	0
3/20/2013	AT	17	3	17	3	17	3
6/3/2013	AT	3	3	3	3	3	3
9/4/2013	AT	6	1	6	1	6	1
12/19/2013	AT	3	1	3	1	3	1
3/28/2014	AT	4	0	4	0	4	0
N116mArray-10A	AT	140	87	196	100	280	117
11/14/2005	AT	171	—	171	—	171	—
12/27/2005	AT	158	—	158	—	158	—
1/11/2006	AT	183	—	183	—	183	—
2/7/2006	AT	154	—	154	—	154	—
3/8/2006	AT	177	—	177	—	177	—
4/13/2006	AT	183	—	183	—	183	—
5/10/2006	AT	237	—	237	—	237	—
6/6/2006	AT	274	—	274	—	274	—
9/26/2006	AT	168	117	168	117	168	117
3/14/2007	AT	180	—	180	—	180	—
6/26/2007	AT	240	—	240	—	240	—
8/13/2007	AT	140	100	140	100	140	100
12/14/2007	AT	194	—	194	—	194	—
3/24/2008	AT	223	—	223	—	223	—
6/23/2008	AT	190	—	190	—	190	—
1/7/2009	AT	171	—	180	—	189	—
4/2/2009	AT	210	87	210	87	210	87
9/24/2009	AT	220	—	220	—	220	—

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
12/18/2009	AT	190	90	190	90	190	90
3/16/2010	AT	220	—	220	—	220	—
6/28/2010	AT	210	—	210	—	210	—
9/19/2010	AT	230	—	230	—	230	—
2/7/2011	AT	190	96	190	96	190	96
3/10/2011	AT	150	—	150	—	150	—
1/30/2012	AT	140	110	140	110	140	110
3/21/2012	AT	200	—	200	—	200	—
9/17/2012	AT	280	—	280	—	280	—
1/8/2013	AT	150	97	150	97	150	97
3/18/2013	AT	200	—	200	—	200	—
6/4/2013	AT	240	—	240	—	240	—
9/4/2013	AT	190	110	190	110	190	110
1/24/2014	AT	200	—	200	—	200	—
3/31/2014	AT	210	96	210	96	210	96
N116mArray-11A	AT	263	310	921	465	1,700	640
11/14/2005	AT	824	—	824	—	824	—
12/27/2005	AT	263	—	263	—	263	—
1/11/2006	AT	690	—	690	—	690	—
2/7/2006	AT	614	—	614	—	614	—
3/8/2006	AT	714	—	714	—	714	—
4/13/2006	AT	757	—	757	—	757	—
5/10/2006	AT	1,100	—	1,100	—	1,100	—
6/6/2006	AT	1,020	—	1,020	—	1,020	—
9/26/2006	AT	532	434	532	434	532	434

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
3/14/2007	AT	850	—	850	—	850	—
6/26/2007	AT	820	—	820	—	820	—
8/13/2007	AT	430	420	430	420	430	420
12/14/2007	AT	866	—	866	—	866	—
3/24/2008	AT	1,090	—	1,090	—	1,090	—
6/23/2008	AT	740	—	740	—	740	—
1/7/2009	AT	844	—	844	—	844	—
4/7/2009	AT	1,400	640	1,400	640	1,400	640
6/23/2009	AT	970	—	970	—	970	—
9/24/2009	AT	1,100	—	1,100	—	1,100	—
12/19/2009	AT	820	310	820	310	820	310
3/16/2010	AT	1,700	—	1,700	—	1,700	—
6/28/2010	AT	740	—	740	—	740	—
9/19/2010	AT	1,700	—	1,700	—	1,700	—
2/7/2011	AT	830	400	830	400	830	400
3/10/2011	AT	540	—	540	—	540	—
6/2/2011	AT	840	—	840	—	840	—
8/31/2011	AT	1,100	—	1,100	—	1,100	—
1/27/2012	AT	1,200	600	1,200	600	1,200	600
3/21/2012	AT	1,500	—	1,500	—	1,500	—
6/11/2012	AT	830	—	830	—	830	—
9/11/2012	AT	1,100	—	1,100	—	1,100	—
1/8/2013	AT	670	370	670	370	670	370
3/18/2013	AT	1,600	—	1,600	—	1,600	—
6/4/2013	AT	620	—	620	—	620	—

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
9/4/2013	AT	900	570	900	570	900	570
1/24/2014	AT	740	—	1,020	—	1,300	—
3/28/2014	AT	640	440	640	440	640	440
N116mArray-15A	AT	0	-10	3	-1	8	1
1/10/2007	AT	0	—	0	—	0	—
12/14/2007	AT	2	—	2	—	2	—
3/24/2008	AT	8	—	8	—	8	—
6/23/2008	AT	1	—	1	—	1	—
4/7/2009	AT	3	—	3	—	3	—
6/23/2009	AT	2	—	2	—	2	—
9/24/2009	AT	8	—	8	—	8	—
12/29/2009	AT	3	-10	3	-10	3	-10
3/16/2010	AT	2	—	3	—	4	—
6/28/2010	AT	4	—	4	—	4	—
9/19/2010	AT	3	—	3	—	3	—
2/7/2011	AT	3	-2	3	-2	3	-2
3/10/2011	AT	1	—	1	—	1	—
6/2/2011	AT	4	—	4	—	4	—
8/31/2011	AT	4	—	4	—	4	—
1/18/2012	AT	1	1	1	1	1	1
3/21/2012	AT	5	—	5	—	5	—
6/11/2012	AT	6	—	6	—	6	—
9/10/2012	AT	5	—	5	—	5	—
1/8/2013	AT	1	0	1	0	1	0
3/18/2013	AT	6	—	6	—	6	—

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
6/4/2013	AT	0	—	0	—	0	—
9/4/2013	AT	2	1	2	1	2	1
1/24/2014	AT	3	—	3	—	3	—
3/31/2014	AT	2	1	2	1	2	1
N116mArray-8.5A	AT	89	64	149	73	210	81
3/8/2006	AT	89	—	89	—	89	—
4/13/2006	AT	103	—	103	—	103	—
5/10/2006	AT	130	—	130	—	130	—
6/23/2009	AT	180	—	180	—	180	—
9/24/2009	AT	130	—	130	—	130	—
3/9/2010	AT	140	—	140	—	140	—
6/28/2010	AT	120	—	120	—	120	—
9/19/2010	AT	150	—	150	—	150	—
2/7/2011	AT	140	81	140	81	140	81
3/10/2011	AT	91	—	91	—	91	—
6/2/2011	AT	180	—	180	—	180	—
8/31/2011	AT	170	—	170	—	170	—
1/30/2012	AT	120	64	120	64	120	64
3/21/2012	AT	190	—	190	—	190	—
6/20/2012	AT	190	—	190	—	190	—
9/18/2012	AT	170	—	170	—	170	—
3/19/2013	AT	210	—	210	—	210	—
6/4/2013	AT	180	—	180	—	180	—
N116mArray-9A	AT	10	120	291	171	450	230
8/3/2005	AT	253	—	253	—	253	—

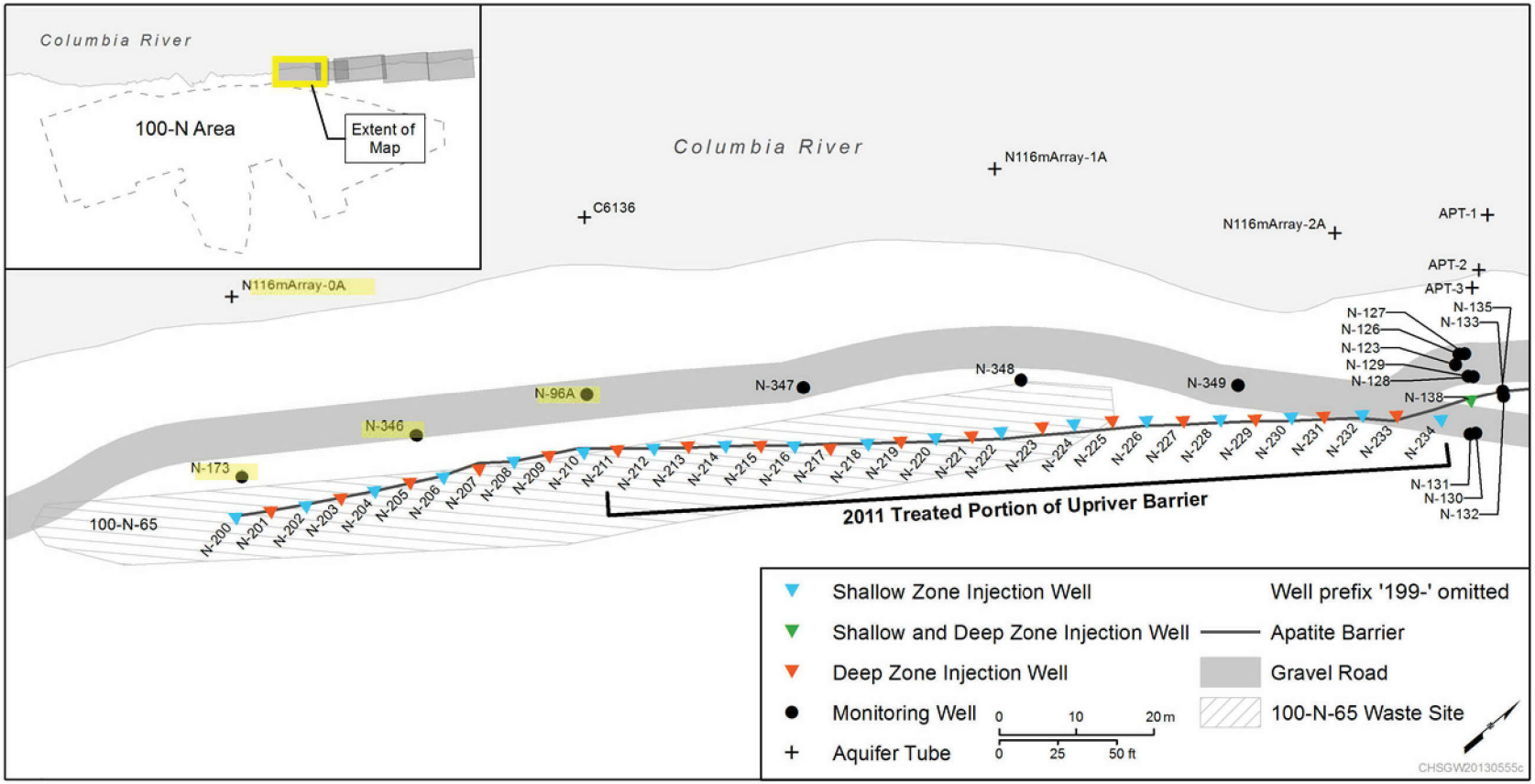
Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
9/28/2005	AT	224	127	224	127	224	127
1/11/2006	AT	250	—	250	—	250	—
2/7/2006	AT	211	—	211	—	211	—
3/8/2006	AT	224	—	224	—	224	—
4/13/2006	AT	259	—	259	—	259	—
5/10/2006	AT	295	—	295	—	295	—
6/6/2006	AT	295	—	295	—	295	—
9/26/2006	AT	232	120	232	120	232	120
3/14/2007	AT	250	—	250	—	250	—
6/26/2007	AT	300	—	300	—	300	—
8/13/2007	AT	240	140	240	140	240	140
12/14/2007	AT	255	—	255	—	255	—
3/26/2008	AT	113	—	113	—	113	—
6/23/2008	AT	47	—	47	—	47	—
1/12/2009	AT	10	—	10	—	10	—
4/2/2009	AT	420	180	420	180	420	180
12/18/2009	AT	340	170	340	170	340	170
3/9/2010	AT	380	—	380	—	380	—
6/28/2010	AT	260	—	260	—	260	—
2/7/2011	AT	350	190	350	190	350	190
3/10/2011	AT	220	—	220	—	220	—
6/2/2011	AT	330	—	330	—	330	—
8/31/2011	AT	410	—	410	—	410	—
1/27/2012	AT	320	180	320	180	320	180
3/21/2012	AT	420	—	420	—	420	—

Table A2-5. Gross Beta and Strontium-90 Concentration for Baseline

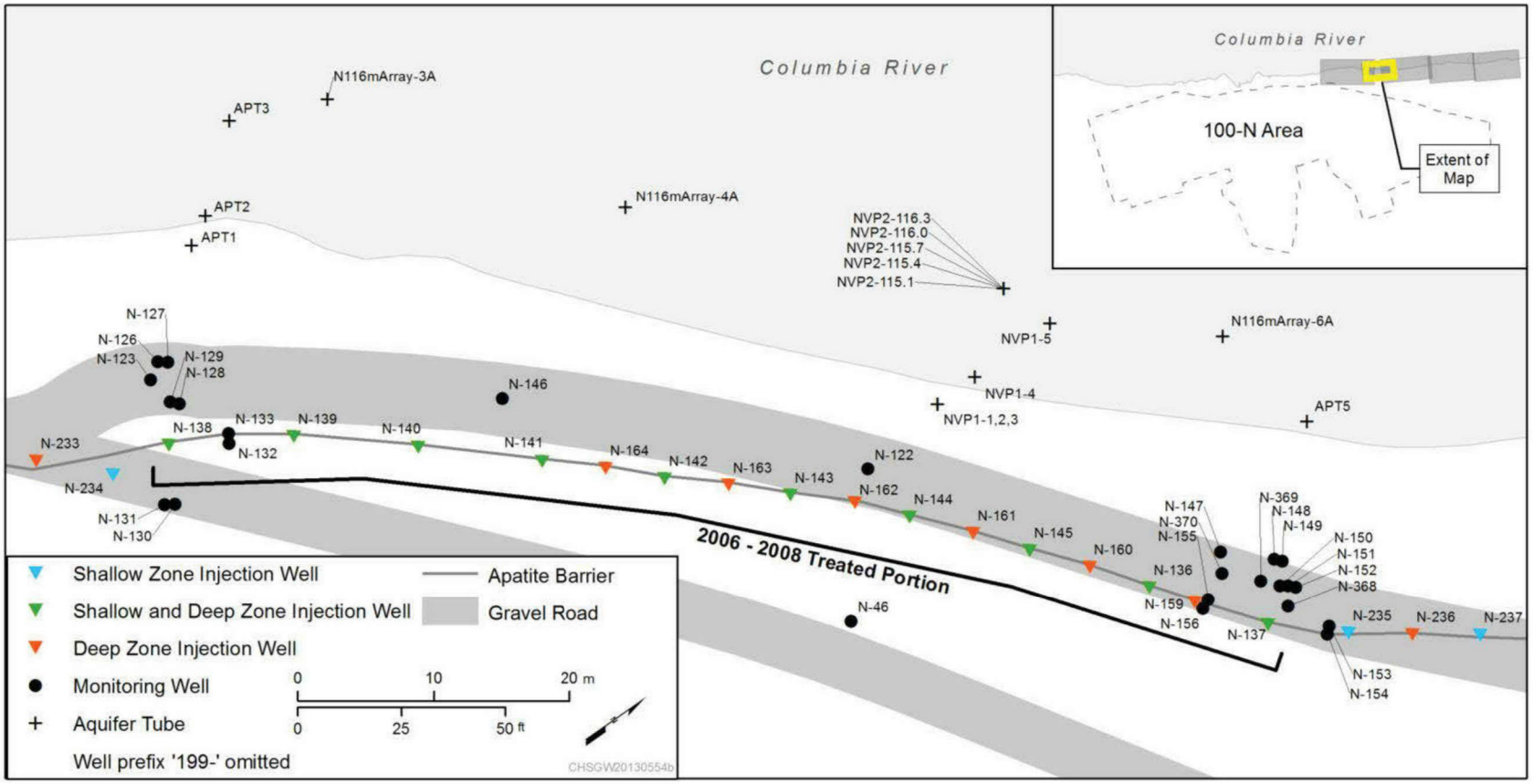
Well Name/ Sample Date	Purpose	Minimum Concentration (pCi/L)		Average Concentration (pCi/L)		Maximum Concentration (pCi/L)	
		Gross Beta	Strontium-90	Gross Beta	Strontium-90	Gross Beta	Strontium-90
6/11/2012	AT	370	—	370	—	370	—
9/11/2012	AT	450	—	450	—	450	—
1/9/2013	AT	300	160	300	160	300	160
3/18/2013	AT	410	—	410	—	410	—
6/4/2013	AT	320	—	320	—	320	—
9/4/2013	AT	360	230	360	230	360	230
1/24/2014	AT	370	—	370	—	370	—
3/31/2014	AT	390	210	390	210	390	210

AT = aquifer tube
MW = monitoring well



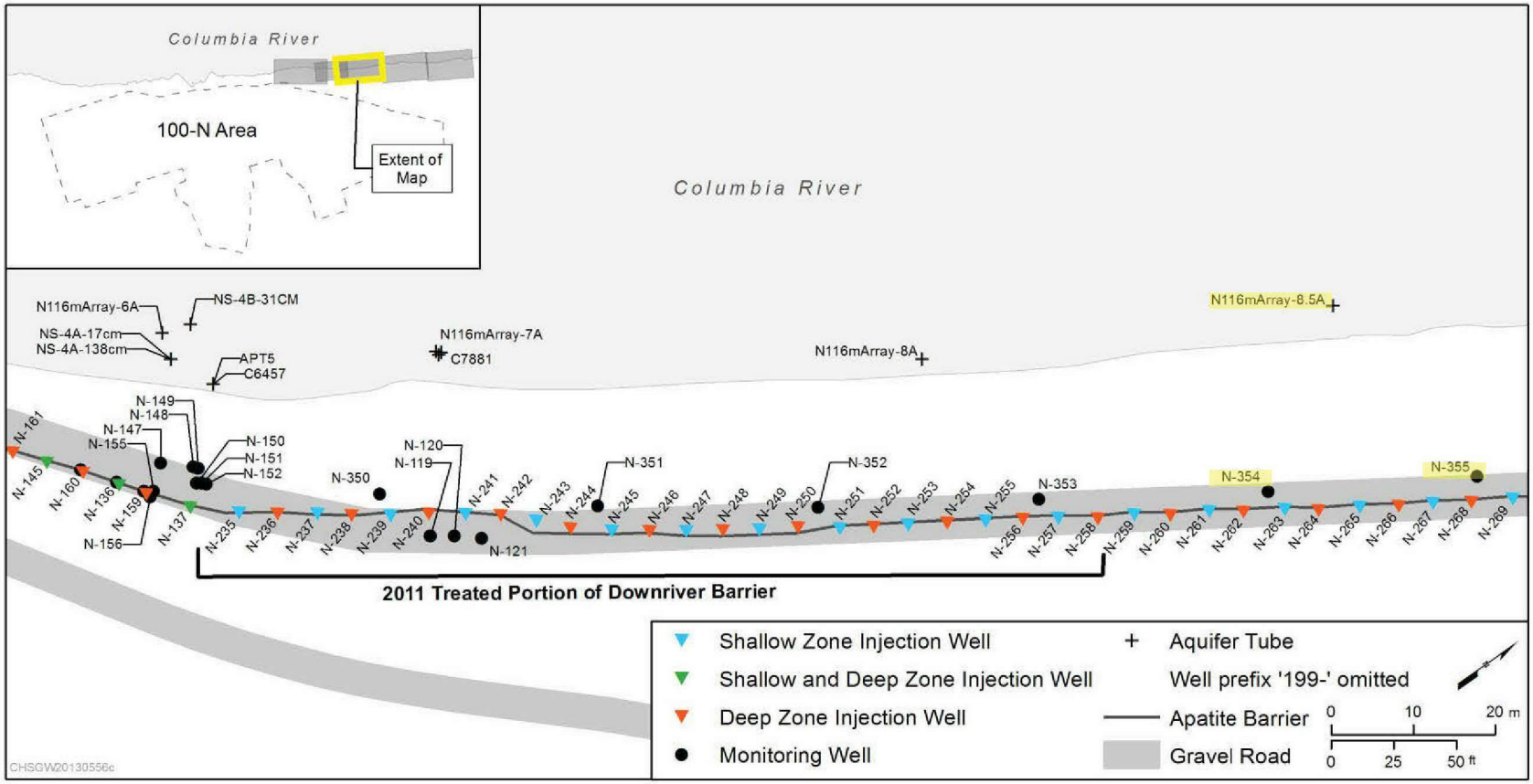
* Yellow highlights denote wells/aquifer tubes that were sampled in spring 2014 for baseline sampling.

Figure A2-4. Upriver Apatite Barrier Extension Injection Wells, Monitoring Wells, and Aquifer Tube Locations



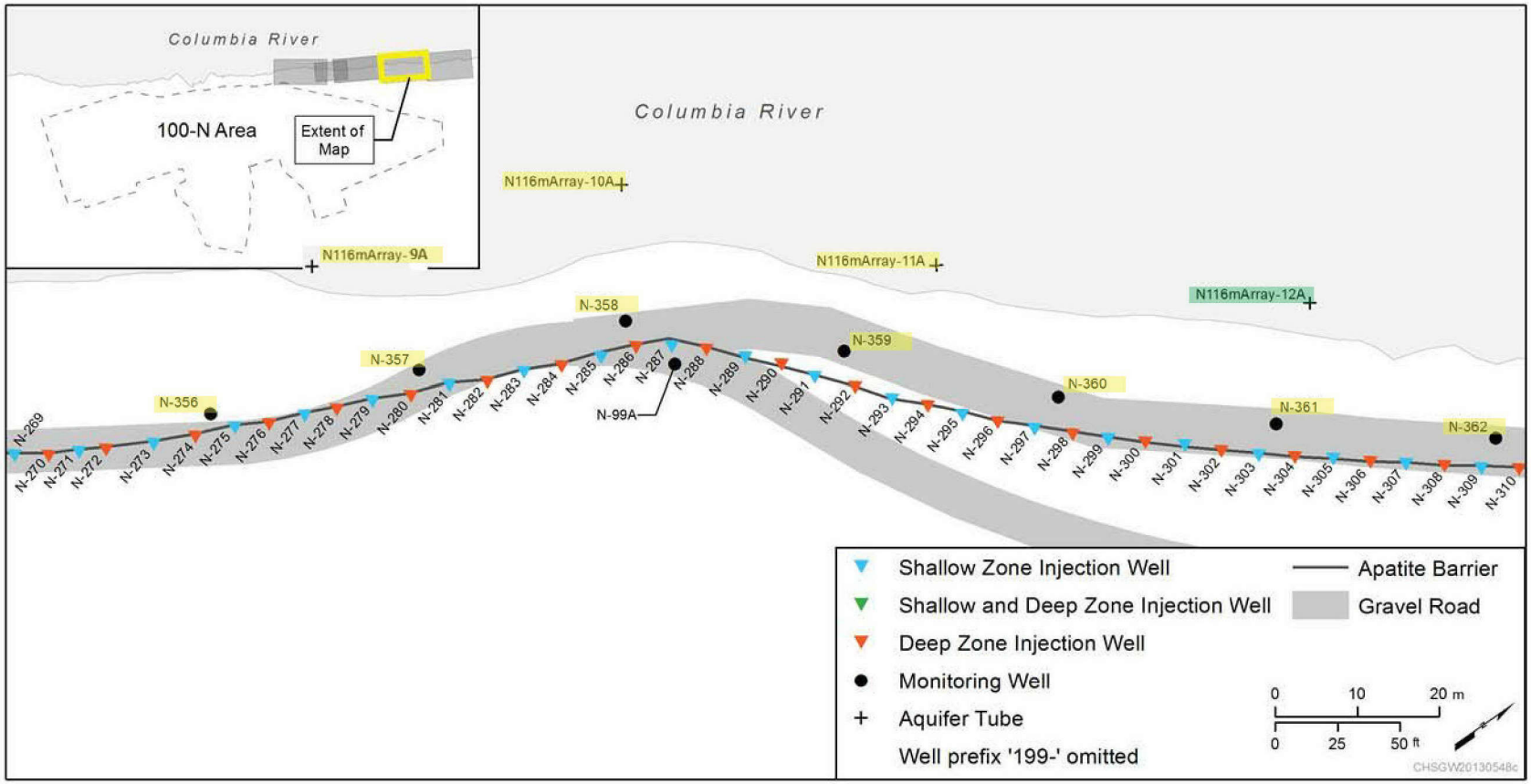
* Yellow highlights denote wells/aquifer tubes that were sampled in spring 2014 for baseline sampling.

Figure A2-5. Original 90 m (300 ft) Apatite Barrier Injection Wells, Monitoring Wells, and Aquifer Tube Locations



* Yellow highlights denote wells/aquifer tubes that were sampled in spring 2014 for baseline sampling.

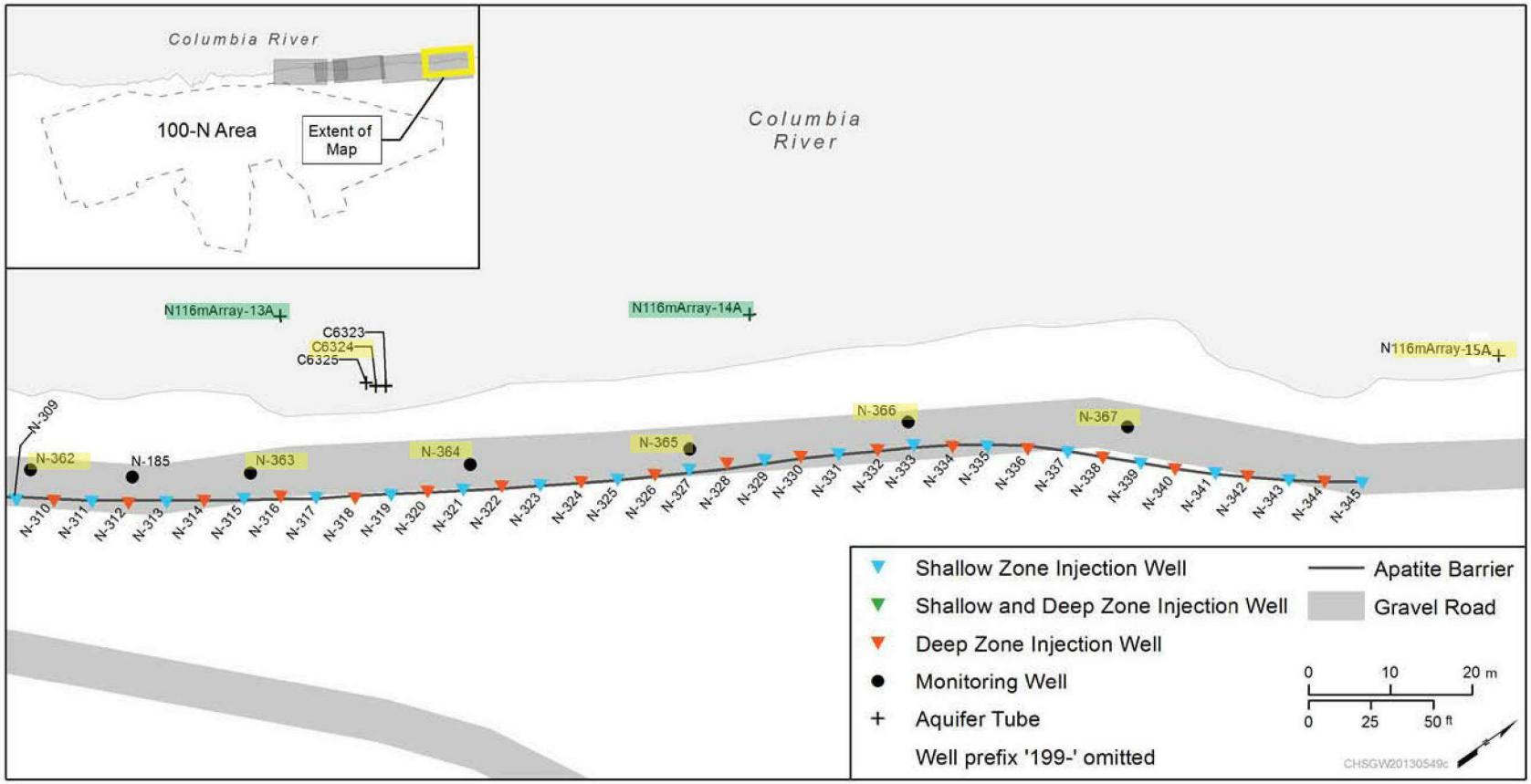
Figure A2-6. Downriver Apatite Barrier Extension Injection Wells, Monitoring Wells, and Aquifer Tube Locations



* Yellow highlights denote wells/aquifer tubes that were sampled in spring 2014 for baseline sampling.

* Green highlights indicate aquifer tube requires repair/replacement prior to sampling.

Figure A2-7. Downriver Apatite Barrier Injection Wells, Monitoring Wells, and Aquifer Tube Locations



* Yellow highlights denote wells/aquifer tubes that were sampled in spring 2014 for baseline sampling.

* Green highlights indicate aquifer tube requires repair/replacement prior to sampling.

Figure A2-8. Downriver Apatite Barrier Injection Wells, Monitoring Wells, and Aquifer Tube Locations

A2.5.1 Injection Skid Sampling, Flow Rate, and Volume

Flow rates and pressure within the injection skid system will be monitored during injections, and any needed flow adjustments will be made. Samples will be periodically collected from the injection skid to ensure that the apatite precursors are being injected at the correct concentrations. Specific conductance will be monitored every 4 hours as a field indicator of concentration. Specific conductance of the injection solution will be measured from samples collected at the injection skid. This will be compared to the specific conductance measured by the monitoring probes in selected wells to determine the distribution of the injection solution within the aquifer. Injection skid sampling frequency is provided in Table A2-3.

A2.5.2 Groundwater Sampling and Analysis

Groundwater samples and field parameters will be collected from wells located within the potential area of injection influence to track the transport of apatite precursors (injection arrival) and to monitor PRB performance. Table A2-4 provides the groundwater sample frequency through the first year following injection of apatite forming chemicals. Long-term barrier performance monitoring following the first year is identified in the SAP (Appendix A).

Groundwater samples will be collected using either a peristaltic pump or a 12-volt electric submersible pump. Sample collection using peristaltic pumps and maintenance of peristaltic pumps are provided in field-specific operating procedures. Field parameters will be measured for each sample using portable field instruments. Specific conductance, oxidation-reduction potential, temperature, dissolved oxygen, and pH will all be measured in the field. Aqueous samples for analyses of analytical laboratory parameters will be collected. Table A-9 of the SAP (Appendix A) lists the analytic sampling requirements for the parameters, container volume, and preservation methods required for laboratory analyses.

A2.5.3 Aquifer Tube Sampling

Samples will be collected from aquifer tubes located within the potential area of injection influence. Previous work for the high-concentration injections (PNNL-19572, *100-NR-2 Apatite Treatability Test: High-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization Final Report*) have shown that if elevated Sr-90 and other metal concentrations occur as a result of injecting a high ionic-strength Ca-citrate-PO_4 solution, the aquifer stabilizes within a few weeks following injections. Gross-beta analysis will initially be used for estimating Sr-90 concentrations to provide a quicker turnaround time for analytical results. Table A2-4 provides the aquifer tube sample frequency through the first year following injection of apatite forming chemicals. Long-term barrier performance monitoring following the first year is identified in the SAP (Appendix A).

A2.6 Vadose Zone Injection Monitoring

Sampling and analysis requirements for the jet injections include chemical makeup sampling, injection flow rate and volume monitoring, and groundwater and aquifer tube sampling. Samples will be collected in a number of monitoring wells and aquifer tubes along the 100-N Area shoreline during and after treatment. The wells and aquifer tubes that will be sampled are listed in Table A2-6 and were selected based on their proximity to the area along the shoreline to be injected, which also correlates with the areas of highest Sr-90 vadose zone concentrations. Figures A2-4 through A2-8 can be used to identify the monitoring well and aquifer tube locations. Specific details on which wells and aquifer tubes will be sampled as the jet injections proceed will also be provided in activity-specific field instructions.

Table A2-6. Vadose Zone Jet Injection Monitoring Points

Well Name/Identification	Well Type	Well Name/Identification	Well Type
199-N-173/C7038	MW	N116mArray-4A/C5258	AT
199-N-346/C7442	MW	199-N-122/C4954	MW
199-N-96A/A9882	MW	NVP2-116.0m/C5251	AT
C6136	AT	N116mArray-6A/C5259	AT
199-N-347/C7441	MW	199-N-147/C5116	MW
N116mArray-1A/C5255	AT	APT-5/C5386	AT
199-N-348/C7440	MW	199-N-350/C7443	MW
N116mArray-2A/C5256	AT	C7881	AT
199-N-349/C7439	MW	199-N-351/C7444	MW
199-N-123/C4955	MW	199-N-352/C7445	MW
APT-1/C5269	AT	199-N-353/C7446	MW
N116mArray-3A/C5257	AT	N116mArray 8A/C5261	AT
199-N-146/C5052	MW		

AT = aquifer tube
MW = monitoring well

The objectives of the vadose zone jet injection monitoring are to determine the following information:

- Pre-jet injection baseline concentrations of Sr-90 for evaluating overall combined saturated zone and vadose zone PRB performance
- Mass and extent of apatite emplacement within the aquifer and vadose zone to evaluate effective PRB installation
- Reduction in Sr-90 concentrations in response to the PRB installation

Sampling protocols are designed to determine these conditions.

A2.6.1 Injection Flow Rate and Volume

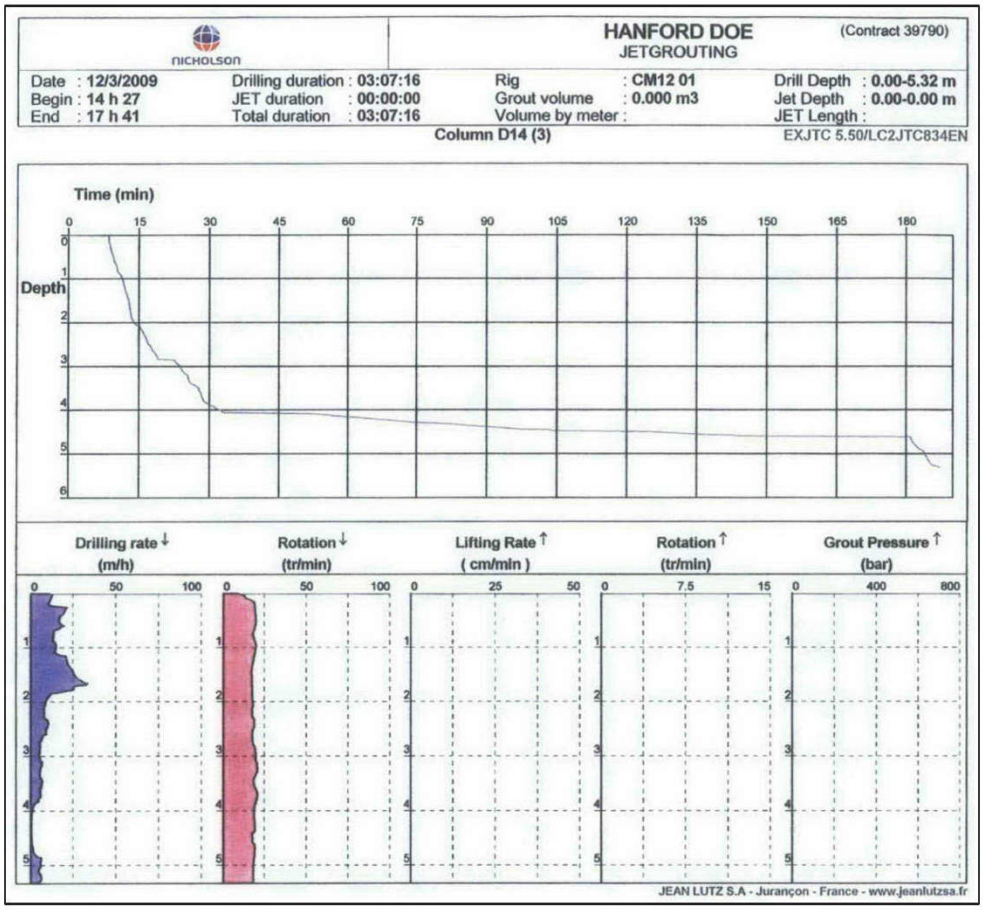
Flow rates during drilling and jet injection will be monitored and any necessary flow adjustments will be made accordingly. Flow rates will be determined by conditions encountered during jet injection and the capacity of the formation to accept the material.

A data recorder system will be used to record important parameters continuously through the drilling and injection of each borehole. Table A2-7 summarizes the types, information and frequency that data will be recorded on the data sheets. At the completion of borehole jet injection, logs will be prepared (similar to Figure A2-3, showing a jet injection log report from SGW-47062 for the jet injection pilot test). All field activities will be overseen by qualified staff, as described in Section A2.1.1 of the SAP (Appendix A).

Table A2-7. Data Recorder Parameter Logging During Borehole Jet Injection

Data Recorded	Reading Locations	Frequency
Drill depth	Drilling rig data recorder	Continuously
Drilling rate	Drilling rig data recorder	Continuously
Drill duration	Drilling rig data recorder	Continuously
Rod rotation	Drilling rig data recorder	Continuously
Lifting rate	Drilling rig data recorder	Continuously
Solution flow rate	Drilling rig data recorder	Continuously
Injection quantity/volume	Chemical makeup tanks	At end of each borehole injection on field instruction data sheet
Specific conductance	Installed field instruments for continuous monitoring in monitoring and injection wells	Every 4 hours on field instruction data sheet
Field parameters*	Samples from injection feed hose	Every 4 hours on field instruction data sheet

* Field parameters include specific conductance, temperature, pH, oxidation-reduction potential, and dissolved oxygen.



Source: SGW-47062, *Treatability Test Report for Field-Scale Apatite Jet Injection Demonstration for the 100-NR-2 Operable Unit.*

Figure A2-3. Example Injection Log Report

A2.6.2 Groundwater Sampling and Analysis

Short-term groundwater monitoring for the vadose zone injections includes the following activities:

- Prior to injection, baseline concentrations will be determined for each monitoring well and aquifer tube downgradient from the vadose zone PRB to serve as the basis for evaluating barrier performance (Table A2-6). The vadose zone PRB will be installed along the previously treated length of the saturated zone PRB, so additional sampling prior to vadose zone injections will not be required. Data from groundwater sample results (from performance monitoring wells and aquifer tubes downgradient of the treated saturated zone PRB) will be used to establish a baseline for determining PRB performance gains from the vadose zone PRB.

- Previous work for the saturated zone injections (PNNL-20252, *100-NR-2 Apatite Treatability Test: An Update on Barrier Performance*) showed temporary increases in Sr-90 concentrations as it was displaced from the sediment by the high ionic-strength solution. Groundwater monitoring will be conducted following injections to monitor the short-term impacts. Sampling frequency detail is provided in Table A2-8. Aqueous samples will be collected from specified monitoring wells and aquifer tubes and analyzed for major anions and cations (particularly Sr-90, phosphate, and gross beta).

Groundwater samples will be collected using either a peristaltic pump or a 12-volt electric submersible pump. Field parameters (specific conductance, oxidation-reduction potential, temperature, dissolved oxygen, and pH) for each sample will be measured using portable field instruments. Aqueous samples for laboratory analyses of other parameters will be collected. Table A-9 of the SAP (Appendix A) lists the analytic sampling requirements for the parameters, container volume, and preservation methods for laboratory analyses. Wells will be purged according to standard practices and procedures to ensure that the sample collected represents the aquifer conditions.

Table A2-8. Vadose Zone Jet Injection Sample Locations and Frequencies

Sample Purpose	Sample Locations	Sample Frequency	Analytes[a]
Injection monitoring[a]	Downgradient monitoring wells/aquifer tubes	Field parameters continuously in situ from wells, aqueous samples at the end of each injection series from both wells and aquifer tubes (upriver and downriver)	Cations, anions, Sr-90, gross beta, TPH-diesel[b], and field parameters[c]
Performance monitoring	Nearby monitoring wells, multipurpose wells, and aquifer tubes	Once a week for 6 weeks with confirmatory samples after 3 months and 6 months	Cations, anions, Sr-90, gross beta, and field parameters[c]

a. For injection monitoring, probes will be placed in injection and/or monitoring wells adjacent to borehole(s) being drilled/injected.

b. If floating product is observed during sampling, the samples will also be analyzed for TPH-diesel.

c. Field parameters include specific conductance, temperature, pH, oxidation-reduction potential, and dissolved oxygen.

TPH = total petroleum hydrocarbons

A2.6.3 Aquifer Tube Sampling

Samples will be collected from aquifer tubes located within the potential area of injection influence. Table A2-8 provides the aquifer tube sample frequency for the vadose zone injections. Initially, gross-beta analysis will be used for estimating Sr-90 concentrations to provide analytical results more quickly.

A2.6.4 Sediment Core Sampling

Continuous core samples will be collected at four locations within the vadose zone treated PRB where higher Sr-90 concentrations are observed. Two continuous core samples will be collected at each of the four locations (for a total of eight core samples) in alignment from saturated zone injection wells and existing downgradient monitoring wells. Core samples will be collected for analysis at approximately 0.8 m (2.5 ft) intervals. Core samples will be collected at least 3 months, but not more than one year, after the jet injections have been completed to determine the nature and extent of the apatite-forming phosphate and pre-formed apatite emplacement.

A 10.2 cm (4 in.) inner diameter core will be collected in 0.762 m (2.5 ft) long runs using splitspoon samplers. The splitspoon sampler will be lined with pre-cut 15.2 cm (6 in.) long Lexan® liner sections. Upon retrieval of the sampler, the ends of each 15.2 cm (6 in.) core segment will be capped, and the liner will be labeled according to depth and well number. The core sections will also be labeled with an 'up arrow indicating core orientation. Once the core section has been appropriately labeled, end caps will be securely tied to prevent the caps from coming off during transport or storage.

The cores will be collected from the ground surface to the top of the Ringold Formation upper mud unit. A determination of the amount of strontium and Sr-90 incorporated in the apatite matrix, adsorbed to apatite material by ion exchange, and sorbed to sediments may be completed later. These cores will be collected in order to have samples that can be compared to those taken during the jet injection pilot study and to serve as an additional basis for judging barrier performance. Tables A-6 and A-9 of the SAP (Appendix A) provide analytical performance requirements and sample preservation, container, and holding time guidelines, respectively, for the soil samples.

A2.7 Performance Monitoring Through 2013

Performance monitoring results of the PRB have been presented in a number of reports since 2009, which are identified in Table A2-9.

Table A2-9. Reports on Performance Monitoring of the Apatite PRB

Year	Report Number	Report Title
2009	PNNL-19572	*100-NR-2 Apatite Treatability Test: High-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization: Final Report*
2010	PNNL-20252	*100-NR-2 Apatite Treatability Test: An Update on Barrier Performance*
2011	DOE/RL-2012-02	*Calendar Year 2011 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*

Table A2-9. Reports on Performance Monitoring of the Apatite PRB

Year	Report Number	Report Title
2012	DOE/RL-2013-13	*Calendar Year 2012 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*
2013	DOE/RL-2014-25	*Calendar Year 2013 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*

As discussed in DOE/RL-2014-25, *Calendar Year 2013 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation*, following the apatite injections in 2008 in wells in the central (original) segment of the barrier, Sr-90 concentrations declined in the performance monitoring wells. The wells showed temporary higher Sr-90 concentrations immediately following the injections of the apatite solution, which had a higher ionic strength than groundwater and temporarily mobilized cations and anions, causing their concentrations in groundwater to increase. Strontium-90 concentrations in performance monitoring wells 199-N-122 and 199-N-123, which are near the upriver and downriver ends of the central barrier segment, temporarily increased again following injections into the nearby upriver and downriver barrier extension wells in 2011. These temporary elevated concentrations have since declined.

Performance monitoring at the apatite barrier was conducted twice in 2013. Groundwater samples were collected from performance monitoring wells and aquifer tubes during high river stage in May and during low river stage in September. A comparison of fall 2013 data to baseline conditions is provided in Table A2-10.

As of fall 2013, the Sr-90 concentrations were still considerably lower in the performance monitoring wells along the central segment of the barrier than before injections started in 2006. The treatability test plan objective was a 90 percent reduction in Sr-90 concentrations in the performance monitoring wells (DOE/RL-2005-96). The data for 2013 indicate that the Sr-90 concentrations in groundwater have been reduced by approximately 90 percent in three of the four performance monitoring wells. The percent reduction in Sr-90 concentrations in fall 2013 ranged from 73 percent (Well 199-N-146) to 93 percent (Well 199-N-147) (Table A2-10).

In the performance monitoring wells along the upriver barrier extension, the percent reduction in Sr-90 concentrations in September 2013 (the end of the second year following the injections) ranged from 17 percent (Well 199-N-347) to 98 percent (Well 199-N-348) (Table A2-10). The relatively low percent reduction in Well 199-N-347 reflects a comparison of the low baseline Sr-90 concentration in this well (the Sr-90 concentration was nondetect, and the Sr-90 concentration estimated from gross beta was 7.0 pCi/L) to the low Sr-90 concentration measured during September 2013 performance monitoring (5.8 pCi/L). Both the baseline and the September 2013 sample concentrations are below the DWS (8 pCi/L).

In the performance monitoring wells along the downriver barrier extension, the percent reduction in Sr-90 concentrations in September 2013 ranged from 87 percent (Well 199-N-351) to 97 percent (Well 199-N-353) (Table A2-10). The downriver extension intercepts higher Sr-90 groundwater concentrations than the upriver extension and indicates an initial successful barrier performance.

Table A2-10. Performance Monitoring at the Apatite PRB at the 100-NR-2 OU

Well Name	Number of Baseline Samples	Number of Baseline Nondetects	Strontium-90 Concentration (pCi/L)				Percent Reduction in Sr-90 (Baseline to Fall 2013)[a]	
			Minimum Detected Baseline	Maximum Baseline	Spring 2013	Fall 2013	Minimum Baseline	Maximum Baseline
Upriver Apatite PRB								
			04/06/10		**05/06/13**	**09/06/13**		
199-N-96A	56	8	1.54[b]	37.9[b]	2.3	5.9	-283	84
199-N-347	1	1	7[c]	7[c]	8.5	5.8	17	17
199-N-348	1	0	1,800	1,800	28	41	98	98
199-N-349	2	0	220	230	27	66	70	71
Central (Original) Apatite PRB								
(See footnote d)			(See footnote e)		**05/06/13**	**09/06/13**		
199-N-122	10	0	657	4,630	390; 390	550; 560[f]	16	88
199-N-146	4	0	318	985	180	270	15	73
199-N-147	3	0	522	1,842	150	120[g]	77	93
199-N-123	6	0	689	1,180	110	140[c]	80	88
Downriver Apatite PRB								
			07/28/10 and 07/29/10		**05/06/13**	**09/06/13**		
199-N-350	1	0	240	240	13	29	88	88
199-N-351	1	0	350	350	32	46	87	87
199-N-352	1	0	580	580	26	31	95	95
199-N-353	1	0	83	83	3.5	2.8	97	97

Table A2-10. Performance Monitoring at the Apatite PRB at the 100-NR-2 OU

Well Name	Number of Baseline Samples	Number of Baseline Nondetects	Strontium-90 Concentration (pCi/L)				Percent Reduction in Sr-90 (Baseline to Fall 2013)[a]	
			Minimum Detected Baseline	Maximum Baseline	Spring 2013	Fall 2013	Minimum Baseline	Maximum Baseline

Note: Between 1995 and 2011, the maximum baseline was measured on December 6, 1995; the minimum detected baseline was measured on June 13, 2006, and June 22, 2007.

a. The percent reduction in Sr-90 concentration is calculated as ([baseline value] – [fall 2013 value]/[baseline value]) × 100). For Well 199-N-96A, the minimum baseline value used in the calculation was the lowest detected value.

b. Strontium-90 is a beta emitter. Gross-beta concentrations are approximately two times the Sr-90 concentrations. The Sr-90 concentration was 1.1 pCi/L (U).

c. The gross beta concentration, 14 pCi/L, was divided by two to approximate the Sr-90 concentration of 7 pCi/L.

d. From Table 8.1 in PNNL-17429, *Interim Report: 100-NR-2 Apatite Treatability Test: Low-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization*.

e. From Table 4.1 in PNNL-19572, *100-NR-2 Apatite Treatability Test: High-Concentration Calcium-Citrate-Phosphate Solution Injection for In Situ Strontium-90 Immobilization Final Report*.

f. Sampled on November 11, 2013.

g. Sampled on November 13, 2013.

PRB = permeable reactive barrier

U = analyzed for but not detected

Semiannual performance monitoring (high and low river stages) will continue for the apatite PRB. Ongoing monitoring will determine the continued effectiveness of the apatite treatment along the expanded barrier.

A2.8 Reporting

Results of CERCLA groundwater monitoring are reported annually in Hanford Sitewide groundwater monitoring reports (e.g., DOE/RL-2013-22, *Hanford Site Groundwater Monitoring Report for 2012*) and interim action reports (e.g., DOE/RL-2013-13).

Regular evaluation and reporting of monitoring data and of operations and maintenance activities (e.g., inspections of riprap and surface road integrity) will be necessary to document performance, identify conditions potentially impacting system performance, and determine if the remedial action needs to be modified. Annual reports will be used to present the results of sampling activities and inspections. These reports will include tabular summaries and graphical depictions of compliance well and performance well analytical results and trends, along with QA data. A brief narrative will be included with recommendations for modifying the performance monitoring, if warranted.

The annual performance evaluation will include data collected from the performance monitoring program and will be submitted to the regulatory agencies and onsite contractors as needed. The results will be used to evaluate the performance of the remedial action toward meeting the RAOs identified in the Interim Action ROD (EPA/ROD/R10-99/112).

A2.9 Change Control

Table A-5 of the SAP (Appendix A) and Table A2-11 list how changes to 100-N Area groundwater monitoring activities, associated documents, and approval requirements are made and documented to meet the primary document requirements of Section 9.3 of the Tri-Party Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*).

Table A2-11. Actions and Documentation for Changes to the 100-NR-2 OU SAP

Type of Change	Action*	Documentation
Temporarily (less than or equal to one year) adding constituent or wells; increasing sampling frequency	Project management approval; provide email notification to DOE project technical lead.	Project's schedule tracking system; no change to document required.
Temporarily (less than or equal to one year) reducing constituent analysis or well sampling frequency	Obtain DOE project technical lead and appropriate regulatory agency's approval before making change.	Approval via email or letter.
Permanently (greater than one year) adding or reducing constituent analysis or well sampling frequency	Revise SAP; undergo Tri-Party Agreement primary document process.	Tri-Party Agreement change notice and/or revise plan; plan will be reviewed for revision annually, incorporating all change notices.

Table A2-11. Actions and Documentation for Changes to the 100-NR-2 OU SAP

Type of Change	Action*	Documentation
Unavoidable changes (e.g., dry wells; delayed samples, one-time missed samples due to broken pump, and lost bottle)	Notify DOE project technical lead and appropriate regulatory agency.	Project's schedule tracking system; notification via letter, email, or meeting minutes to DOE project technical lead and appropriate regulatory agency.

* Notifications will be made within 15 days.

DOE = U.S. Department of Energy

SAP = sampling and analysis plan

Tri-Party Agreement = *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a).

A2.10 References

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Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	12/18/2013	7429-90-5	Aluminum	68	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	9/15/2010	7440-36-0	Antimony	53.2	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-36-0	Antimony	40.2	µg/L	N	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-36-0	Antimony	3.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-38-2	Arsenic	5	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-39-3	Barium	264	µg/L	Y				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-39-3	Barium	266	µg/L	N				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-39-3	Barium	227	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	9/15/2010	7440-39-3	Barium	233	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-39-3	Barium	232	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-39-3	Barium	241	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-39-3	Barium	155	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-39-3	Barium	163	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-39-3	Barium	157	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-39-3	Barium	160	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-39-3	Barium	241	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-39-3	Barium	243	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-39-3	Barium	172	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-39-3	Barium	188	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-39-3	Barium	186	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-39-3	Barium	196	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-39-3	Barium	197	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-41-7	Beryllium	1.8	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-41-7	Beryllium	1.4	µg/L	N	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	12/18/2013	7440-41-7	Beryllium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-69-9	Bismuth	0.5	µg/L	N	U			GEL	6020_METALS_ICPMS
199-N-173	MW	12/18/2013	7440-42-8	Boron	19.8	µg/L	N	B			GEL	6010_METALS_ICP_TR
199-N-173	MW	12/18/2013	24959-67-9	Bromide	167	µg/L	N	B			GEL	9056_ANIONS_IC
199-N-173	MW	9/15/2010	7440-43-9	Cadmium	1.8	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-43-9	Cadmium	1	µg/L	N	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-43-9	Cadmium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-70-2	Calcium	138,000	µg/L	Y	DN			TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	9/15/2010	7440-70-2	Calcium	138,000	µg/L	N	DN			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-70-2	Calcium	163,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-70-2	Calcium	165,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-70-2	Calcium	137,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-70-2	Calcium	149,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-70-2	Calcium	79,300	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-70-2	Calcium	84,700	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-70-2	Calcium	83,700	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-70-2	Calcium	83,500	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-70-2	Calcium	162,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-70-2	Calcium	158,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-70-2	Calcium	143,000	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-70-2	Calcium	159,000	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-70-2	Calcium	159,000	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-70-2	Calcium	168,000	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-70-2	Calcium	170,000	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	16887-00-6	Chloride	37,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	16887-00-6	Chloride	35,600	µg/L	N	D			TASL	300.0_ANIONS_IC
199-N-173	MW	12/15/2011	16887-00-6	Chloride	36,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	16887-00-6	Chloride	5,310	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	16887-00-6	Chloride	5,650	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	11/11/2013	16887-00-6	Chloride	53,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/18/2013	16887-00-6	Chloride	50,700	µg/L	N	D			GEL	9056_ANIONS_IC
199-N-173	MW	3/31/2014	16887-00-6	Chloride	53,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	3/31/2014	16887-00-6	Chloride	53,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	7440-47-3	Chromium	3.1	µg/L	Y	U			TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	9/15/2010	7440-47-3	Chromium	3.1	µg/L	N	U			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-47-3	Chromium	8.82	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-47-3	Chromium	14	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-48-4	Cobalt	13	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-48-4	Cobalt	8.3	µg/L	N	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	11/11/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-48-4	Cobalt	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-50-8	Copper	4.6	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-50-8	Copper	4.6	µg/L	N	U			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-50-8	Copper	3.28	µg/L	N	B			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	DO	Dissolved oxygen	420	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-173	MW	12/15/2011	DO	Dissolved oxygen	3,980	µg/L	N				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	8/27/2012	DO	Dissolved oxygen	220	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-173	MW	6/24/2013	DO	Dissolved oxygen	40	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-173	MW	11/11/2013	DO	Dissolved oxygen	1,330	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-173	MW	12/18/2013	DO	Dissolved oxygen	4,720	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-173	MW	3/31/2014	DO	Dissolved oxygen	1,970	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-173	MW	9/15/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	16984-48-8	Fluoride	88	µg/L	N	B			TASL	300.0_ANIONS_IC
199-N-173	MW	12/15/2011	16984-48-8	Fluoride	78.6	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	16984-48-8	Fluoride	120	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	16984-48-8	Fluoride	120	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	11/11/2013	16984-48-8	Fluoride	105	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/18/2013	16984-48-8	Fluoride	130	µg/L	N	B			GEL	9056_ANIONS_IC
199-N-173	MW	3/31/2014	16984-48-8	Fluoride	59.4	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-173	MW	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	3/31/2014	12587-46-1	Gross alpha	2.7	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-173	MW	3/31/2014	12587-46-1	Gross alpha	2.5	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-173	MW	9/15/2010	12587-47-2	Gross beta	65	pCi/L	N				WSCF	BETA_GPC
199-N-173	MW	9/15/2010	12587-47-2	Gross beta	55.4	pCi/L	N				TARL	9310_ALPHABETA_GPC
199-N-173	MW	12/15/2011	12587-47-2	Gross beta	45	pCi/L	N				WSCF	BETA_GPC
199-N-173	MW	8/27/2012	12587-47-2	Gross beta	44	pCi/L	N				WSCF	BETA_GPC
199-N-173	MW	8/27/2012	12587-47-2	Gross beta	48	pCi/L	N				WSCF	BETA_GPC
199-N-173	MW	11/11/2013	12587-47-2	Gross beta	57	pCi/L	N				WSCF	BETA_GPC
199-N-173	MW	3/31/2014	12587-47-2	Gross beta	51	pCi/L	N				WSCF	BETA_GPC
199-N-173	MW	3/31/2014	12587-47-2	Gross beta	45	pCi/L	N				WSCF	BETA_GPC
199-N-173	MW	9/15/2010	7439-89-6	Iron	834	µg/L	Y				TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	9/15/2010	7439-89-6	Iron	829	µg/L	N				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-89-6	Iron	496	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-89-6	Iron	585	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7439-89-6	Iron	1,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7439-89-6	Iron	361	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-89-6	Iron	161	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-89-6	Iron	163	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-89-6	Iron	136	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-89-6	Iron	133	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7439-89-6	Iron	28	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7439-89-6	Iron	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7439-89-6	Iron	30	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-89-6	Iron	56.4	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7439-92-1	Lead	3.3	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7439-93-2	Lithium	2.26	µg/L	N	B			GEL	6020_METALS_ICPMS
199-N-173	MW	9/15/2010	7439-95-4	Magnesium	27,800	µg/L	Y				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-95-4	Magnesium	27,900	µg/L	N				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-95-4	Magnesium	27,600	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-95-4	Magnesium	28,200	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	12/15/2011	7439-95-4	Magnesium	25,500	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7439-95-4	Magnesium	25,400	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-95-4	Magnesium	19,300	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-95-4	Magnesium	20,200	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-95-4	Magnesium	19,200	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-95-4	Magnesium	19,600	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7439-95-4	Magnesium	27,700	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7439-95-4	Magnesium	27,700	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7439-95-4	Magnesium	26,600	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7439-95-4	Magnesium	28,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-95-4	Magnesium	28,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-95-4	Magnesium	30,500	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-95-4	Magnesium	30,900	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-96-5	Manganese	4,460	µg/L	Y				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-96-5	Manganese	4,520	µg/L	N				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-96-5	Manganese	4,420	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7439-96-5	Manganese	4,570	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7439-96-5	Manganese	4,320	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7439-96-5	Manganese	3,220	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-96-5	Manganese	2,490	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-96-5	Manganese	2,580	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-96-5	Manganese	2,450	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7439-96-5	Manganese	2,510	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7439-96-5	Manganese	2,520	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7439-96-5	Manganese	2,540	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7439-96-5	Manganese	305	µg/L	N				GEL	6010_METALS_ICP_TR

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	3/31/2014	7439-96-5	Manganese	441	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-96-5	Manganese	435	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-96-5	Manganese	418	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-96-5	Manganese	404	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7439-98-7	Molybdenum	2	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-02-0	Nickel	13.3	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-02-0	Nickel	13.3	µg/L	N	U			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-02-0	Nickel	4.5	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-02-0	Nickel	6.7	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-02-0	Nickel	6.7	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-02-0	Nickel	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-02-0	Nickel	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-02-0	Nickel	11.4	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	9/15/2010	14797-55-8	Nitrate	16,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	14797-55-8	Nitrate	15,900	µg/L	N	D	H		TASL	300.0_ANIONS_IC
199-N-173	MW	12/15/2011	14797-55-8	Nitrate	3,980	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	14797-55-8	Nitrate	421	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	14797-55-8	Nitrate	421	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	11/11/2013	14797-55-8	Nitrate	6,330	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/18/2013	14797-55-8	Nitrate	5,090	µg/L	N	X			GEL	9056_ANIONS_IC
199-N-173	MW	3/31/2014	14797-55-8	Nitrate	18,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	3/31/2014	14797-55-8	Nitrate	18,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	14797-65-0	Nitrite	52.6	µg/L	N	B	H		TASL	300.0_ANIONS_IC
199-N-173	MW	12/15/2011	14797-65-0	Nitrite	851	µg/L	N	D	G		WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	14797-65-0	Nitrite	312	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	14797-65-0	Nitrite	434	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-173	MW	11/11/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/18/2013	14797-65-0	Nitrite	125	µg/L	N	UX			GEL	9056_ANIONS_IC
199-N-173	MW	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/18/2013	OIL/GREASE	Oil and grease	1,730	µg/L	N	B			GEL	1664A_OILGREASE
199-N-173	MW	9/15/2010	EH	Oxidation Reduction Potential	284.9	mV	N				FIELD	REDOX_PROBE_FLD
199-N-173	MW	12/15/2011	EH	Oxidation Reduction Potential	258.2	mV	N				FIELD	REDOX_PROBE_FLD
199-N-173	MW	8/27/2012	EH	Oxidation Reduction Potential	263.7	mV	N				FIELD	REDOX_PROBE_FLD
199-N-173	MW	6/24/2013	EH	Oxidation Reduction Potential	345	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	11/11/2013	EH	Oxidation Reduction Potential	189.3	mV	N				FIELD	REDOX_PROBE_FLD
199-N-173	MW	12/18/2013	EH	Oxidation Reduction Potential	274.5	mV	N				FIELD	REDOX_PROBE_FLD
199-N-173	MW	3/31/2014	EH	Oxidation Reduction Potential	351.2	mV	N				FIELD	REDOX_PROBE_FLD
199-N-173	MW	9/15/2010	PH	pH Measurement	7.01	unitless	N				FIELD	PH_ELECT_FLD
199-N-173	MW	12/15/2011	PH	pH Measurement	6.94	unitless	N				FIELD	PH_ELECT_FLD
199-N-173	MW	8/27/2012	PH	pH Measurement	6.7	unitless	N				FIELD	PH_ELECT_FLD
199-N-173	MW	6/24/2013	PH	pH Measurement	6.84	unitless	N				FIELD	PH_ELECT_FLD
199-N-173	MW	11/11/2013	PH	pH Measurement	7.06	unitless	N				FIELD	PH_ELECT_FLD
199-N-173	MW	12/18/2013	PH	pH Measurement	7.03	unitless	N				FIELD	PH_ELECT_FLD
199-N-173	MW	3/31/2014	PH	pH Measurement	6.93	unitless	N				FIELD	PH_ELECT_FLD
199-N-173	MW	12/18/2013	14265-44-2	Phosphate	205	µg/L	N	UX			GEL	9056_ANIONS_IC
199-N-173	MW	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/18/2013	7723-14-0	Phosphorus	60	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	9/15/2010	9/7/7440	Potassium	6,840	µg/L	Y	N			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	9/7/7440	Potassium	6,980	µg/L	N	N			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	9/7/7440	Potassium	6,280	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	9/7/7440	Potassium	6,430	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	9/7/7440	Potassium	6,860	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	9/7/7440	Potassium	6,930	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	9/7/7440	Potassium	4,560	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	9/7/7440	Potassium	4,750	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	9/7/7440	Potassium	4,600	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	8/27/2012	9/7/7440	Potassium	4,760	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	9/7/7440	Potassium	7,120	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	9/7/7440	Potassium	7,100	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	9/7/7440	Potassium	6,110	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	9/7/7440	Potassium	5,590	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	9/7/7440	Potassium	5,590	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	9/7/7440	Potassium	5,730	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	9/7/7440	Potassium	5,880	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7782-49-2	Selenium	6	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	12/18/2013	7440-21-3	Silicon	14,600	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	9/15/2010	7440-22-4	Silver	21	µg/L	Y	N			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-22-4	Silver	14.1	µg/L	N	N			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-22-4	Silver	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-22-4	Silver	6.57	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-22-4	Silver	6.32	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-22-4	Silver	6.35	µg/L	N	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	3/31/2014	7440-22-4	Silver	6.49	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-23-5	Sodium	56,600	µg/L	Y				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-23-5	Sodium	56,000	µg/L	N				TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-23-5	Sodium	51,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-23-5	Sodium	53,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-23-5	Sodium	47,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-23-5	Sodium	51,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-23-5	Sodium	23,700	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-23-5	Sodium	25,500	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-23-5	Sodium	23,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-23-5	Sodium	24,300	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-23-5	Sodium	55,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-23-5	Sodium	56,400	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-23-5	Sodium	49,300	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-23-5	Sodium	50,600	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-23-5	Sodium	50,200	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-23-5	Sodium	53,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-23-5	Sodium	54,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	CONDUCT	Specific Conductance	1,119	µS/cm	N				FIELD	CONDUCT_FLD
199-N-173	MW	12/15/2011	CONDUCT	Specific Conductance	1,013	µS/cm	N				FIELD	CONDUCT_FLD
199-N-173	MW	8/27/2012	CONDUCT	Specific Conductance	563	µS/cm	N				FIELD	CONDUCT_FLD
199-N-173	MW	6/24/2013	CONDUCT	Specific Conductance	589	µS/cm	N				FIELD	CONDUCT_FLD
199-N-173	MW	11/11/2013	CONDUCT	Specific Conductance	1,189	µS/cm	N				FIELD	CONDUCT_FLD
199-N-173	MW	12/18/2013	CONDUCT	Specific Conductance	1,106	µS/cm	N				FIELD	CONDUCT_FLD
199-N-173	MW	3/31/2014	CONDUCT	Specific Conductance	1,144	µS/cm	N				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	9/15/2010	7440-24-6	Strontium	711	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-24-6	Strontium	717	µg/L	N	D			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-24-6	Strontium	791	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-24-6	Strontium	807	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-24-6	Strontium	692	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-24-6	Strontium	740	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-24-6	Strontium	405	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-24-6	Strontium	424	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-24-6	Strontium	413	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-24-6	Strontium	409	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-24-6	Strontium	800	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-24-6	Strontium	780	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-24-6	Strontium	738	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-24-6	Strontium	806	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-24-6	Strontium	803	µg/L	Y				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-24-6	Strontium	845	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-24-6	Strontium	863	µg/L	N				WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	10098-97-2	Strontium-90	23	pCi/L	N				TARL	SRISO_SEP_PRECIP_GPC
199-N-173	MW	9/15/2010	10098-97-2	Strontium-90	18	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-173	MW	12/15/2011	10098-97-2	Strontium-90	19	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-173	MW	8/27/2012	10098-97-2	Strontium-90	15	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-173	MW	8/27/2012	10098-97-2	Strontium-90	14	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-173	MW	11/11/2013	10098-97-2	Strontium-90	22	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-173	MW	3/31/2014	10098-97-2	Strontium-90	23	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-173	MW	3/31/2014	10098-97-2	Strontium-90	25	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	9/15/2010	14808-79-8	Sulfate	70,900	µg/L	N	D			TASL	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	14808-79-8	Sulfate	74,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/15/2011	14808-79-8	Sulfate	117,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	14808-79-8	Sulfate	50,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	8/27/2012	14808-79-8	Sulfate	51,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	11/11/2013	14808-79-8	Sulfate	149,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	12/18/2013	14808-79-8	Sulfate	159,000	µg/L	N	D			GEL	9056_ANIONS_IC
199-N-173	MW	3/31/2014	14808-79-8	Sulfate	209,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	3/31/2014	14808-79-8	Sulfate	213,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-173	MW	9/15/2010	TEMPERATURE	Temperature	20.6	Deg C	N				FIELD	TEMP_FLD
199-N-173	MW	12/15/2011	TEMPERATURE	Temperature	18	Deg C	N				FIELD	TEMP_FLD
199-N-173	MW	8/27/2012	TEMPERATURE	Temperature	17.7	Deg C	N				FIELD	TEMP_FLD
199-N-173	MW	6/24/2013	TEMPERATURE	Temperature	16.9	Deg C	N				FIELD	TEMP_FLD
199-N-173	MW	11/11/2013	TEMPERATURE	Temperature	17.8	Deg C	N				FIELD	TEMP_FLD
199-N-173	MW	12/18/2013	TEMPERATURE	Temperature	16.8	Deg C	N				FIELD	TEMP_FLD
199-N-173	MW	3/31/2014	TEMPERATURE	Temperature	15.9	Deg C	N				FIELD	TEMP_FLD
199-N-173	MW	12/18/2013	7440-28-0	Thallium	5	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	12/18/2013	7440-31-5	Tin	25	µg/L	N	DU			GEL	6010_METALS_ICP_TR
199-N-173	MW	9/15/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	4,700	µg/L	N	N	Y		TASL	WTPH_DIESEL
199-N-173	MW	9/15/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	2,100	µg/L	N				WSCF	WTPH_DIESEL

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	12/15/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
199-N-173	MW	8/27/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	2,100	µg/L	N				WSCF	WTPH_DIESEL
199-N-173	MW	8/27/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	1,800	µg/L	N				WSCF	WTPH_DIESEL
199-N-173	MW	11/11/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	410	µg/L	N				WSCF	WTPH_DIESEL
199-N-173	MW	12/18/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	477	µg/L	N	J			GEL	WTPH_DIESEL
199-N-173	MW	3/31/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
199-N-173	MW	3/31/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
199-N-173	MW	9/15/2010	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	10	µg/L	N	U			TASL	WTPH_GASOLINE
199-N-173	MW	9/15/2010	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-173	MW	12/15/2011	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-173	MW	8/27/2012	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	290	µg/L	N				WSCF	WTPH_GASOLINE
199-N-173	MW	8/27/2012	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	290	µg/L	N				WSCF	WTPH_GASOLINE
199-N-173	MW	11/11/2013	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-173	MW	12/18/2013	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	16.7	µg/L	N	U			GEL	WTPH_GASOLINE
199-N-173	MW	12/18/2013	TPH/OILH	Total petroleum hydrocarbons - motor oil (high boiling)	736	µg/L	N				GEL	WTPH_DIESEL

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	12/15/2011	10028-17-8	Tritium	1,600	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-173	MW	8/27/2012	10028-17-8	Tritium	70	pCi/L	N	U			WSCF	TRITIUM_EIE_LSC
199-N-173	MW	8/27/2012	10028-17-8	Tritium	190	pCi/L	N	U			WSCF	TRITIUM_EIE_LSC
199-N-173	MW	11/11/2013	10028-17-8	Tritium	1,300	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-173	MW	9/15/2010	TURBIDITY	Turbidity	1.66	NTU	N				FIELD	TURBIDITY_FLD
199-N-173	MW	12/15/2011	TURBIDITY	Turbidity	0.85	NTU	N				FIELD	TURBIDITY_FLD
199-N-173	MW	8/27/2012	TURBIDITY	Turbidity	1.21	NTU	N				FIELD	TURBIDITY_FLD
199-N-173	MW	6/24/2013	TURBIDITY	Turbidity	3.02	NTU	N				FIELD	TURBIDITY_FLD
199-N-173	MW	11/11/2013	TURBIDITY	Turbidity	0.9	NTU	N				FIELD	TURBIDITY_FLD
199-N-173	MW	12/18/2013	TURBIDITY	Turbidity	0.59	NTU	N				FIELD	TURBIDITY_FLD
199-N-173	MW	3/31/2014	TURBIDITY	Turbidity	0.88	NTU	N				FIELD	TURBIDITY_FLD
199-N-173	MW	12/18/2013	7440-61-1	Uranium	10.4	µg/L	N	B			GEL	6010_METALS_ICP_TR
199-N-173	MW	9/15/2010	7440-62-2	Vanadium	15.7	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-62-2	Vanadium	11.6	µg/L	N	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-62-2	Vanadium	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-62-2	Vanadium	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-62-2	Vanadium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-173	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-66-6	Zinc	14.2	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-66-6	Zinc	17.3	µg/L	N	B			TASL	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-66-6	Zinc	6	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-173	MW	9/15/2010	7440-66-6	Zinc	11	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-66-6	Zinc	5.1	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	12/15/2011	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-66-6	Zinc	5.4	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-66-6	Zinc	5.3	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	8/27/2012	7440-66-6	Zinc	5.5	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-66-6	Zinc	12.9	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-173	MW	11/11/2013	7440-66-6	Zinc	10	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-173	MW	12/18/2013	7440-66-6	Zinc	16.6	µg/L	N	C			GEL	6010_METALS_ICP_TR
199-N-173	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-173	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7429-90-5	Aluminum	6.96	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-346	MW	4/6/2010	7440-36-0	Antimony	0.3	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-38-2	Arsenic	0.472	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-346	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-39-3	Barium	127	µg/L	N	N			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-39-3	Barium	213	µg/L	Y				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-39-3	Barium	224	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-43-9	Cadmium	0.1	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-70-2	Calcium	140,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-70-2	Calcium	117,000	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-70-2	Calcium	124,000	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	16887-00-6	Chloride	35,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-346	MW	3/31/2014	16887-00-6	Chloride	57,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-346	MW	4/6/2010	7440-47-3	Chromium	0.5	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-48-4	Cobalt	0.681	µg/L	N				WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-50-8	Copper	0.103	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	DO	Dissolved oxygen	1,830	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-346	MW	3/31/2014	DO	Dissolved oxygen	2,330	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-346	MW	4/6/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-346	MW	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-346	MW	3/31/2014	12587-46-1	Gross alpha	5.2	pCi/L	N				WSCF	ALPHA_GPC
199-N-346	MW	4/6/2010	12587-47-2	Gross beta	16	pCi/L	N				WSCF	BETA_GPC
199-N-346	MW	3/31/2014	12587-47-2	Gross beta	8.4	pCi/L	N				WSCF	BETA_GPC
199-N-346	MW	4/6/2010	7439-89-6	Iron	1,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-89-6	Iron	1,010	µg/L	Y				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-89-6	Iron	1,180	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7439-95-4	Magnesium	24,300	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-95-4	Magnesium	21,800	µg/L	Y				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-95-4	Magnesium	22,900	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7439-96-5	Manganese	1,890	µg/L	N				WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7439-96-5	Manganese	3,100	µg/L	Y				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-96-5	Manganese	3,280	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-02-0	Nickel	0.45	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	14797-55-8	Nitrate	13,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-346	MW	3/31/2014	14797-55-8	Nitrate	1,670	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-346	MW	4/6/2010	14797-65-0	Nitrite	959	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-346	MW	3/31/2014	14797-65-0	Nitrite	220	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-346	MW	4/6/2010	EH	Oxidation Reduction Potential	10.9	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-346	MW	3/31/2014	EH	Oxidation Reduction Potential	280.5	mV	N				FIELD	REDOX_PROBE_FLD
199-N-346	MW	4/6/2010	PH	pH Measurement	7.02	unitless	N				FIELD	PH_ELECT_FLD
199-N-346	MW	3/31/2014	PH	pH Measurement	7	unitless	N				FIELD	PH_ELECT_FLD
199-N-346	MW	4/6/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-346	MW	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-346	MW	3/31/2014	9/7/7440	Potassium	4,440	µg/L	Y				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	9/7/7440	Potassium	4,680	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-22-4	Silver	0.1	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-22-4	Silver	5.13	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-23-5	Sodium	60,400	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-23-5	Sodium	52,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-23-5	Sodium	55,700	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	CONDUCT	Specific Conductance	1,096	µS/cm	N				FIELD	CONDUCT_FLD
199-N-346	MW	3/31/2014	CONDUCT	Specific Conductance	944	µS/cm	N				FIELD	CONDUCT_FLD
199-N-346	MW	4/6/2010	7440-24-6	Strontium	431	µg/L	N				WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-24-6	Strontium	684	µg/L	Y				WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-24-6	Strontium	722	µg/L	N				WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	10098-97-2	Strontium-90	1	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
199-N-346	MW	3/31/2014	10098-97-2	Strontium-90	5.4	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-346	MW	4/6/2010	14808-79-8	Sulfate	79,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-346	MW	3/31/2014	14808-79-8	Sulfate	110,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-346	MW	4/6/2010	TEMPERATURE	Temperature	16.8	Deg C	N				FIELD	TEMP_FLD
199-N-346	MW	3/31/2014	TEMPERATURE	Temperature	16.5	Deg C	N				FIELD	TEMP_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-346	MW	4/6/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	3,700	µg/L	N				TASL	WTPH_DIESEL
199-N-346	MW	3/31/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	2,900	µg/L	N				WSCF	WTPH_DIESEL
199-N-346	MW	4/6/2010	TPHKEROSENE	Total petroleum hydrocarbons - kerosene range	10	µg/L	N	U			TASL	WTPH_DIESEL
199-N-346	MW	4/6/2010	10028-17-8	Tritium	2,600	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-346	MW	4/6/2010	TURBIDITY	Turbidity	17.9	NTU	N				FIELD	TURBIDITY_FLD
199-N-346	MW	3/31/2014	TURBIDITY	Turbidity	4.98	NTU	N				FIELD	TURBIDITY_FLD
199-N-346	MW	4/6/2010	7440-62-2	Vanadium	0.839	µg/L	N	BC			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-346	MW	4/6/2010	7440-66-6	Zinc	1.12	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-346	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-346	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7429-90-5	Aluminum	12.4	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	8/5/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-39-3	Barium	50.1	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-39-3	Barium	44.5	µg/L	Y				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-39-3	Barium	42.6	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-354	MW	8/5/2010	7440-43-9	Cadmium	0.549	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-70-2	Calcium	33,400	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-70-2	Calcium	40,700	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-70-2	Calcium	40,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	16887-00-6	Chloride	3,490	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	16887-00-6	Chloride	4,790	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-354	MW	8/5/2010	7440-47-3	Chromium	1.14	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-50-8	Copper	0.297	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	DO	Dissolved oxygen	9,990	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-354	MW	3/31/2014	DO	Dissolved oxygen	10,150	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-354	MW	8/5/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	12587-46-1	Gross alpha	-0.22	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-354	MW	8/5/2010	12587-47-2	Gross beta	24	pCi/L	N				WSCF	BETA_GPC
199-N-354	MW	3/31/2014	12587-47-2	Gross beta	20	pCi/L	N				WSCF	BETA_GPC
199-N-354	MW	8/5/2010	7439-89-6	Iron	18	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-354	MW	3/31/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7439-95-4	Magnesium	5,820	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-95-4	Magnesium	7,210	µg/L	Y				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-95-4	Magnesium	6,860	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7439-96-5	Manganese	0.544	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	14797-55-8	Nitrate	22,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	14797-55-8	Nitrate	22,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-354	MW	8/5/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-354	MW	8/5/2010	EH	Oxidation Reduction Potential	-99.6	mV	N				FIELD	REDOX_PROBE_FLD
199-N-354	MW	3/31/2014	EH	Oxidation Reduction Potential	295	mV	N				FIELD	REDOX_PROBE_FLD
199-N-354	MW	8/5/2010	PH	pH Measurement	7.66	unitless	N				FIELD	PH_ELECT_FLD
199-N-354	MW	3/31/2014	PH	pH Measurement	7.65	unitless	N				FIELD	PH_ELECT_FLD
199-N-354	MW	8/5/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	9/7/7440	Potassium	1,750	µg/L	Y	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-354	MW	3/31/2014	9/7/7440	Potassium	1,700	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-23-5	Sodium	5,950	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-23-5	Sodium	4,380	µg/L	Y				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-23-5	Sodium	4,220	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	CONDUCT	Specific Conductance	242	µS/cm	N				FIELD	CONDUCT_FLD
199-N-354	MW	3/31/2014	CONDUCT	Specific Conductance	281	µS/cm	N				FIELD	CONDUCT_FLD
199-N-354	MW	8/5/2010	7440-24-6	Strontium	161	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-24-6	Strontium	187	µg/L	Y				WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-24-6	Strontium	181	µg/L	N				WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	10098-97-2	Strontium-90	12	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-354	MW	3/31/2014	10098-97-2	Strontium-90	7.8	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-354	MW	8/5/2010	14808-79-8	Sulfate	27,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-354	MW	3/31/2014	14808-79-8	Sulfate	38,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-354	MW	8/5/2010	TEMPERATURE	Temperature	16.8	Deg C	N				FIELD	TEMP_FLD
199-N-354	MW	3/31/2014	TEMPERATURE	Temperature	13.1	Deg C	N				FIELD	TEMP_FLD
199-N-354	MW	8/5/2010	10028-17-8	Tritium	2,400	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-354	MW	8/5/2010	TURBIDITY	Turbidity	0.21	NTU	N				FIELD	TURBIDITY_FLD
199-N-354	MW	3/31/2014	TURBIDITY	Turbidity	0.64	NTU	N				FIELD	TURBIDITY_FLD
199-N-354	MW	8/5/2010	7440-62-2	Vanadium	2.47	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-354	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-354	MW	8/5/2010	7440-66-6	Zinc	3.99	µg/L	N	BD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-354	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-354	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7429-90-5	Aluminum	26.2	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	8/5/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-38-2	Arsenic	0.805	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-39-3	Barium	41.1	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-39-3	Barium	44.4	µg/L	Y				WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-39-3	Barium	44.9	µg/L	N				WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-70-2	Calcium	39,300	µg/L	N				WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-70-2	Calcium	59,500	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-70-2	Calcium	60,300	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	16887-00-6	Chloride	5,150	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	16887-00-6	Chloride	10,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-355	MW	8/5/2010	7440-47-3	Chromium	1.42	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-355	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-50-8	Copper	0.348	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	DO	Dissolved oxygen	9,570	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-355	MW	3/31/2014	DO	Dissolved oxygen	9,120	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-355	MW	8/5/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	12587-46-1	Gross alpha	-0.92	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-355	MW	8/5/2010	12587-47-2	Gross beta	2,200	pCi/L	N				WSCF	BETA_GPC
199-N-355	MW	3/31/2014	12587-47-2	Gross beta	2,600	pCi/L	N				WSCF	BETA_GPC
199-N-355	MW	8/5/2010	7439-89-6	Iron	18	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7439-95-4	Magnesium	6,470	µg/L	N				WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-95-4	Magnesium	9,880	µg/L	Y				WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-95-4	Magnesium	10,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7439-96-5	Manganese	1.6	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-355	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	14797-55-8	Nitrate	23,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	14797-55-8	Nitrate	54,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-355	MW	8/5/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-355	MW	8/5/2010	EH	Oxidation Reduction Potential	-34.2	mV	N				FIELD	REDOX_PROBE_FLD
199-N-355	MW	3/31/2014	EH	Oxidation Reduction Potential	297.8	mV	N				FIELD	REDOX_PROBE_FLD
199-N-355	MW	8/5/2010	PH	pH Measurement	7.62	unitless	N				FIELD	PH_ELECT_FLD
199-N-355	MW	3/31/2014	PH	pH Measurement	7.69	unitless	N				FIELD	PH_ELECT_FLD
199-N-355	MW	8/5/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	9/7/7440	Potassium	1,900	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	9/7/7440	Potassium	1,940	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-23-5	Sodium	4,420	µg/L	N				WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-23-5	Sodium	5,020	µg/L	Y				WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-23-5	Sodium	5,070	µg/L	N				WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	CONDUCT	Specific Conductance	277	µS/cm	N				FIELD	CONDUCT_FLD
199-N-355	MW	3/31/2014	CONDUCT	Specific Conductance	421	µS/cm	N				FIELD	CONDUCT_FLD
199-N-355	MW	8/5/2010	7440-24-6	Strontium	182	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-24-6	Strontium	247	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-355	MW	3/31/2014	7440-24-6	Strontium	250	µg/L	N				WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	10098-97-2	Strontium-90	1,400	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-355	MW	3/31/2014	10098-97-2	Strontium-90	1,200	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-355	MW	8/5/2010	14808-79-8	Sulfate	36,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-355	MW	3/31/2014	14808-79-8	Sulfate	72,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-355	MW	8/5/2010	TEMPERATURE	Temperature	17	Deg C	N				FIELD	TEMP_FLD
199-N-355	MW	3/31/2014	TEMPERATURE	Temperature	13	Deg C	N				FIELD	TEMP_FLD
199-N-355	MW	8/5/2010	10028-17-8	Tritium	5,600	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-355	MW	8/5/2010	TURBIDITY	Turbidity	0.27	NTU	N				FIELD	TURBIDITY_FLD
199-N-355	MW	3/31/2014	TURBIDITY	Turbidity	0.28	NTU	N				FIELD	TURBIDITY_FLD
199-N-355	MW	8/5/2010	7440-62-2	Vanadium	2.98	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-355	MW	8/5/2010	7440-66-6	Zinc	7.14	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-355	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-355	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-356	MW	8/4/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-38-2	Arsenic	6.38	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-39-3	Barium	76.3	µg/L	N	DN			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-39-3	Barium	40.8	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-356	MW	3/27/2014	7440-39-3	Barium	40.4	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-70-2	Calcium	27,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-70-2	Calcium	44,800	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-70-2	Calcium	43,100	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	16887-00-6	Chloride	1,880	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	16887-00-6	Chloride	6,060	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-356	MW	8/4/2010	7440-47-3	Chromium	14	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-48-4	Cobalt	0.107	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-50-8	Copper	3.81	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	DO	Dissolved oxygen	9,600	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-356	MW	3/27/2014	DO	Dissolved oxygen	10,150	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-356	MW	8/4/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	12587-46-1	Gross alpha	1.4	pCi/L	N				WSCF	ALPHA_GPC
199-N-356	MW	8/4/2010	12587-47-2	Gross beta	550	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-356	MW	3/27/2014	12587-47-2	Gross beta	750	pCi/L	N				WSCF	BETA_GPC
199-N-356	MW	8/4/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-89-6	Iron	54.6	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7439-95-4	Magnesium	4,350	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-95-4	Magnesium	7,790	µg/L	Y				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-95-4	Magnesium	7,610	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7439-96-5	Manganese	1.4	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-02-0	Nickel	4.12	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	14797-55-8	Nitrate	11,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	14797-55-8	Nitrate	30,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-356	MW	8/4/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-356	MW	8/4/2010	EH	Oxidation Reduction Potential	-29.4	mV	N				FIELD	REDOX_PROBE_FLD
199-N-356	MW	3/27/2014	EH	Oxidation Reduction Potential	424	mV	N				FIELD	REDOX_PROBE_FLD
199-N-356	MW	8/4/2010	PH	pH Measurement	7.93	unitless	N				FIELD	PH_ELECT_FLD
199-N-356	MW	3/27/2014	PH	pH Measurement	7.56	unitless	N				FIELD	PH_ELECT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-356	MW	8/4/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	9/7/7440	Potassium	1,610	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	9/7/7440	Potassium	1,560	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-23-5	Sodium	4,060	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-23-5	Sodium	6,210	µg/L	Y				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-23-5	Sodium	5,990	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	CONDUCT	Specific Conductance	189.5	µS/cm	N				FIELD	CONDUCT_FLD
199-N-356	MW	3/27/2014	CONDUCT	Specific Conductance	307	µS/cm	N				FIELD	CONDUCT_FLD
199-N-356	MW	8/4/2010	7440-24-6	Strontium	369	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-24-6	Strontium	183	µg/L	Y				WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-24-6	Strontium	178	µg/L	N				WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	10098-97-2	Strontium-90	300	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-356	MW	3/27/2014	10098-97-2	Strontium-90	480	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-356	MW	8/4/2010	14808-79-8	Sulfate	16,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-356	MW	3/27/2014	14808-79-8	Sulfate	44,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-356	MW	8/4/2010	TEMPERATURE	Temperature	16	Deg C	N				FIELD	TEMP_FLD
199-N-356	MW	3/27/2014	TEMPERATURE	Temperature	13	Deg C	N				FIELD	TEMP_FLD
199-N-356	MW	8/4/2010	10028-17-8	Tritium	1,100	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-356	MW	8/4/2010	TURBIDITY	Turbidity	0.46	NTU	N				FIELD	TURBIDITY_FLD
199-N-356	MW	3/27/2014	TURBIDITY	Turbidity	3.22	NTU	N				FIELD	TURBIDITY_FLD
199-N-356	MW	8/4/2010	7440-62-2	Vanadium	18.3	µg/L	N	DC			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-356	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-356	MW	8/4/2010	7440-66-6	Zinc	3.7	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-356	MW	3/27/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-356	MW	3/27/2014	7440-66-6	Zinc	6.42	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7429-90-5	Aluminum	22.1	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7429-90-5	Aluminum	54	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-39-3	Barium	33.6	µg/L	N	DN			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-39-3	Barium	41	µg/L	N	DN			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-39-3	Barium	40.1	µg/L	Y				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-39-3	Barium	42.8	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-43-9	Cadmium	0.404	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-70-2	Calcium	33,300	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-357	MW	8/4/2010	7440-70-2	Calcium	34,300	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-70-2	Calcium	45,100	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-70-2	Calcium	44,900	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	16887-00-6	Chloride	3,480	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	16887-00-6	Chloride	3,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	3/27/2014	16887-00-6	Chloride	5,640	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	7440-47-3	Chromium	1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-47-3	Chromium	1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-50-8	Copper	3.4	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-50-8	Copper	2.73	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	DO	Dissolved oxygen	9,320	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-357	MW	3/27/2014	DO	Dissolved oxygen	9,900	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-357	MW	8/4/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	3/27/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	3/27/2014	12587-46-1	Gross alpha	3.3	pCi/L	N				WSCF	ALPHA_GPC
199-N-357	MW	8/4/2010	12587-47-2	Gross beta	2,400	pCi/L	N				WSCF	BETA_GPC
199-N-357	MW	8/4/2010	12587-47-2	Gross beta	2,700	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-357	MW	3/27/2014	12587-47-2	Gross beta	3,500	pCi/L	N				WSCF	BETA_GPC
199-N-357	MW	8/4/2010	7439-89-6	Iron	86	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7439-89-6	Iron	54	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-89-6	Iron	195	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7439-95-4	Magnesium	5,440	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7439-95-4	Magnesium	5,390	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-95-4	Magnesium	7,430	µg/L	Y				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-95-4	Magnesium	7,500	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7439-96-5	Manganese	3.72	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7439-96-5	Manganese	12.4	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-96-5	Manganese	12.8	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	14797-55-8	Nitrate	14,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	14797-55-8	Nitrate	14,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	3/27/2014	14797-55-8	Nitrate	31,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-357	MW	3/27/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	EH	Oxidation Reduction Potential	-37.2	mV	N				FIELD	REDOX_PROBE_FLD
199-N-357	MW	3/27/2014	EH	Oxidation Reduction Potential	415.5	mV	N				FIELD	REDOX_PROBE_FLD
199-N-357	MW	8/4/2010	PH	pH Measurement	8.06	unitless	N				FIELD	PH_ELECT_FLD
199-N-357	MW	3/27/2014	PH	pH Measurement	7.61	unitless	N				FIELD	PH_ELECT_FLD
199-N-357	MW	8/4/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	3/27/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-357	MW	3/27/2014	9/7/7440	Potassium	1,510	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	9/7/7440	Potassium	1,510	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-23-5	Sodium	4,130	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-23-5	Sodium	4,020	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-23-5	Sodium	4,940	µg/L	Y				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-23-5	Sodium	4,930	µg/L	N				WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	CONDUCT	Specific Conductance	224	µS/cm	N				FIELD	CONDUCT_FLD
199-N-357	MW	3/27/2014	CONDUCT	Specific Conductance	303	µS/cm	N				FIELD	CONDUCT_FLD
199-N-357	MW	8/4/2010	7440-24-6	Strontium	107	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-24-6	Strontium	118	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-24-6	Strontium	165	µg/L	Y				WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-24-6	Strontium	165	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-357	MW	8/4/2010	10098-97-2	Strontium-90	1,400	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-357	MW	8/4/2010	10098-97-2	Strontium-90	1,300	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-357	MW	3/27/2014	10098-97-2	Strontium-90	2,000	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-357	MW	8/4/2010	14808-79-8	Sulfate	24,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	14808-79-8	Sulfate	24,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	3/27/2014	14808-79-8	Sulfate	36,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-357	MW	8/4/2010	TEMPERATURE	Temperature	15.7	Deg C	N				FIELD	TEMP_FLD
199-N-357	MW	3/27/2014	TEMPERATURE	Temperature	13	Deg C	N				FIELD	TEMP_FLD
199-N-357	MW	8/4/2010	10028-17-8	Tritium	1,700	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-357	MW	8/4/2010	10028-17-8	Tritium	1,800	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-357	MW	8/4/2010	TURBIDITY	Turbidity	1.43	NTU	N				FIELD	TURBIDITY_FLD
199-N-357	MW	3/27/2014	TURBIDITY	Turbidity	4.8	NTU	N				FIELD	TURBIDITY_FLD
199-N-357	MW	8/4/2010	7440-62-2	Vanadium	2.2	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-62-2	Vanadium	2.11	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-357	MW	8/4/2010	7440-66-6	Zinc	1.67	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	8/4/2010	7440-66-6	Zinc	5.64	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-357	MW	3/27/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-357	MW	3/27/2014	7440-66-6	Zinc	8.1	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7429-90-5	Aluminum	44.4	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	8/4/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-358	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-39-3	Barium	40	µg/L	N	DN			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-39-3	Barium	42.5	µg/L	Y				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-39-3	Barium	42	µg/L	N				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-70-2	Calcium	37,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-70-2	Calcium	46,700	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-70-2	Calcium	45,600	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	16887-00-6	Chloride	6,220	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	16887-00-6	Chloride	8,930	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-358	MW	8/4/2010	7440-47-3	Chromium	1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-50-8	Copper	2.21	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	DO	Dissolved oxygen	8,970	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-358	MW	3/27/2014	DO	Dissolved oxygen	9,880	µg/L	N				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-358	MW	8/4/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	12587-46-1	Gross alpha	2	pCi/L	N				WSCF	ALPHA_GPC
199-N-358	MW	8/4/2010	12587-47-2	Gross beta	1,400	pCi/L	N				WSCF	BETA_GPC
199-N-358	MW	3/27/2014	12587-47-2	Gross beta	1,900	pCi/L	N				WSCF	BETA_GPC
199-N-358	MW	8/4/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7439-95-4	Magnesium	5,680	µg/L	N				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-95-4	Magnesium	7,680	µg/L	Y				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-95-4	Magnesium	7,490	µg/L	N				WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7439-96-5	Manganese	11.8	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	14797-55-8	Nitrate	23,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	14797-55-8	Nitrate	35,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-358	MW	8/4/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-358	MW	8/4/2010	EH	Oxidation Reduction Potential	-19.9	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-358	MW	3/27/2014	EH	Oxidation Reduction Potential	458.1	mV	N				FIELD	REDOX_PROBE_FLD
199-N-358	MW	8/4/2010	PH	pH Measurement	7.77	unitless	N				FIELD	PH_ELECT_FLD
199-N-358	MW	3/27/2014	PH	pH Measurement	7.52	unitless	N				FIELD	PH_ELECT_FLD
199-N-358	MW	8/4/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	9/7/7440	Potassium	1,530	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	9/7/7440	Potassium	1,540	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-23-5	Sodium	5,640	µg/L	N				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-23-5	Sodium	8,390	µg/L	Y				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-23-5	Sodium	8,200	µg/L	N				WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	CONDUCT	Specific Conductance	256	µS/cm	N				FIELD	CONDUCT_FLD
199-N-358	MW	3/27/2014	CONDUCT	Specific Conductance	332	µS/cm	N				FIELD	CONDUCT_FLD
199-N-358	MW	8/4/2010	7440-24-6	Strontium	116	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-24-6	Strontium	176	µg/L	Y				WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-24-6	Strontium	174	µg/L	N				WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	10098-97-2	Strontium-90	920	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-358	MW	3/27/2014	10098-97-2	Strontium-90	1,100	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-358	MW	8/4/2010	14808-79-8	Sulfate	29,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-358	MW	3/27/2014	14808-79-8	Sulfate	46,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-358	MW	8/4/2010	TEMPERATURE	Temperature	16.3	Deg C	N				FIELD	TEMP_FLD
199-N-358	MW	3/27/2014	TEMPERATURE	Temperature	13.5	Deg C	N				FIELD	TEMP_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-358	MW	8/4/2010	10028-17-8	Tritium	3,900	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-358	MW	8/4/2010	TURBIDITY	Turbidity	0.38	NTU	N				FIELD	TURBIDITY_FLD
199-N-358	MW	3/27/2014	TURBIDITY	Turbidity	0.56	NTU	N				FIELD	TURBIDITY_FLD
199-N-358	MW	8/4/2010	7440-62-2	Vanadium	2.1	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-358	MW	8/4/2010	7440-66-6	Zinc	2.63	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-358	MW	3/27/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-358	MW	3/27/2014	7440-66-6	Zinc	11	µg/L	N				WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7429-90-5	Aluminum	14.2	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-359	MW	8/29/2010	7440-36-0	Antimony	0.3	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-38-2	Arsenic	0.592	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-39-3	Barium	23.8	µg/L	N				WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-39-3	Barium	13.7	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-39-3	Barium	13.9	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-43-9	Cadmium	0.1	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-70-2	Calcium	51,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-70-2	Calcium	27,700	µg/L	Y	N			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-359	MW	3/27/2014	7440-70-2	Calcium	27,700	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	16887-00-6	Chloride	10,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	16887-00-6	Chloride	2,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-359	MW	8/29/2010	7440-47-3	Chromium	2.3	µg/L	N	B			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-48-4	Cobalt	0.05	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-50-8	Copper	0.1	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	DO	Dissolved oxygen	10,910	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-359	MW	8/29/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	12587-46-1	Gross alpha	0.42	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-359	MW	8/29/2010	12587-47-2	Gross beta	450	pCi/L	N				WSCF	BETA_GPC
199-N-359	MW	3/27/2014	12587-47-2	Gross beta	480	pCi/L	N				WSCF	BETA_GPC
199-N-359	MW	8/29/2010	7439-89-6	Iron	38	µg/L	N	UN			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7439-95-4	Magnesium	7,650	µg/L	N				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-95-4	Magnesium	4,670	µg/L	Y				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-95-4	Magnesium	4,740	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-359	MW	8/29/2010	7439-96-5	Manganese	2.62	µg/L	N	C			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-96-5	Manganese	5.28	µg/L	N				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-02-0	Nickel	0.2	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	14797-55-8	Nitrate	36,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	14797-55-8	Nitrate	7,750	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-359	MW	8/29/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	EH	Oxidation Reduction Potential	457.1	mV	N				FIELD	REDOX_PROBE_FLD
199-N-359	MW	3/27/2014	PH	pH Measurement	7.81	unitless	N				FIELD	PH_ELECT_FLD
199-N-359	MW	8/29/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	9/7/7440	Potassium	1,040	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	9/7/7440	Potassium	1,050	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-22-4	Silver	0.1	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-23-5	Sodium	3,450	µg/L	N				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-23-5	Sodium	2,610	µg/L	Y				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-23-5	Sodium	2,640	µg/L	N				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	CONDUCT	Specific Conductance	189.7	µS/cm	N				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-359	MW	8/29/2010	7440-24-6	Strontium	169	µg/L	N				WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-24-6	Strontium	106	µg/L	Y				WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-24-6	Strontium	109	µg/L	N				WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	10098-97-2	Strontium-90	210	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-359	MW	3/27/2014	10098-97-2	Strontium-90	220	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-359	MW	8/29/2010	14808-79-8	Sulfate	51,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	14808-79-8	Sulfate	17,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-359	MW	3/27/2014	TEMPERATURE	Temperature	12.4	Deg C	N				FIELD	TEMP_FLD
199-N-359	MW	8/29/2010	10028-17-8	Tritium	11,000	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-359	MW	3/27/2014	TURBIDITY	Turbidity	2.21	NTU	N				FIELD	TURBIDITY_FLD
199-N-359	MW	8/29/2010	7440-62-2	Vanadium	2.08	µg/L	N	C			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-359	MW	8/29/2010	7440-66-6	Zinc	0.8	µg/L	N	U			WSCF	200.8_METALS_ICPMS
199-N-359	MW	3/27/2014	7440-66-6	Zinc	7.34	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-359	MW	3/27/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	8/29/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-39-3	Barium	27.3	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-39-3	Barium	17.1	µg/L	Y	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-360	MW	3/27/2014	7440-39-3	Barium	16.6	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-70-2	Calcium	32,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-70-2	Calcium	22,700	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-70-2	Calcium	20,800	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	16887-00-6	Chloride	3,090	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	16887-00-6	Chloride	1,250	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-360	MW	8/29/2010	7440-47-3	Chromium	2.71	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-50-8	Copper	0.442	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	DO	Dissolved oxygen	11,450	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-360	MW	8/29/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	12587-46-1	Gross alpha	0.91	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-360	MW	8/29/2010	12587-47-2	Gross beta	1,500	pCi/L	N				WSCF	BETA_GPC
199-N-360	MW	3/27/2014	12587-47-2	Gross beta	800	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-360	MW	8/29/2010	7439-89-6	Iron	38	µg/L	N	UN			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7439-95-4	Magnesium	5,500	µg/L	N				WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-95-4	Magnesium	4,610	µg/L	Y				WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-95-4	Magnesium	4,240	µg/L	N				WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7439-96-5	Manganese	0.61	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-02-0	Nickel	0.482	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	14797-55-8	Nitrate	13,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	14797-55-8	Nitrate	4,210	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-360	MW	8/29/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	EH	Oxidation Reduction Potential	481	mV	N				FIELD	REDOX_PROBE_FLD
199-N-360	MW	3/27/2014	PH	pH Measurement	7.75	unitless	N				FIELD	PH_ELECT_FLD
199-N-360	MW	8/29/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	9/7/7440	Potassium	996	µg/L	Y	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-360	MW	3/27/2014	9/7/7440	Potassium	965	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-23-5	Sodium	6,390	µg/L	N				WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-23-5	Sodium	5,420	µg/L	Y				WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-23-5	Sodium	5,030	µg/L	N				WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	CONDUCT	Specific Conductance	163.8	µS/cm	N				FIELD	CONDUCT_FLD
199-N-360	MW	8/29/2010	7440-24-6	Strontium	118	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-24-6	Strontium	89.5	µg/L	Y				WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-24-6	Strontium	83	µg/L	N				WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	10098-97-2	Strontium-90	700	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-360	MW	3/27/2014	10098-97-2	Strontium-90	400	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-360	MW	8/29/2010	14808-79-8	Sulfate	28,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	14808-79-8	Sulfate	11,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-360	MW	3/27/2014	TEMPERATURE	Temperature	12.4	Deg C	N				FIELD	TEMP_FLD
199-N-360	MW	8/29/2010	10028-17-8	Tritium	2,200	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-360	MW	3/27/2014	TURBIDITY	Turbidity	1.32	NTU	N				FIELD	TURBIDITY_FLD
199-N-360	MW	8/29/2010	7440-62-2	Vanadium	1.58	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-360	MW	8/29/2010	7440-66-6	Zinc	1.8	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-360	MW	3/27/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-360	MW	3/27/2014	7440-66-6	Zinc	6.29	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-361	MW	8/29/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-39-3	Barium	29.8	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-39-3	Barium	25	µg/L	Y				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-39-3	Barium	24.2	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-43-9	Cadmium	0.246	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-70-2	Calcium	41,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-70-2	Calcium	40,700	µg/L	Y				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-70-2	Calcium	39,400	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	16887-00-6	Chloride	10,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	16887-00-6	Chloride	8,250	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-361	MW	8/29/2010	7440-47-3	Chromium	2.29	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-361	MW	3/26/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	DO	Dissolved oxygen	9,820	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-361	MW	8/29/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	12587-46-1	Gross alpha	2.9	pCi/L	N				WSCF	ALPHA_GPC
199-N-361	MW	8/29/2010	12587-47-2	Gross beta	68	pCi/L	N				WSCF	BETA_GPC
199-N-361	MW	3/26/2014	12587-47-2	Gross beta	150	pCi/L	N				WSCF	BETA_GPC
199-N-361	MW	8/29/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-89-6	Iron	50.9	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7439-95-4	Magnesium	6,980	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-95-4	Magnesium	7,020	µg/L	Y				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-95-4	Magnesium	6,800	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7439-96-5	Manganese	3.97	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	14797-55-8	Nitrate	32,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	14797-55-8	Nitrate	29,400	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-361	MW	8/29/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	EH	Oxidation Reduction Potential	178	mV	N				FIELD	REDOX_PROBE_FLD
199-N-361	MW	3/26/2014	PH	pH Measurement	7.76	unitless	N				FIELD	PH_ELECT_FLD
199-N-361	MW	8/29/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	9/7/7440	Potassium	1,510	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	9/7/7440	Potassium	1,480	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-23-5	Sodium	3,940	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-23-5	Sodium	5,640	µg/L	Y				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-23-5	Sodium	5,520	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	CONDUCT	Specific Conductance	291	µS/cm	N				FIELD	CONDUCT_FLD
199-N-361	MW	8/29/2010	7440-24-6	Strontium	188	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-24-6	Strontium	169	µg/L	Y				WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-24-6	Strontium	162	µg/L	N				WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	10098-97-2	Strontium-90	29	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-361	MW	3/26/2014	10098-97-2	Strontium-90	82	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-361	MW	8/29/2010	14808-79-8	Sulfate	45,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	14808-79-8	Sulfate	38,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-361	MW	3/26/2014	TEMPERATURE	Temperature	13	Deg C	N				FIELD	TEMP_FLD
199-N-361	MW	8/29/2010	10028-17-8	Tritium	9,800	pCi/L	N				WSCF	TRITIUM_EIE_LSC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-361	MW	3/26/2014	TURBIDITY	Turbidity	0.43	NTU	N				FIELD	TURBIDITY_FLD
199-N-361	MW	8/29/2010	7440-62-2	Vanadium	2.84	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-361	MW	8/29/2010	7440-66-6	Zinc	1.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-361	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-361	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-38-2	Arsenic	0.811	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-39-3	Barium	40.8	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-39-3	Barium	38.2	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-39-3	Barium	48.9	µg/L	Y				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-39-3	Barium	49.4	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-43-9	Cadmium	1.11	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-362	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-70-2	Calcium	44,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-70-2	Calcium	43,900	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-70-2	Calcium	59,400	µg/L	Y				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-70-2	Calcium	59,900	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	16887-00-6	Chloride	8,540	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	8/29/2010	16887-00-6	Chloride	8,530	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	16887-00-6	Chloride	13,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	8/29/2010	7440-47-3	Chromium	2.63	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-47-3	Chromium	2.72	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	DO	Dissolved oxygen	8,990	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-362	MW	8/29/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	8/29/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	12587-46-1	Gross alpha	-1.4	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-362	MW	8/29/2010	12587-47-2	Gross beta	840	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-362	MW	8/29/2010	12587-47-2	Gross beta	850	pCi/L	N				WSCF	BETA_GPC
199-N-362	MW	3/26/2014	12587-47-2	Gross beta	1,100	pCi/L	N				WSCF	BETA_GPC
199-N-362	MW	8/29/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7439-95-4	Magnesium	7,300	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7439-95-4	Magnesium	7,260	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-95-4	Magnesium	10,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-95-4	Magnesium	10,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7439-96-5	Manganese	0.228	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7439-96-5	Manganese	0.262	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	14797-55-8	Nitrate	30,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	8/29/2010	14797-55-8	Nitrate	30,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	14797-55-8	Nitrate	46,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	8/29/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-362	MW	8/29/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	EH	Oxidation Reduction Potential	182	mV	N				FIELD	REDOX_PROBE_FLD
199-N-362	MW	3/26/2014	PH	pH Measurement	7.51	unitless	N				FIELD	PH_ELECT_FLD
199-N-362	MW	8/29/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	8/29/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	9/7/7440	Potassium	1,880	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	9/7/7440	Potassium	1,870	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-23-5	Sodium	4,650	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-23-5	Sodium	4,660	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-23-5	Sodium	5,140	µg/L	Y				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-23-5	Sodium	5,080	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	CONDUCT	Specific Conductance	402	µS/cm	N				FIELD	CONDUCT_FLD
199-N-362	MW	8/29/2010	7440-24-6	Strontium	201	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-24-6	Strontium	186	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-24-6	Strontium	245	µg/L	Y				WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-24-6	Strontium	243	µg/L	N				WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	10098-97-2	Strontium-90	450	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-362	MW	8/29/2010	10098-97-2	Strontium-90	410	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-362	MW	3/26/2014	10098-97-2	Strontium-90	580	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-362	MW	8/29/2010	14808-79-8	Sulfate	44,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	8/29/2010	14808-79-8	Sulfate	45,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	14808-79-8	Sulfate	63,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-362	MW	3/26/2014	TEMPERATURE	Temperature	13.5	Deg C	N				FIELD	TEMP_FLD
199-N-362	MW	8/29/2010	10028-17-8	Tritium	8,700	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-362	MW	8/29/2010	10028-17-8	Tritium	8,400	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-362	MW	3/26/2014	TURBIDITY	Turbidity	1.19	NTU	N				FIELD	TURBIDITY_FLD
199-N-362	MW	8/29/2010	7440-62-2	Vanadium	2.74	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-62-2	Vanadium	2.56	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-362	MW	8/29/2010	7440-66-6	Zinc	1.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	8/29/2010	7440-66-6	Zinc	2.05	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-362	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-362	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	9/12/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-39-3	Barium	52.4	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-39-3	Barium	39.5	µg/L	Y				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-39-3	Barium	40.5	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-363	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-70-2	Calcium	54,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-70-2	Calcium	41,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-70-2	Calcium	41,900	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	16887-00-6	Chloride	12,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-363	MW	3/26/2014	16887-00-6	Chloride	7,090	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-363	MW	9/12/2010	7440-47-3	Chromium	2.62	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	DO	Dissolved oxygen	7,480	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-363	MW	3/26/2014	DO	Dissolved oxygen	10,720	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-363	MW	9/12/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-363	MW	3/26/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-363	MW	3/26/2014	12587-46-1	Gross alpha	0.1	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-363	MW	9/12/2010	12587-47-2	Gross beta	980	pCi/L	N				WSCF	BETA_GPC
199-N-363	MW	3/26/2014	12587-47-2	Gross beta	890	pCi/L	N				WSCF	BETA_GPC
199-N-363	MW	9/12/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-363	MW	3/26/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-89-6	Iron	50.6	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7439-95-4	Magnesium	9,010	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-95-4	Magnesium	7,620	µg/L	Y				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-95-4	Magnesium	7,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7439-96-5	Manganese	0.238	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-96-5	Manganese	10.1	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	14797-55-8	Nitrate	42,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-363	MW	3/26/2014	14797-55-8	Nitrate	30,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-363	MW	9/12/2010	14797-65-0	Nitrite	191	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-363	MW	3/26/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-363	MW	9/12/2010	EH	Oxidation Reduction Potential	187.9	mV	N				FIELD	REDOX_PROBE_FLD
199-N-363	MW	3/26/2014	EH	Oxidation Reduction Potential	175	mV	N				FIELD	REDOX_PROBE_FLD
199-N-363	MW	9/12/2010	PH	pH Measurement	7.38	unitless	N				FIELD	PH_ELECT_FLD
199-N-363	MW	3/26/2014	PH	pH Measurement	7.29	unitless	N				FIELD	PH_ELECT_FLD
199-N-363	MW	9/12/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-363	MW	3/26/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-363	MW	3/26/2014	9/7/7440	Potassium	1,410	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	9/7/7440	Potassium	1,380	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	7440-23-5	Sodium	4,060	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-23-5	Sodium	4,260	µg/L	Y				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-23-5	Sodium	4,150	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	CONDUCT	Specific Conductance	418	µS/cm	N				FIELD	CONDUCT_FLD
199-N-363	MW	3/26/2014	CONDUCT	Specific Conductance	288	µS/cm	N				FIELD	CONDUCT_FLD
199-N-363	MW	9/12/2010	7440-24-6	Strontium	229	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-24-6	Strontium	180	µg/L	Y				WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-24-6	Strontium	176	µg/L	N				WSCF	6010_METALS_ICP
199-N-363	MW	9/12/2010	10098-97-2	Strontium-90	470	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-363	MW	3/26/2014	10098-97-2	Strontium-90	480	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-363	MW	9/12/2010	14808-79-8	Sulfate	66,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-363	MW	3/26/2014	14808-79-8	Sulfate	39,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-363	MW	9/12/2010	TEMPERATURE	Temperature	15.6	Deg C	N				FIELD	TEMP_FLD
199-N-363	MW	3/26/2014	TEMPERATURE	Temperature	11.9	Deg C	N				FIELD	TEMP_FLD
199-N-363	MW	9/12/2010	10028-17-8	Tritium	12,000	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-363	MW	9/12/2010	TURBIDITY	Turbidity	1	NTU	N				FIELD	TURBIDITY_FLD
199-N-363	MW	3/26/2014	TURBIDITY	Turbidity	4.53	NTU	N				FIELD	TURBIDITY_FLD
199-N-363	MW	9/12/2010	7440-62-2	Vanadium	2.24	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-363	MW	9/12/2010	7440-66-6	Zinc	1.72	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-363	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-363	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7429-90-5	Aluminum	56.9	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	9/12/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-38-2	Arsenic	0.811	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-39-3	Barium	39.3	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-39-3	Barium	54.3	µg/L	Y				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-39-3	Barium	53.6	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-70-2	Calcium	35,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-70-2	Calcium	59,500	µg/L	Y				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-70-2	Calcium	59,700	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	16887-00-6	Chloride	6,230	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	16887-00-6	Chloride	13,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-364	MW	9/12/2010	7440-47-3	Chromium	1.55	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-364	MW	9/12/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	DO	Dissolved oxygen	8.4	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-364	MW	3/26/2014	DO	Dissolved oxygen	8,920	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-364	MW	9/12/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	12587-46-1	Gross alpha	-2.2	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-364	MW	9/12/2010	12587-47-2	Gross beta	460	pCi/L	N				WSCF	BETA_GPC
199-N-364	MW	3/26/2014	12587-47-2	Gross beta	940	pCi/L	N				WSCF	BETA_GPC
199-N-364	MW	9/12/2010	7439-89-6	Iron	71	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7439-95-4	Magnesium	6,050	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-95-4	Magnesium	10,700	µg/L	Y				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-95-4	Magnesium	10,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7439-96-5	Manganese	9.26	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-364	MW	9/12/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	14797-55-8	Nitrate	20,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	14797-55-8	Nitrate	48,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-364	MW	9/12/2010	14797-65-0	Nitrite	143	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-364	MW	9/12/2010	EH	Oxidation Reduction Potential	163.9	mV	N				FIELD	REDOX_PROBE_FLD
199-N-364	MW	3/26/2014	EH	Oxidation Reduction Potential	177	mV	N				FIELD	REDOX_PROBE_FLD
199-N-364	MW	9/12/2010	PH	pH Measurement	7.81	unitless	N				FIELD	PH_ELECT_FLD
199-N-364	MW	3/26/2014	PH	pH Measurement	7.58	unitless	N				FIELD	PH_ELECT_FLD
199-N-364	MW	9/12/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	9/7/7440	Potassium	1,890	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	9/7/7440	Potassium	1,870	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-23-5	Sodium	3,310	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-23-5	Sodium	4,750	µg/L	Y				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-23-5	Sodium	4,630	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	CONDUCT	Specific Conductance	281	µS/cm	N				FIELD	CONDUCT_FLD
199-N-364	MW	3/26/2014	CONDUCT	Specific Conductance	411	µS/cm	N				FIELD	CONDUCT_FLD
199-N-364	MW	9/12/2010	7440-24-6	Strontium	170	µg/L	N	D			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-364	MW	3/26/2014	7440-24-6	Strontium	267	µg/L	Y				WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-24-6	Strontium	264	µg/L	N				WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	10098-97-2	Strontium-90	200	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-364	MW	3/26/2014	10098-97-2	Strontium-90	570	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-364	MW	9/12/2010	14808-79-8	Sulfate	33,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-364	MW	3/26/2014	14808-79-8	Sulfate	64,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-364	MW	9/12/2010	TEMPERATURE	Temperature	16.8	Deg C	N				FIELD	TEMP_FLD
199-N-364	MW	3/26/2014	TEMPERATURE	Temperature	13	Deg C	N				FIELD	TEMP_FLD
199-N-364	MW	9/12/2010	10028-17-8	Tritium	5,000	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-364	MW	9/12/2010	TURBIDITY	Turbidity	0.58	NTU	N				FIELD	TURBIDITY_FLD
199-N-364	MW	3/26/2014	TURBIDITY	Turbidity	0.4	NTU	N				FIELD	TURBIDITY_FLD
199-N-364	MW	9/12/2010	7440-62-2	Vanadium	3.29	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-364	MW	9/12/2010	7440-66-6	Zinc	2.72	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-364	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-364	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	9/12/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-38-2	Arsenic	0.884	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-39-3	Barium	43.2	µg/L	N	D			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-365	MW	3/26/2014	7440-39-3	Barium	47.2	µg/L	Y				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-39-3	Barium	50.1	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-70-2	Calcium	49,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-70-2	Calcium	56,600	µg/L	Y				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-70-2	Calcium	57,900	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	16887-00-6	Chloride	11,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	16887-00-6	Chloride	11,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-365	MW	9/12/2010	7440-47-3	Chromium	2.41	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	DO	Dissolved oxygen	8,550	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-365	MW	3/26/2014	DO	Dissolved oxygen	9,260	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-365	MW	9/12/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	12587-46-1	Gross alpha	-2.5	pCi/L	N	U			WSCF	ALPHA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-365	MW	9/12/2010	12587-47-2	Gross beta	400	pCi/L	N				WSCF	BETA_GPC
199-N-365	MW	3/26/2014	12587-47-2	Gross beta	460	pCi/L	N				WSCF	BETA_GPC
199-N-365	MW	9/12/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7439-95-4	Magnesium	8,250	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-95-4	Magnesium	9,820	µg/L	Y				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-95-4	Magnesium	9,860	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7439-96-5	Manganese	0.315	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	14797-55-8	Nitrate	36,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	14797-55-8	Nitrate	39,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-365	MW	9/12/2010	14797-65-0	Nitrite	271	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-365	MW	9/12/2010	EH	Oxidation Reduction Potential	170.1	mV	N				FIELD	REDOX_PROBE_FLD
199-N-365	MW	3/26/2014	EH	Oxidation Reduction Potential	177	mV	N				FIELD	REDOX_PROBE_FLD
199-N-365	MW	9/12/2010	PH	pH Measurement	7.83	unitless	N				FIELD	PH_ELECT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-365	MW	3/26/2014	PH	pH Measurement	7.51	unitless	N				FIELD	PH_ELECT_FLD
199-N-365	MW	9/12/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	9/7/7440	Potassium	1,940	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	9/7/7440	Potassium	1,990	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-23-5	Sodium	4,030	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-23-5	Sodium	6,480	µg/L	Y				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-23-5	Sodium	6,550	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	CONDUCT	Specific Conductance	384	µS/cm	N				FIELD	CONDUCT_FLD
199-N-365	MW	3/26/2014	CONDUCT	Specific Conductance	383	µS/cm	N				FIELD	CONDUCT_FLD
199-N-365	MW	9/12/2010	7440-24-6	Strontium	237	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-24-6	Strontium	258	µg/L	Y				WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-24-6	Strontium	254	µg/L	N				WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	10098-97-2	Strontium-90	180	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-365	MW	3/26/2014	10098-97-2	Strontium-90	210	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-365	MW	9/12/2010	14808-79-8	Sulfate	59,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-365	MW	3/26/2014	14808-79-8	Sulfate	61,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-365	MW	9/12/2010	TEMPERATURE	Temperature	17.3	Deg C	N				FIELD	TEMP_FLD
199-N-365	MW	3/26/2014	TEMPERATURE	Temperature	13.4	Deg C	N				FIELD	TEMP_FLD
199-N-365	MW	9/12/2010	10028-17-8	Tritium	9,500	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-365	MW	9/12/2010	TURBIDITY	Turbidity	0.37	NTU	N				FIELD	TURBIDITY_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-365	MW	3/26/2014	TURBIDITY	Turbidity	0.17	NTU	N				FIELD	TURBIDITY_FLD
199-N-365	MW	9/12/2010	7440-62-2	Vanadium	3.04	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-365	MW	9/12/2010	7440-66-6	Zinc	4.46	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-365	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-365	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	9/12/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-39-3	Barium	42	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-39-3	Barium	35.6	µg/L	Y				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-39-3	Barium	37.9	µg/L	N				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-70-2	Calcium	41,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-70-2	Calcium	40,800	µg/L	Y				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-70-2	Calcium	43,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	16887-00-6	Chloride	8,470	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-366	MW	3/26/2014	16887-00-6	Chloride	8,630	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-366	MW	9/12/2010	7440-47-3	Chromium	2.15	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	DO	Dissolved oxygen	8,400	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-366	MW	3/26/2014	DO	Dissolved oxygen	9,890	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-366	MW	9/12/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-366	MW	3/26/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-366	MW	3/26/2014	12587-46-1	Gross alpha	0.29	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-366	MW	9/12/2010	12587-47-2	Gross beta	420	pCi/L	N				WSCF	BETA_GPC
199-N-366	MW	3/26/2014	12587-47-2	Gross beta	310	pCi/L	N				WSCF	BETA_GPC
199-N-366	MW	9/12/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7439-95-4	Magnesium	6,980	µg/L	N				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-95-4	Magnesium	8,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-95-4	Magnesium	8,400	µg/L	N				WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7439-96-5	Manganese	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-366	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	14797-55-8	Nitrate	26,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-366	MW	3/26/2014	14797-55-8	Nitrate	26,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-366	MW	9/12/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-366	MW	3/26/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-366	MW	9/12/2010	EH	Oxidation Reduction Potential	37	mV	N				FIELD	REDOX_PROBE_FLD
199-N-366	MW	3/26/2014	EH	Oxidation Reduction Potential	204	mV	N				FIELD	REDOX_PROBE_FLD
199-N-366	MW	9/12/2010	PH	pH Measurement	7.66	unitless	N				FIELD	PH_ELECT_FLD
199-N-366	MW	3/26/2014	PH	pH Measurement	7.33	unitless	N				FIELD	PH_ELECT_FLD
199-N-366	MW	9/12/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-366	MW	3/26/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-366	MW	3/26/2014	9/7/7440	Potassium	1,350	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	9/7/7440	Potassium	1,390	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-23-5	Sodium	3,710	µg/L	N				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-23-5	Sodium	3,930	µg/L	Y				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-23-5	Sodium	4,090	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-366	MW	9/12/2010	CONDUCT	Specific Conductance	304	µS/cm	N				FIELD	CONDUCT_FLD
199-N-366	MW	3/26/2014	CONDUCT	Specific Conductance	299	µS/cm	N				FIELD	CONDUCT_FLD
199-N-366	MW	9/12/2010	7440-24-6	Strontium	199	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-24-6	Strontium	189	µg/L	Y				WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-24-6	Strontium	200	µg/L	N				WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	10098-97-2	Strontium-90	220	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-366	MW	3/26/2014	10098-97-2	Strontium-90	190	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-366	MW	9/12/2010	14808-79-8	Sulfate	42,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-366	MW	3/26/2014	14808-79-8	Sulfate	44,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-366	MW	9/12/2010	TEMPERATURE	Temperature	16.3	Deg C	N				FIELD	TEMP_FLD
199-N-366	MW	3/26/2014	TEMPERATURE	Temperature	12.4	Deg C	N				FIELD	TEMP_FLD
199-N-366	MW	9/12/2010	10028-17-8	Tritium	8,000	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-366	MW	9/12/2010	TURBIDITY	Turbidity	0.18	NTU	N				FIELD	TURBIDITY_FLD
199-N-366	MW	3/26/2014	TURBIDITY	Turbidity	2.15	NTU	N				FIELD	TURBIDITY_FLD
199-N-366	MW	9/12/2010	7440-62-2	Vanadium	2.3	µg/L	N	BDC			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-366	MW	9/12/2010	7440-66-6	Zinc	2.65	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-366	MW	3/26/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-366	MW	3/26/2014	7440-66-6	Zinc	15.7	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-367	MW	3/26/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-38-2	Arsenic	0.974	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-38-2	Arsenic	0.973	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-39-3	Barium	37.7	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-39-3	Barium	38.7	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-39-3	Barium	45.7	µg/L	Y				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-39-3	Barium	44.9	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-70-2	Calcium	40,800	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-70-2	Calcium	40,500	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-70-2	Calcium	49,800	µg/L	Y				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-70-2	Calcium	51,300	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	16887-00-6	Chloride	8,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	16887-00-6	Chloride	8,060	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	16887-00-6	Chloride	11,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	7440-47-3	Chromium	2.13	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-47-3	Chromium	2.04	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-367	MW	9/12/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-50-8	Copper	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	DO	Dissolved oxygen	8,680	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-367	MW	3/26/2014	DO	Dissolved oxygen	9,340	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-367	MW	9/12/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	12587-46-1	Gross alpha	1.6	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-367	MW	9/12/2010	12587-47-2	Gross beta	48	pCi/L	N				WSCF	BETA_GPC
199-N-367	MW	9/12/2010	12587-47-2	Gross beta	42	pCi/L	N				WSCF	BETA_GPC
199-N-367	MW	3/26/2014	12587-47-2	Gross beta	57	pCi/L	N				WSCF	BETA_GPC
199-N-367	MW	9/12/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7439-95-4	Magnesium	6,660	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7439-95-4	Magnesium	6,680	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-95-4	Magnesium	9,510	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-367	MW	3/26/2014	7439-95-4	Magnesium	9,710	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7439-96-5	Manganese	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7439-96-5	Manganese	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-02-0	Nickel	0.4	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	14797-55-8	Nitrate	25,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	14797-55-8	Nitrate	24,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	14797-55-8	Nitrate	34,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	14797-65-0	Nitrite	209	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	EH	Oxidation Reduction Potential	1.1	mV	N				FIELD	REDOX_PROBE_FLD
199-N-367	MW	3/26/2014	EH	Oxidation Reduction Potential	227	mV	N				FIELD	REDOX_PROBE_FLD
199-N-367	MW	9/12/2010	PH	pH Measurement	7.85	unitless	N				FIELD	PH_ELECT_FLD
199-N-367	MW	3/26/2014	PH	pH Measurement	7.39	unitless	N				FIELD	PH_ELECT_FLD
199-N-367	MW	9/12/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	9/7/7440	Potassium	1,840	µg/L	Y	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-367	MW	3/26/2014	9/7/7440	Potassium	1,860	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-23-5	Sodium	3,530	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-23-5	Sodium	3,490	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-23-5	Sodium	4,570	µg/L	Y				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-23-5	Sodium	4,630	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	CONDUCT	Specific Conductance	283	µS/cm	N				FIELD	CONDUCT_FLD
199-N-367	MW	3/26/2014	CONDUCT	Specific Conductance	349	µS/cm	N				FIELD	CONDUCT_FLD
199-N-367	MW	9/12/2010	7440-24-6	Strontium	203	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-24-6	Strontium	202	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-24-6	Strontium	242	µg/L	Y				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-24-6	Strontium	253	µg/L	N				WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	10098-97-2	Strontium-90	21	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-367	MW	9/12/2010	10098-97-2	Strontium-90	20	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-367	MW	3/26/2014	10098-97-2	Strontium-90	28	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-367	MW	9/12/2010	14808-79-8	Sulfate	40,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	14808-79-8	Sulfate	39,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	3/26/2014	14808-79-8	Sulfate	55,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-367	MW	9/12/2010	TEMPERATURE	Temperature	17	Deg C	N				FIELD	TEMP_FLD
199-N-367	MW	3/26/2014	TEMPERATURE	Temperature	12.9	Deg C	N				FIELD	TEMP_FLD
199-N-367	MW	9/12/2010	10028-17-8	Tritium	8,700	pCi/L	N				WSCF	TRITIUM_EIE_LSC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-367	MW	9/12/2010	10028-17-8	Tritium	8,200	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-367	MW	9/12/2010	TURBIDITY	Turbidity	0.35	NTU	N				FIELD	TURBIDITY_FLD
199-N-367	MW	3/26/2014	TURBIDITY	Turbidity	0.24	NTU	N				FIELD	TURBIDITY_FLD
199-N-367	MW	9/12/2010	7440-62-2	Vanadium	4.32	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-62-2	Vanadium	4.18	µg/L	N	DC			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-367	MW	9/12/2010	7440-66-6	Zinc	3.95	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	9/12/2010	7440-66-6	Zinc	1.7	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-367	MW	3/26/2014	7440-66-6	Zinc	13.9	µg/L	Y				WSCF	6010_METALS_ICP
199-N-367	MW	3/26/2014	7440-66-6	Zinc	16.9	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7429-90-5	Aluminum	13.6	µg/L	Y	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7429-90-5	Aluminum	29	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7429-90-5	Aluminum	30	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7429-90-5	Aluminum	45	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	8.3	µg/L	Y	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	8.3	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	5	µg/L	Y	U			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	79.9	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	79.9	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	111	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7429-90-5	Aluminum	103	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7429-90-5	Aluminum	10	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7429-90-5	Aluminum	33	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7429-90-5	Aluminum	10	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	1/18/2011	7429-90-5	Aluminum	103	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7429-90-5	Aluminum	2,320	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7429-90-5	Aluminum	79.9	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7429-90-5	Aluminum	83.7	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7429-90-5	Aluminum	68	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	7440-36-0	Antimony	0.6	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-36-0	Antimony	38	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-36-0	Antimony	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	1.1	µg/L	Y	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	1.1	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	0.3	µg/L	Y	U			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	4	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	4	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-36-0	Antimony	0.6	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-36-0	Antimony	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-36-0	Antimony	4	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-36-0	Antimony	4	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-36-0	Antimony	5.1	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-36-0	Antimony	4	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-36-0	Antimony	4	µg/L	Y	U			TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	5/6/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-36-0	Antimony	3.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-38-2	Arsenic	0.8	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-38-2	Arsenic	65	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-38-2	Arsenic	65	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	1.4	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	0.95	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	0.502	µg/L	Y	B			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	2.7	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	2.7	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	50	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-38-2	Arsenic	50	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-38-2	Arsenic	0.8	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-38-2	Arsenic	50	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-38-2	Arsenic	0.8	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-38-2	Arsenic	50	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/16/2011	7440-38-2	Arsenic	176	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-38-2	Arsenic	20.5	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-38-2	Arsenic	11.8	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-38-2	Arsenic	44	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-38-2	Arsenic	44	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-38-2	Arsenic	44	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-38-2	Arsenic	8.67	µg/L	N	B			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-39-3	Barium	19.5	µg/L	Y	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-39-3	Barium	18	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-39-3	Barium	20.7	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-39-3	Barium	19	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-39-3	Barium	215	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-39-3	Barium	216	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-39-3	Barium	207	µg/L	Y				TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-39-3	Barium	198	µg/L	N				TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-39-3	Barium	201	µg/L	Y		Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-39-3	Barium	205	µg/L	N	D	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-39-3	Barium	186	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-39-3	Barium	193	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-39-3	Barium	143	µg/L	Y	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-39-3	Barium	11	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-39-3	Barium	143	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-39-3	Barium	151	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-39-3	Barium	323	µg/L	Y				TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/20/2011	7440-39-3	Barium	74.9	µg/L	N	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-39-3	Barium	85.9	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-39-3	Barium	38.9	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-39-3	Barium	14.6	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-39-3	Barium	17.1	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-39-3	Barium	14.9	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-39-3	Barium	14.3	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-39-3	Barium	10.6	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-39-3	Barium	11.3	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-39-3	Barium	55.3	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-39-3	Barium	18.3	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-39-3	Barium	37.6	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-39-3	Barium	13.2	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-39-3	Barium	14.2	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-41-7	Beryllium	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-41-7	Beryllium	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	0.35	µg/L	Y	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	0.35	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	0.05	µg/L	Y	U	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	0.1	µg/L	N	UD	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	0.61	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	0.61	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	1/18/2011	7440-41-7	Beryllium	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-41-7	Beryllium	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-41-7	Beryllium	0.61	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-41-7	Beryllium	0.61	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-41-7	Beryllium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-69-9	Bismuth	23	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-69-9	Bismuth	23	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-69-9	Bismuth	125	µg/L	Y	BCN			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-69-9	Bismuth	105	µg/L	N	UN			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-69-9	Bismuth	37	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-69-9	Bismuth	37	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-69-9	Bismuth	37	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-69-9	Bismuth	37	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-69-9	Bismuth	0.5	µg/L	N	U			GEL	6020_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-42-8	Boron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-42-8	Boron	19	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-42-8	Boron	26.3	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-42-8	Boron	23.7	µg/L	N	B			TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	7440-42-8	Boron	41	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-42-8	Boron	41	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-42-8	Boron	41	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-42-8	Boron	41	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-42-8	Boron	17.8	µg/L	N	B			GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	24959-67-9	Bromide	90	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	24959-67-9	Bromide	190	µg/L	N	B			TASL	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	24959-67-9	Bromide	198	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	1/18/2011	24959-67-9	Bromide	122	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/16/2011	24959-67-9	Bromide	3,360	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	12/18/2013	24959-67-9	Bromide	182	µg/L	N	B			GEL	9056_ANIONS_IC
199-N-96A	MW	6/24/2010	7440-43-9	Cadmium	0.2	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	0.91	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	0.91	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	0.27	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	0.072	µg/L	N	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	0.1	µg/L	Y	U	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	0.2	µg/L	N	UD	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-43-9	Cadmium	0.2	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-43-9	Cadmium	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	1/18/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-43-9	Cadmium	0.91	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-43-9	Cadmium	0.91	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-43-9	Cadmium	0.91	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-43-9	Cadmium	0.91	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-43-9	Cadmium	0.91	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-43-9	Cadmium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-70-2	Calcium	17,200	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-70-2	Calcium	17,400	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-70-2	Calcium	141,000	µg/L	Y	DN			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-70-2	Calcium	146,000	µg/L	N	DN			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-70-2	Calcium	126,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-70-2	Calcium	132,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-70-2	Calcium	15,800	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-70-2	Calcium	98,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-70-2	Calcium	108,000	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-70-2	Calcium	72,200	µg/L	N	D			TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/20/2011	7440-70-2	Calcium	66,500	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-70-2	Calcium	62,100	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-70-2	Calcium	26,300	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-70-2	Calcium	18,500	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-70-2	Calcium	18,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-70-2	Calcium	18,200	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-70-2	Calcium	23,400	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-70-2	Calcium	15,500	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-70-2	Calcium	18,200	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-70-2	Calcium	17,800	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-70-2	Calcium	42,000	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-70-2	Calcium	13,900	µg/L	Y	N			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-70-2	Calcium	13,900	µg/L	N	N			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	16887-00-6	Chloride	1,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	16887-00-6	Chloride	31,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	16887-00-6	Chloride	31,000	µg/L	N	D			TASL	300.0_ANIONS_IC
199-N-96A	MW	1/18/2011	16887-00-6	Chloride	21,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/16/2011	16887-00-6	Chloride	270,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/20/2011	16887-00-6	Chloride	238,000	µg/L	N	D	G		WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/28/2011	16887-00-6	Chloride	27,5000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	10/13/2011	16887-00-6	Chloride	164,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2012	16887-00-6	Chloride	2,010	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	8/27/2012	16887-00-6	Chloride	3,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/27/2012	16887-00-6	Chloride	9,940	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2013	16887-00-6	Chloride	1,290	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/6/2013	16887-00-6	Chloride	8,540	µg/L	Y	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	12/18/2013	16887-00-6	Chloride	26,000	µg/L	N	D			GEL	9056_ANIONS_IC
199-N-96A	MW	3/31/2014	16887-00-6	Chloride	2,530	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	6/24/2010	7440-47-3	Chromium	1.26	µg/L	Y	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-47-3	Chromium	13	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-47-3	Chromium	1.59	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-47-3	Chromium	13	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	3.6	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	4	µg/L	N	B			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	3.6	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	3.6	µg/L	N	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	3.37	µg/L	Y	B			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	4.05	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-47-3	Chromium	7.64	µg/L	Y	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-47-3	Chromium	8.45	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-47-3	Chromium	44.4	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-47-3	Chromium	17	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-47-3	Chromium	11.5	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-47-3	Chromium	12.2	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-47-3	Chromium	10.6	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/27/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-47-3	Chromium	13.2	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-47-3	Chromium	24.5	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-47-3	Chromium	19.2	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-47-3	Chromium	28.1	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-47-3	Chromium	25.9	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-47-3	Chromium	26.5	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-48-4	Cobalt	0.647	µg/L	Y	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	4	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	4	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	0.38	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	0.22	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	0.05	µg/L	Y	U	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	0.133	µg/L	N	BD	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-48-4	Cobalt	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-48-4	Cobalt	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-48-4	Cobalt	6.9	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-48-4	Cobalt	8.8	µg/L	N	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-48-4	Cobalt	11	µg/L	Y	B			TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/28/2011	7440-48-4	Cobalt	15.1	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-48-4	Cobalt	4	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-48-4	Cobalt	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-50-8	Copper	0.745	µg/L	Y	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-50-8	Copper	1.27	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-50-8	Copper	4.6	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-50-8	Copper	4.6	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-50-8	Copper	1.2	µg/L	Y				TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-50-8	Copper	0.95	µg/L	N	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-50-8	Copper	0.252	µg/L	Y	B			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-50-8	Copper	0.339	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-50-8	Copper	0.679	µg/L	Y	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	1/18/2011	7440-50-8	Copper	0.973	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-50-8	Copper	15.4	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-50-8	Copper	48.4	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-50-8	Copper	16.3	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-50-8	Copper	22.6	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-50-8	Copper	5.9	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-50-8	Copper	4.3	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-50-8	Copper	3	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	DO	Dissolved oxygen	8,390	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	11/14/2010	DO	Dissolved oxygen	2,600	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	1/18/2011	DO	Dissolved oxygen	3,830	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	9/16/2011	DO	Dissolved oxygen	1,800	µg/L	Y				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	9/20/2011	DO	Dissolved oxygen	1,870	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	9/28/2011	DO	Dissolved oxygen	1,770	µg/L	Y				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	10/13/2011	DO	Dissolved oxygen	2,850	µg/L	Y				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	5/6/2012	DO	Dissolved oxygen	10,000	µg/L	Y				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	8/27/2012	DO	Dissolved oxygen	4,450	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	9/27/2012	DO	Dissolved oxygen	2,780	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	5/6/2013	DO	Dissolved oxygen	7,430	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	6/24/2013	DO	Dissolved oxygen	8,720	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	9/6/2013	DO	Dissolved oxygen	2,580	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	12/18/2013	DO	Dissolved oxygen	6,410	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	3/31/2014	DO	Dissolved oxygen	8,640	µg/L	N				FIELD	360.1_OXYGEN_FLD
199-N-96A	MW	6/24/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	16984-48-8	Fluoride	41	µg/L	N	B			TASL	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	1/18/2011	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/16/2011	16984-48-8	Fluoride	360	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/20/2011	16984-48-8	Fluoride	110	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/28/2011	16984-48-8	Fluoride	110	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	10/13/2011	16984-48-8	Fluoride	89.5	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2012	16984-48-8	Fluoride	46	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	8/27/2012	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/27/2012	16984-48-8	Fluoride	46	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2013	16984-48-8	Fluoride	50	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/6/2013	16984-48-8	Fluoride	55.9	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	12/18/2013	16984-48-8	Fluoride	64.1	µg/L	N	B			GEL	9056_ANIONS_IC
199-N-96A	MW	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	12587-46-1	Gross alpha	4.7	pCi/L	N				WSCF	ALPHA_GPC
199-N-96A	MW	11/14/2010	12587-46-1	Gross alpha	2.98	pCi/L	N				TARL	9310_ALPHABETA_GPC
199-N-96A	MW	1/18/2011	12587-46-1	Gross alpha	1.7	pCi/L	N	U			WSCF	ALPHA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/16/2011	12587-46-1	Gross alpha	20	pCi/L	Y	U			WSCF	ALPHA_GPC
199-N-96A	MW	9/28/2011	12587-46-1	Gross alpha	1.71	pCi/L	Y	U			TARL	ALPHA_GPC
199-N-96A	MW	10/13/2011	12587-46-1	Gross alpha	-3.35	pCi/L	Y	U			TARL	ALPHA_GPC
199-N-96A	MW	5/6/2013	12587-46-1	Gross alpha	-0.61	pCi/L	Y	U			WSCF	ALPHA_GPC
199-N-96A	MW	9/6/2013	12587-46-1	Gross alpha	-0.13	pCi/L	Y	U			WSCF	ALPHA_GPC
199-N-96A	MW	3/31/2014	12587-46-1	Gross alpha	1.6	pCi/L	N	U			WSCF	ALPHA_GPC
199-N-96A	MW	11/14/2010	12587-47-2	Gross beta	5.6	pCi/L	N				WSCF	BETA_GPC
199-N-96A	MW	11/14/2010	12587-47-2	Gross beta	14.3	pCi/L	N				TARL	9310_ALPHABETA_GPC
199-N-96A	MW	11/14/2010	12587-47-2	Gross beta	16.2	pCi/L	N				TARL	9310_ALPHABETA_GPC
199-N-96A	MW	11/14/2010	12587-47-2	Gross beta	18	pCi/L	N				WSCF	BETA_GPC
199-N-96A	MW	1/18/2011	12587-47-2	Gross beta	14	pCi/L	N				WSCF	BETA_GPC
199-N-96A	MW	9/16/2011	12587-47-2	Gross beta	100	pCi/L	Y				WSCF	BETA_GPC
199-N-96A	MW	9/20/2011	12587-47-2	Gross beta	16	pCi/L	N	U			WSCF	BETA_GPC
199-N-96A	MW	9/28/2011	12587-47-2	Gross beta	32.9	pCi/L	Y				TARL	BETA_GPC
199-N-96A	MW	10/13/2011	12587-47-2	Gross beta	13.6	pCi/L	Y				TARL	BETA_GPC
199-N-96A	MW	5/6/2012	12587-47-2	Gross beta	2.3	pCi/L	Y	U			WSCF	BETA_GPC
199-N-96A	MW	8/27/2012	12587-47-2	Gross beta	4.5	pCi/L	N				WSCF	BETA_GPC
199-N-96A	MW	9/27/2012	12587-47-2	Gross beta	1.5	pCi/L	Y	U			WSCF	BETA_GPC
199-N-96A	MW	5/6/2013	12587-47-2	Gross beta	1.4	pCi/L	Y	U			WSCF	BETA_GPC
199-N-96A	MW	9/6/2013	12587-47-2	Gross beta	5.1	pCi/L	Y				WSCF	BETA_GPC
199-N-96A	MW	3/31/2014	12587-47-2	Gross beta	-0.5	pCi/L	N	U			WSCF	BETA_GPC
199-N-96A	MW	6/24/2010	7439-89-6	Iron	18	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-89-6	Iron	42	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-89-6	Iron	28.2	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-89-6	Iron	28.2	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-89-6	Iron	38	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-89-6	Iron	808	µg/L	Y		Y		WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7439-89-6	Iron	85.6	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7439-89-6	Iron	51.6	µg/L	N	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7439-89-6	Iron	94.5	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7439-89-6	Iron	1,950	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7439-89-6	Iron	2,940	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7439-89-6	Iron	24.4	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7439-89-6	Iron	38.7	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7439-89-6	Iron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7439-89-6	Iron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7439-89-6	Iron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7439-89-6	Iron	397	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7439-89-6	Iron	20	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7439-89-6	Iron	30	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7439-89-6	Iron	121	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-92-1	Lead	0.2	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7439-92-1	Lead	23	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-92-1	Lead	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7439-92-1	Lead	23	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-92-1	Lead	0.26	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-92-1	Lead	0.17	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-92-1	Lead	0.1	µg/L	Y	U	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-92-1	Lead	0.2	µg/L	N	UD	Q		WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	7439-92-1	Lead	1.3	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-92-1	Lead	1.3	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-92-1	Lead	42	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-92-1	Lead	42	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-92-1	Lead	0.2	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7439-92-1	Lead	42	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-92-1	Lead	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7439-92-1	Lead	42	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7439-92-1	Lead	1.5	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7439-92-1	Lead	1.6	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7439-92-1	Lead	1.5	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7439-92-1	Lead	46	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7439-92-1	Lead	46	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7439-92-1	Lead	46	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7439-92-1	Lead	3.3	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-93-2	Lithium	6	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-93-2	Lithium	6	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-93-2	Lithium	96.2	µg/L	Y	UD			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-93-2	Lithium	96.2	µg/L	N	UD			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-93-2	Lithium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-93-2	Lithium	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-93-2	Lithium	5	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-93-2	Lithium	4	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7439-93-2	Lithium	2	µg/L	N	U			GEL	6020_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	6/24/2010	7439-95-4	Magnesium	3,670	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-95-4	Magnesium	3,730	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-95-4	Magnesium	23,300	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-95-4	Magnesium	24,000	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-95-4	Magnesium	21,400	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-95-4	Magnesium	22,100	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-95-4	Magnesium	6,830	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-95-4	Magnesium	17,200	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7439-95-4	Magnesium	53,500	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7439-95-4	Magnesium	29,300	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7439-95-4	Magnesium	31,700	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7439-95-4	Magnesium	25,100	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7439-95-4	Magnesium	15,800	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7439-95-4	Magnesium	4,060	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7439-95-4	Magnesium	3,480	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7439-95-4	Magnesium	3,510	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7439-95-4	Magnesium	4,390	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7439-95-4	Magnesium	3,580	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7439-95-4	Magnesium	3,700	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7439-95-4	Magnesium	3,700	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7439-95-4	Magnesium	8,940	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7439-95-4	Magnesium	3,100	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7439-95-4	Magnesium	3,080	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-96-5	Manganese	4	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-96-5	Manganese	3.3	µg/L	Y	U			TASL	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	7439-96-5	Manganese	3.3	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-96-5	Manganese	6	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-96-5	Manganese	6	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-96-5	Manganese	69	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-96-5	Manganese	6	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7439-96-5	Manganese	1,630	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7439-96-5	Manganese	3,790	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7439-96-5	Manganese	4,130	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7439-96-5	Manganese	4,990	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7439-96-5	Manganese	2,000	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7439-96-5	Manganese	13.5	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7439-96-5	Manganese	11.2	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7439-96-5	Manganese	8.3	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7439-96-5	Manganese	48.1	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7439-96-5	Manganese	183	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7439-96-5	Manganese	2	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7439-96-5	Manganese	7.6	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-97-6	Mercury	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7439-97-6	Mercury	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-97-6	Mercury	0.023	µg/L	Y	BC			TASL	7470_HG_CVAA
199-N-96A	MW	11/14/2010	7439-97-6	Mercury	0.05	µg/L	N	U			TASL	7470_HG_CVAA
199-N-96A	MW	11/14/2010	7439-97-6	Mercury	0.05	µg/L	Y	U			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-97-6	Mercury	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	1/18/2011	7439-97-6	Mercury	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7439-97-6	Mercury	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7439-98-7	Molybdenum	0.809	µg/L	Y	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7439-98-7	Molybdenum	0.81	µg/L	N	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	1.4	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	0.59	µg/L	N	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	0.698	µg/L	Y		Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	0.767	µg/L	N	BD	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	5	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	5	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-98-7	Molybdenum	0.909	µg/L	Y	BD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7439-98-7	Molybdenum	1.02	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7439-98-7	Molybdenum	30.7	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7439-98-7	Molybdenum	56.2	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7439-98-7	Molybdenum	47.6	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7439-98-7	Molybdenum	6.3	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7439-98-7	Molybdenum	7.9	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7439-98-7	Molybdenum	6	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7439-98-7	Molybdenum	2	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-02-0	Nickel	13.3	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-02-0	Nickel	13.3	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-02-0	Nickel	5	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-02-0	Nickel	91.1	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-02-0	Nickel	50.2	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-02-0	Nickel	66.5	µg/L	Y	UD			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-02-0	Nickel	51.5	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-02-0	Nickel	13.3	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-02-0	Nickel	4.3	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-02-0	Nickel	7.8	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-02-0	Nickel	7.5	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-02-0	Nickel	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-02-0	Nickel	1.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	14797-55-8	Nitrate	735	µg/L	N	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	14797-55-8	Nitrate	15,500	µg/L	N	D			TASL	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	14797-55-8	Nitrate	15,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	1/18/2011	14797-55-8	Nitrate	13,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/16/2011	14797-55-8	Nitrate	841	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/20/2011	14797-55-8	Nitrate	252	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/28/2011	14797-55-8	Nitrate	252	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	10/13/2011	14797-55-8	Nitrate	176	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2012	14797-55-8	Nitrate	1,790	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	8/27/2012	14797-55-8	Nitrate	12,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/27/2012	14797-55-8	Nitrate	10,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2013	14797-55-8	Nitrate	2,580	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/6/2013	14797-55-8	Nitrate	12,200	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	12/18/2013	14797-55-8	Nitrate	11,600	µg/L	N	X			GEL	9056_ANIONS_IC
199-N-96A	MW	3/31/2014	14797-55-8	Nitrate	4,910	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	6/24/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	14797-65-0	Nitrite	9.85	µg/L	N	U	H		TASL	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	1/18/2011	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/16/2011	14797-65-0	Nitrite	2,870	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/20/2011	14797-65-0	Nitrite	463	µg/L	N	BD	G		WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/28/2011	14797-65-0	Nitrite	581	µg/L	Y	BD	G		WSCF	300.0_ANIONS_IC
199-N-96A	MW	10/13/2011	14797-65-0	Nitrite	131	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2012	14797-65-0	Nitrite	125	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	8/27/2012	14797-65-0	Nitrite	1,020	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/27/2012	14797-65-0	Nitrite	397	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2013	14797-65-0	Nitrite	131	µg/L	Y	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/6/2013	14797-65-0	Nitrite	131	µg/L	Y	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	12/18/2013	14797-65-0	Nitrite	125	µg/L	N	UX			GEL	9056_ANIONS_IC
199-N-96A	MW	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	OIL/GREASE	Oil and grease	2,100	µg/L	N	U			TASL	9070_OILGREASE
199-N-96A	MW	11/14/2010	OIL/GREASE	Oil and grease	2,000	µg/L	N	U			LVL	1664A_OILGREASE
199-N-96A	MW	9/20/2011	OIL/GREASE	Oil and grease	2,100	µg/L	N	U			TASL	9070_OILGREASE
199-N-96A	MW	8/27/2012	OIL/GREASE	Oil and grease	2,000	µg/L	N	UO			TASL	9070_OILGREASE
199-N-96A	MW	9/6/2013	OIL/GREASE	Oil and grease	1,900	µg/L	N	U			TASL	1664A_OILGREASE
199-N-96A	MW	12/18/2013	OIL/GREASE	Oil and grease	2,650	µg/L	N	B			GEL	1664A_OILGREASE
199-N-96A	MW	6/24/2010	EH	Oxidation Reduction Potential	377	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	11/14/2010	EH	Oxidation Reduction Potential	169	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	1/18/2011	EH	Oxidation Reduction Potential	346.1	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	9/16/2011	EH	Oxidation Reduction Potential	-189.8	mV	Y				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	9/20/2011	EH	Oxidation Reduction Potential	-50.3	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	9/28/2011	EH	Oxidation Reduction Potential	-137.9	mV	Y				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	10/13/2011	EH	Oxidation Reduction Potential	-121.4	mV	Y				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	5/6/2012	EH	Oxidation Reduction Potential	-11.2	mV	Y				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	8/27/2012	EH	Oxidation Reduction Potential	348.1	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	5/6/2013	EH	Oxidation Reduction Potential	377	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	6/24/2013	EH	Oxidation Reduction Potential	364	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/6/2013	EH	Oxidation Reduction Potential	303.2	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	12/18/2013	EH	Oxidation Reduction Potential	309.6	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	3/31/2014	EH	Oxidation Reduction Potential	353	mV	N				FIELD	REDOX_PROBE_FLD
199-N-96A	MW	6/24/2010	PH	pH Measurement	7.28	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	11/14/2010	PH	pH Measurement	6.9	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	1/18/2011	PH	pH Measurement	7.15	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	9/16/2011	PH	pH Measurement	6.85	unitless	Y				FIELD	PH_ELECT_FLD
199-N-96A	MW	9/20/2011	PH	pH Measurement	6.95	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	9/28/2011	PH	pH Measurement	6.9	unitless	Y				FIELD	PH_ELECT_FLD
199-N-96A	MW	10/13/2011	PH	pH Measurement	7.4	unitless	Y				FIELD	PH_ELECT_FLD
199-N-96A	MW	5/6/2012	PH	pH Measurement	7.27	unitless	Y				FIELD	PH_ELECT_FLD
199-N-96A	MW	8/27/2012	PH	pH Measurement	7.67	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	9/27/2012	PH	pH Measurement	7.6	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	5/6/2013	PH	pH Measurement	7.53	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	6/24/2013	PH	pH Measurement	7.34	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	9/6/2013	PH	pH Measurement	7.35	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	12/18/2013	PH	pH Measurement	7.38	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	3/31/2014	PH	pH Measurement	7.56	unitless	N				FIELD	PH_ELECT_FLD
199-N-96A	MW	6/24/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	14265-44-2	Phosphate	54.6	µg/L	N	UN	G		TASL	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	1/18/2011	14265-44-2	Phosphate	429	µg/L	N	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/16/2011	14265-44-2	Phosphate	1,590,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/28/2011	14265-44-2	Phosphate	362,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	10/13/2011	14265-44-2	Phosphate	448,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2012	14265-44-2	Phosphate	14,300	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/27/2012	14265-44-2	Phosphate	159,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2013	14265-44-2	Phosphate	16,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/6/2013	14265-44-2	Phosphate	45,400	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	12/18/2013	14265-44-2	Phosphate	23,900	µg/L	N	DX			GEL	9056_ANIONS_IC
199-N-96A	MW	3/31/2014	14265-44-2	Phosphate	18,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	6/24/2010	7723-14-0	Phosphorus	55	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7723-14-0	Phosphorus	55	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7723-14-0	Phosphorus	50.7	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7723-14-0	Phosphorus	46.7	µg/L	N	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7723-14-0	Phosphorus	72	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7723-14-0	Phosphorus	72	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7723-14-0	Phosphorus	72	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7723-14-0	Phosphorus	72	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7723-14-0	Phosphorus	8,510	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	9/7/7440	Potassium	1,040	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	9/7/7440	Potassium	1,060	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	9/7/7440	Potassium	2,410	µg/L	Y	BC			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	9/7/7440	Potassium	5,770	µg/L	N	C			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	9/7/7440	Potassium	3,760	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	9/7/7440	Potassium	3,580	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	9/7/7440	Potassium	4,690	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	9/7/7440	Potassium	3,460	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/16/2011	9/7/7440	Potassium	7,640	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	9/7/7440	Potassium	6,120	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	9/7/7440	Potassium	6,910	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	9/7/7440	Potassium	3,770	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	9/7/7440	Potassium	1,650	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	9/7/7440	Potassium	980	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	9/7/7440	Potassium	1,680	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	9/7/7440	Potassium	1,630	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	9/7/7440	Potassium	2,230	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	9/7/7440	Potassium	1,170	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	9/7/7440	Potassium	1,780	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	9/7/7440	Potassium	1,810	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	9/7/7440	Potassium	2,720	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	9/7/7440	Potassium	1,210	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	9/7/7440	Potassium	1,210	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7782-49-2	Selenium	0.6	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7782-49-2	Selenium	45	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7782-49-2	Selenium	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7782-49-2	Selenium	45	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	1.3	µg/L	Y	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	1.3	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	0.3	µg/L	Y	U			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	5	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	5	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	47	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	7782-49-2	Selenium	47	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7782-49-2	Selenium	0.6	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7782-49-2	Selenium	47	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7782-49-2	Selenium	0.6	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7782-49-2	Selenium	47	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7782-49-2	Selenium	6.29	µg/L	N	B			GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	7440-21-3	Silicon	4,700	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-21-3	Silicon	4,800	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-21-3	Silicon	8,690	µg/L	Y	N			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-21-3	Silicon	8,780	µg/L	N	N			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-21-3	Silicon	8,470	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-21-3	Silicon	8,800	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-21-3	Silicon	1,100	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-21-3	Silicon	8,550	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-21-3	Silicon	11,100	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	7440-22-4	Silver	0.2	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-22-4	Silver	6	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-22-4	Silver	6	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-22-4	Silver	0.04	µg/L	Y	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-22-4	Silver	0.04	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-22-4	Silver	0.1	µg/L	Y	U			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-22-4	Silver	0.2	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-22-4	Silver	0.2	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-22-4	Silver	6	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-22-4	Silver	6	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-22-4	Silver	6	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-22-4	Silver	6	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-22-4	Silver	6	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-22-4	Silver	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-23-5	Sodium	3,060	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-23-5	Sodium	3,170	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-23-5	Sodium	41,100	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-23-5	Sodium	41,900	µg/L	N				TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-23-5	Sodium	36,400	µg/L	Y	X			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-23-5	Sodium	33,400	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	1/18/2011	7440-23-5	Sodium	14,900	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-23-5	Sodium	31,600	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-23-5	Sodium	1,190,000	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-23-5	Sodium	883,000	µg/L	N	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-23-5	Sodium	893,000	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-23-5	Sodium	964,000	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-23-5	Sodium	795,000	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-23-5	Sodium	19,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-23-5	Sodium	84,800	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-23-5	Sodium	85,400	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-23-5	Sodium	157,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-23-5	Sodium	25,700	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-23-5	Sodium	90,000	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-23-5	Sodium	91,200	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-23-5	Sodium	132,000	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-23-5	Sodium	35,000	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-23-5	Sodium	34,400	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	CONDUCT	Specific Conductance	124	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	11/14/2010	CONDUCT	Specific Conductance	925	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	1/18/2011	CONDUCT	Specific Conductance	697	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	9/16/2011	CONDUCT	Specific Conductance	4,681	µS/cm	Y				FIELD	CONDUCT_FLD
199-N-96A	MW	9/20/2011	CONDUCT	Specific Conductance	3,598	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	9/28/2011	CONDUCT	Specific Conductance	3,966	µS/cm	Y				FIELD	CONDUCT_FLD
199-N-96A	MW	10/13/2011	CONDUCT	Specific Conductance	3013	µS/cm	Y				FIELD	CONDUCT_FLD
199-N-96A	MW	5/6/2012	CONDUCT	Specific Conductance	182	µS/cm	Y				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	8/27/2012	CONDUCT	Specific Conductance	474	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	9/27/2012	CONDUCT	Specific Conductance	770	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	5/6/2013	CONDUCT	Specific Conductance	207	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	6/24/2013	CONDUCT	Specific Conductance	140	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	9/6/2013	CONDUCT	Specific Conductance	484	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	12/18/2013	CONDUCT	Specific Conductance	791	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	3/31/2014	CONDUCT	Specific Conductance	228	µS/cm	N				FIELD	CONDUCT_FLD
199-N-96A	MW	6/24/2010	7440-24-6	Strontium	79	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-24-6	Strontium	80	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-24-6	Strontium	634	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-24-6	Strontium	660	µg/L	N	D			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-24-6	Strontium	567	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-24-6	Strontium	591	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-24-6	Strontium	111	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-24-6	Strontium	457	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-24-6	Strontium	677	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-24-6	Strontium	523	µg/L	N	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-24-6	Strontium	452	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-24-6	Strontium	387	µg/L	Y	D			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-24-6	Strontium	142	µg/L	Y				TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-24-6	Strontium	79.5	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-24-6	Strontium	65.1	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-24-6	Strontium	63.9	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-24-6	Strontium	70.3	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-24-6	Strontium	54.9	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/6/2013	7440-24-6	Strontium	85.9	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-24-6	Strontium	82	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-24-6	Strontium	173	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-24-6	Strontium	56.6	µg/L	Y				WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-24-6	Strontium	56.7	µg/L	N				WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	10098-97-2	Strontium-90	-3	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	11/14/2010	10098-97-2	Strontium-90	3.94	pCi/L	N				TARL	SRISO_SEP_PRECIP_GPC
199-N-96A	MW	11/14/2010	10098-97-2	Strontium-90	-1.8	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	1/18/2011	10098-97-2	Strontium-90	-5	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	9/20/2011	10098-97-2	Strontium-90	9.9	pCi/L	N				TARL	SRISO_SEP_PRECIP_GPC
199-N-96A	MW	5/6/2012	10098-97-2	Strontium-90	0.76	pCi/L	Y	U			WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	8/27/2012	10098-97-2	Strontium-90	4.6	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	9/27/2012	10098-97-2	Strontium-90	0.76	pCi/L	Y	U			WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	5/6/2013	10098-97-2	Strontium-90	2.3	pCi/L	Y				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	9/6/2013	10098-97-2	Strontium-90	5.9	pCi/L	Y				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	3/31/2014	10098-97-2	Strontium-90	1.5	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
199-N-96A	MW	6/24/2010	14808-79-8	Sulfate	8,180	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	14808-79-8	Sulfate	69,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	11/14/2010	14808-79-8	Sulfate	65,000	µg/L	N	D			TASL	300.0_ANIONS_IC
199-N-96A	MW	1/18/2011	14808-79-8	Sulfate	54,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/16/2011	14808-79-8	Sulfate	9,090	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/20/2011	14808-79-8	Sulfate	6,140	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/28/2011	14808-79-8	Sulfate	755	µg/L	Y	BD			WSCF	300.0_ANIONS_IC
199-N-96A	MW	10/13/2011	14808-79-8	Sulfate	16,100	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2012	14808-79-8	Sulfate	10,000	µg/L	Y	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	8/27/2012	14808-79-8	Sulfate	21,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/27/2012	14808-79-8	Sulfate	36,200	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	5/6/2013	14808-79-8	Sulfate	10,600	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	9/6/2013	14808-79-8	Sulfate	26,100	µg/L	Y	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	12/18/2013	14808-79-8	Sulfate	58,100	µg/L	N	D			GEL	9056_ANIONS_IC
199-N-96A	MW	3/31/2014	14808-79-8	Sulfate	14,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
199-N-96A	MW	6/24/2010	TEMPERATURE	Temperature	15.7	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	11/14/2010	TEMPERATURE	Temperature	18	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	1/18/2011	TEMPERATURE	Temperature	17.6	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	9/16/2011	TEMPERATURE	Temperature	18.3	Deg C	Y				FIELD	TEMP_FLD
199-N-96A	MW	9/20/2011	TEMPERATURE	Temperature	19.7	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	9/28/2011	TEMPERATURE	Temperature	18.4	Deg C	Y				FIELD	TEMP_FLD
199-N-96A	MW	10/13/2011	TEMPERATURE	Temperature	18.8	Deg C	Y				FIELD	TEMP_FLD
199-N-96A	MW	5/6/2012	TEMPERATURE	Temperature	12.2	Deg C	Y				FIELD	TEMP_FLD
199-N-96A	MW	8/27/2012	TEMPERATURE	Temperature	17.8	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	9/27/2012	TEMPERATURE	Temperature	16.5	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	5/6/2013	TEMPERATURE	Temperature	17.7	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	6/24/2013	TEMPERATURE	Temperature	17.1	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	9/6/2013	TEMPERATURE	Temperature	18.4	Deg C	N				FIELD	TEMP_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	12/18/2013	TEMPERATURE	Temperature	17	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	3/31/2014	TEMPERATURE	Temperature	15.6	Deg C	N				FIELD	TEMP_FLD
199-N-96A	MW	6/24/2010	7440-28-0	Thallium	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-28-0	Thallium	35	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-28-0	Thallium	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-28-0	Thallium	35	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	0.85	µg/L	Y	B			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	0.55	µg/L	N	U			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	0.05	µg/L	Y	U	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	0.1	µg/L	N	UD	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	4	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	4	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	49	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-28-0	Thallium	49	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-28-0	Thallium	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-28-0	Thallium	49	µg/L	Y	U		J	WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-28-0	Thallium	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-28-0	Thallium	49	µg/L	N	U		J	WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-28-0	Thallium	5	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	7440-31-5	Tin	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-31-5	Tin	39	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-31-5	Tin	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	6/24/2010	7440-31-5	Tin	39	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-31-5	Tin	2.7	µg/L	Y	C			TASL	6020_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-31-5	Tin	5.1	µg/L	N	C			TASL	6020_METALS_ICPMS

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	11/14/2010	7440-31-5	Tin	0.05	µg/L	Y	U	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-31-5	Tin	0.1	µg/L	N	UD	Q		WSCF	200.8_METALS_ICPMS
199-N-96A	MW	11/14/2010	7440-31-5	Tin	13.5	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-31-5	Tin	28.2	µg/L	N	B			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-31-5	Tin	49	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-31-5	Tin	49	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-31-5	Tin	0.1	µg/L	Y	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-31-5	Tin	49	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-31-5	Tin	0.1	µg/L	N	UD			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-31-5	Tin	49	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-31-5	Tin	2.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
199-N-96A	MW	11/14/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	17	µg/L	N	U			TASL	WTPH_DIESEL
199-N-96A	MW	11/14/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	170	µg/L	N	X			WSCF	WTPH_DIESEL
199-N-96A	MW	11/14/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	17	µg/L	N	U			TASL	WTPH_DIESEL
199-N-96A	MW	11/14/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	200	µg/L	N	X			WSCF	WTPH_DIESEL
199-N-96A	MW	1/18/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
199-N-96A	MW	9/16/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	Y	U			WSCF	WTPH_DIESEL
199-N-96A	MW	9/20/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
199-N-96A	MW	9/28/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	80	µg/L	Y	U			WSCF	WTPH_DIESEL

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	10/13/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	85	µg/L	N	U			TASL	WTPH_DIESEL
199-N-96A	MW	5/6/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	Y	U			WSCF	WTPH_DIESEL
199-N-96A	MW	8/27/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	140	µg/L	N				WSCF	WTPH_DIESEL
199-N-96A	MW	5/6/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	Y	U			WSCF	WTPH_DIESEL
199-N-96A	MW	9/6/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	Y	U			WSCF	WTPH_DIESEL
199-N-96A	MW	12/18/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	101	µg/L	N	J			GEL	WTPH_DIESEL
199-N-96A	MW	3/31/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
199-N-96A	MW	6/24/2010	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-96A	MW	11/14/2010	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	10	µg/L	N	U			TASL	WTPH_GASOLINE
199-N-96A	MW	11/14/2010	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-96A	MW	11/14/2010	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	10	µg/L	N	U			TASL	WTPH_GASOLINE
199-N-96A	MW	11/14/2010	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-96A	MW	1/18/2011	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-96A	MW	9/20/2011	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE
199-N-96A	MW	8/27/2012	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	50	µg/L	N	U			WSCF	WTPH_GASOLINE

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/6/2013	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	10	µg/L	N	J			TASL	WTPH_GASOLINE
199-N-96A	MW	12/18/2013	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	16.7	µg/L	N	U			GEL	WTPH_GASOLINE
199-N-96A	MW	9/16/2011	TPHKEROSENE	Total petroleum hydrocarbons - kerosene range	70	µg/L	Y	U			WSCF	WTPH_DIESEL
199-N-96A	MW	9/28/2011	TPHKEROSENE	Total petroleum hydrocarbons - kerosene range	80	µg/L	Y	U			WSCF	WTPH_DIESEL
199-N-96A	MW	10/13/2011	TPHKEROSENE	Total petroleum hydrocarbons - kerosene range	50	µg/L	N	U			TASL	WTPH_DIESEL
199-N-96A	MW	5/6/2012	TPHKEROSENE	Total petroleum hydrocarbons - kerosene range	70	µg/L	Y	U			WSCF	WTPH_DIESEL
199-N-96A	MW	12/18/2013	TPH/OILH	Total petroleum hydrocarbons - motor oil (high boiling)	202	µg/L	N	J			GEL	WTPH_DIESEL
199-N-96A	MW	6/24/2010	10028-17-8	Tritium	-8.1	pCi/L	N	U			WSCF	TRITIUM_EIE_LSC
199-N-96A	MW	11/14/2010	10028-17-8	Tritium	2,160	pCi/L	N				TARL	906.0_H3_LSC
199-N-96A	MW	11/14/2010	10028-17-8	Tritium	2,300	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-96A	MW	1/18/2011	10028-17-8	Tritium	3,000	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-96A	MW	9/20/2011	10028-17-8	Tritium	99.6	pCi/L	N	U			TARL	906.0_H3_LSC
199-N-96A	MW	8/27/2012	10028-17-8	Tritium	-30	pCi/L	N	U			WSCF	TRITIUM_EIE_LSC
199-N-96A	MW	9/6/2013	10028-17-8	Tritium	310	pCi/L	N				WSCF	TRITIUM_EIE_LSC
199-N-96A	MW	6/24/2010	TURBIDITY	Turbidity	2.79	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	11/14/2010	TURBIDITY	Turbidity	1.39	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	1/18/2011	TURBIDITY	Turbidity	1.17	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	9/20/2011	TURBIDITY	Turbidity	4.89	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	10/13/2011	TURBIDITY	Turbidity	4.57	NTU	Y				FIELD	TURBIDITY_FLD
199-N-96A	MW	8/27/2012	TURBIDITY	Turbidity	2.93	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	5/6/2013	TURBIDITY	Turbidity	132	NTU	N				FIELD	TURBIDITY_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	6/24/2013	TURBIDITY	Turbidity	3.37	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	9/6/2013	TURBIDITY	Turbidity	3.34	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	12/18/2013	TURBIDITY	Turbidity	0.51	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	3/31/2014	TURBIDITY	Turbidity	3.15	NTU	N				FIELD	TURBIDITY_FLD
199-N-96A	MW	11/14/2010	7440-61-1	Uranium	6.19	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	1/18/2011	7440-61-1	Uranium	4.34	µg/L	N	D			WSCF	200.8_METALS_ICPMS
199-N-96A	MW	12/18/2013	7440-61-1	Uranium	16.6	µg/L	N	B			GEL	6010_METALS_ICP_TR
199-N-96A	MW	6/24/2010	7440-62-2	Vanadium	12	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-62-2	Vanadium	12	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-62-2	Vanadium	4.1	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-62-2	Vanadium	4.1	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-62-2	Vanadium	14.4	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-62-2	Vanadium	4.1	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-62-2	Vanadium	4.6	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-62-2	Vanadium	4.1	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-62-2	Vanadium	4.1	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-62-2	Vanadium	18.8	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-62-2	Vanadium	17.7	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-62-2	Vanadium	16.7	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-62-2	Vanadium	10	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	9/6/2013	7440-62-2	Vanadium	10.8	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-62-2	Vanadium	9.61	µg/L	N				GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-62-2	Vanadium	5.63	µg/L	Y	B			WSCF	6010_METALS_ICP
199-N-96A	MW	3/31/2014	7440-62-2	Vanadium	5.92	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-66-6	Zinc	6	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	6/24/2010	7440-66-6	Zinc	6	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-66-6	Zinc	7	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-66-6	Zinc	7	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	11/14/2010	7440-66-6	Zinc	4	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	1/18/2011	7440-66-6	Zinc	5	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/16/2011	7440-66-6	Zinc	14.9	µg/L	Y	B			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-66-6	Zinc	7	µg/L	N	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/20/2011	7440-66-6	Zinc	7	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	9/28/2011	7440-66-6	Zinc	7	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	10/13/2011	7440-66-6	Zinc	7	µg/L	Y	U			TASL	6010_METALS_ICP
199-N-96A	MW	5/6/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
199-N-96A	MW	8/27/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/27/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	5/6/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-66-6	Zinc	7.8	µg/L	N	B			WSCF	6010_METALS_ICP
199-N-96A	MW	9/6/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
199-N-96A	MW	12/18/2013	7440-66-6	Zinc	6.79	µg/L	N	BC			GEL	6010_METALS_ICP_TR
199-N-96A	MW	3/31/2014	7440-66-6	Zinc	7.27	µg/L	Y	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
199-N-96A	MW	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-39-3	Barium	70.7	µg/L	Y				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-39-3	Barium	65.1	µg/L	N				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-70-2	Calcium	53,600	µg/L	Y				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-70-2	Calcium	50,200	µg/L	N				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	16887-00-6	Chloride	2,440	µg/L	N	D			WSCF	300.0_ANIONS_IC
C6324	AT	3/28/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	1/14/2010	DO	Dissolved oxygen	11,750	µg/L	N				FIELD	360.1_OXYGEN_FLD
C6324	AT	2/8/2011	DO	Dissolved oxygen	11,120	µg/L	Y				FIELD	360.1_OXYGEN_FLD
C6324	AT	1/17/2012	DO	Dissolved oxygen	9,960	µg/L	N				FIELD	360.1_OXYGEN_FLD
C6324	AT	1/8/2013	DO	Dissolved oxygen	9,770	µg/L	N				FIELD	360.1_OXYGEN_FLD
C6324	AT	9/20/2013	DO	Dissolved oxygen	7,580	µg/L	N				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
C6324	AT	3/28/2014	DO	Dissolved oxygen	10,380	µg/L	N				FIELD	360.1_OXYGEN_FLD
C6324	AT	3/28/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
C6324	AT	3/28/2014	12587-46-1	Gross alpha	-0.43	pCi/L	N	U			WSCF	ALPHA_GPC
C6324	AT	3/28/2014	12587-47-2	Gross beta	45	pCi/L	N				WSCF	BETA_GPC
C6324	AT	3/28/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-95-4	Magnesium	9,460	µg/L	Y				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-95-4	Magnesium	8,790	µg/L	N				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	14797-55-8	Nitrate	6,510	µg/L	N	D			WSCF	300.0_ANIONS_IC
C6324	AT	3/28/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
C6324	AT	1/14/2010	EH	Oxidation Reduction Potential	177	mV	N				FIELD	REDOX_PROBE_FLD
C6324	AT	2/8/2011	EH	Oxidation Reduction Potential	239	mV	Y				FIELD	REDOX_PROBE_FLD
C6324	AT	1/17/2012	EH	Oxidation Reduction Potential	74	mV	N				FIELD	REDOX_PROBE_FLD
C6324	AT	1/8/2013	EH	Oxidation Reduction Potential	301	mV	N				FIELD	REDOX_PROBE_FLD
C6324	AT	9/20/2013	EH	Oxidation Reduction Potential	96	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
C6324	AT	3/28/2014	EH	Oxidation Reduction Potential	185	mV	N				FIELD	REDOX_PROBE_FLD
C6324	AT	1/14/2010	PH	pH Measurement	7.42	unitless	N				FIELD	PH_ELECT_FLD
C6324	AT	2/8/2011	PH	pH Measurement	7.4	unitless	Y				FIELD	PH_ELECT_FLD
C6324	AT	1/17/2012	PH	pH Measurement	7.39	unitless	N				FIELD	PH_ELECT_FLD
C6324	AT	1/8/2013	PH	pH Measurement	7.63	unitless	N				FIELD	PH_ELECT_FLD
C6324	AT	9/20/2013	PH	pH Measurement	7.9	unitless	N				FIELD	PH_ELECT_FLD
C6324	AT	3/28/2014	PH	pH Measurement	7.46	unitless	N				FIELD	PH_ELECT_FLD
C6324	AT	3/28/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
C6324	AT	3/28/2014	9/7/7440	Potassium	1,830	µg/L	Y	B			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	9/7/7440	Potassium	1,720	µg/L	N	B			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-23-5	Sodium	4,210	µg/L	Y				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-23-5	Sodium	3,950	µg/L	N				WSCF	6010_METALS_ICP
C6324	AT	1/14/2010	CONDUCT	Specific Conductance	137	µS/cm	N				FIELD	CONDUCT_FLD
C6324	AT	2/8/2011	CONDUCT	Specific Conductance	140	µS/cm	Y				FIELD	CONDUCT_FLD
C6324	AT	1/17/2012	CONDUCT	Specific Conductance	205	µS/cm	N				FIELD	CONDUCT_FLD
C6324	AT	1/8/2013	CONDUCT	Specific Conductance	171	µS/cm	N				FIELD	CONDUCT_FLD
C6324	AT	9/20/2013	CONDUCT	Specific Conductance	163	µS/cm	N				FIELD	CONDUCT_FLD
C6324	AT	3/28/2014	CONDUCT	Specific Conductance	360	µS/cm	N				FIELD	CONDUCT_FLD
C6324	AT	3/28/2014	7440-24-6	Strontium	256	µg/L	Y				WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-24-6	Strontium	240	µg/L	N				WSCF	6010_METALS_ICP
C6324	AT	2/8/2011	10098-97-2	Strontium-90	3.5	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
C6324	AT	1/17/2012	10098-97-2	Strontium-90	6.6	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
C6324	AT	1/8/2013	10098-97-2	Strontium-90	8.2	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
C6324	AT	9/20/2013	10098-97-2	Strontium-90	7	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
C6324	AT	3/28/2014	10098-97-2	Strontium-90	17	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
C6324	AT	3/28/2014	14808-79-8	Sulfate	18,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
C6324	AT	1/14/2010	TEMPERATURE	Temperature	10	Deg C	N				FIELD	TEMP_FLD
C6324	AT	2/8/2011	TEMPERATURE	Temperature	7.7	Deg C	Y				FIELD	TEMP_FLD
C6324	AT	1/17/2012	TEMPERATURE	Temperature	8.9	Deg C	N				FIELD	TEMP_FLD
C6324	AT	1/8/2013	TEMPERATURE	Temperature	10.7	Deg C	N				FIELD	TEMP_FLD
C6324	AT	9/20/2013	TEMPERATURE	Temperature	16	Deg C	N				FIELD	TEMP_FLD
C6324	AT	3/28/2014	TEMPERATURE	Temperature	8.6	Deg C	N				FIELD	TEMP_FLD
C6324	AT	3/28/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
C6324	AT	1/14/2010	TURBIDITY	Turbidity	6.34	NTU	N				FIELD	TURBIDITY_FLD
C6324	AT	2/8/2011	TURBIDITY	Turbidity	7.05	NTU	Y				FIELD	TURBIDITY_FLD
C6324	AT	1/17/2012	TURBIDITY	Turbidity	2.44	NTU	N				FIELD	TURBIDITY_FLD
C6324	AT	1/8/2013	TURBIDITY	Turbidity	128	NTU	N				FIELD	TURBIDITY_FLD
C6324	AT	9/20/2013	TURBIDITY	Turbidity	1.55	NTU	N				FIELD	TURBIDITY_FLD
C6324	AT	3/28/2014	TURBIDITY	Turbidity	3.43	NTU	N				FIELD	TURBIDITY_FLD
C6324	AT	3/28/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
C6324	AT	3/28/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7429-90-5	Aluminum	68	µg/L	N	U			GEL	6010_METALS_ICP_TR

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	12/19/2013	7429-90-5	Aluminum	68	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	2/8/2011	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-36-0	Antimony	3.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-36-0	Antimony	3.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-38-2	Arsenic	6.89	µg/L	N	B			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-38-2	Arsenic	5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-39-3	Barium	35	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-39-3	Barium	34	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-39-3	Barium	25.6	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-39-3	Barium	27.1	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-39-3	Barium	44.9	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-39-3	Barium	45	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-39-3	Barium	53.7	µg/L	N				GEL	6010_METALS_ICP_TR

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	9/4/2013	7440-39-3	Barium	53.5	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-39-3	Barium	52.5	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-39-3	Barium	21.5	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-39-3	Barium	16	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-39-3	Barium	15.2	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-41-7	Beryllium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7440-41-7	Beryllium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-69-9	Bismuth	0.612	µg/L	N	B			GEL	6020_METALS_ICPMS
N116mArray-0A	AT	12/19/2013	7440-69-9	Bismuth	0.5	µg/L	N	U			GEL	6020_METALS_ICPMS
N116mArray-0A	AT	6/20/2013	7440-42-8	Boron	15	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7440-42-8	Boron	15	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/8/2010	24959-67-9	Bromide	23.7	µg/L	N	U	H		222-S	9056_ANIONS_IC
N116mArray-0A	AT	6/20/2013	24959-67-9	Bromide	67	µg/L	N	U			GEL	9056_ANIONS_IC
N116mArray-0A	AT	12/19/2013	24959-67-9	Bromide	67	µg/L	N	U			GEL	9056_ANIONS_IC
N116mArray-0A	AT	2/8/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	1/14/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-43-9	Cadmium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-43-9	Cadmium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-70-2	Calcium	26,300	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-70-2	Calcium	28,300	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-70-2	Calcium	17,600	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-70-2	Calcium	17,700	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-70-2	Calcium	28,200	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-70-2	Calcium	28,800	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-70-2	Calcium	34,600	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-70-2	Calcium	27,200	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-70-2	Calcium	27,100	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-70-2	Calcium	16,700	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-70-2	Calcium	15,000	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-70-2	Calcium	14,700	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/8/2010	16887-00-6	Chloride	1,800	µg/L	N				222-S	9056_ANIONS_IC
N116mArray-0A	AT	6/28/2010	16887-00-6	Chloride	1,190	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/16/2010	16887-00-6	Chloride	1,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/8/2011	16887-00-6	Chloride	1,160	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/15/2011	16887-00-6	Chloride	1,290	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/1/2011	16887-00-6	Chloride	1,210	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	9/2/2011	16887-00-6	Chloride	1,480	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/1/2012	16887-00-6	Chloride	910	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/27/2012	16887-00-6	Chloride	1,170	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/22/2012	16887-00-6	Chloride	1,220	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/17/2012	16887-00-6	Chloride	2,830	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	1/14/2013	16887-00-6	Chloride	872	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/20/2013	16887-00-6	Chloride	30,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/3/2013	16887-00-6	Chloride	1,530	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/20/2013	16887-00-6	Chloride	3,460	µg/L	N				GEL	9056_ANIONS_IC
N116mArray-0A	AT	9/4/2013	16887-00-6	Chloride	1,940	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	12/19/2013	16887-00-6	Chloride	1,050	µg/L	N				GEL	9056_ANIONS_IC
N116mArray-0A	AT	12/19/2013	16887-00-6	Chloride	1,030	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/28/2014	16887-00-6	Chloride	1,240	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/8/2011	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-47-3	Chromium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-47-3	Chromium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	2/8/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-48-4	Cobalt	1.32	µg/L	N	B			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-48-4	Cobalt	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-50-8	Copper	4	µg/L	N	U	Q		WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-50-8	Copper	4	µg/L	Y	U	Q		WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-50-8	Copper	3	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-50-8	Copper	3	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/8/2010	DO	Dissolved oxygen	3,770	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	6/28/2010	DO	Dissolved oxygen	1,850	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	9/16/2010	DO	Dissolved oxygen	4,230	µg/L	N				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	2/8/2011	DO	Dissolved oxygen	5,200	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	3/15/2011	DO	Dissolved oxygen	3,690	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	6/1/2011	DO	Dissolved oxygen	10,530	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	9/2/2011	DO	Dissolved oxygen	1,760	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	2/1/2012	DO	Dissolved oxygen	3,930	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	3/27/2012	DO	Dissolved oxygen	3,190	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	6/22/2012	DO	Dissolved oxygen	3,700	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	9/17/2012	DO	Dissolved oxygen	5,060	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	1/14/2013	DO	Dissolved oxygen	4,170	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	3/20/2013	DO	Dissolved oxygen	7,760	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	6/3/2013	DO	Dissolved oxygen	3,310	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	6/20/2013	DO	Dissolved oxygen	2,710	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	9/4/2013	DO	Dissolved oxygen	4,480	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	12/19/2013	DO	Dissolved oxygen	4,840	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	12/19/2013	DO	Dissolved oxygen	5,640	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	3/28/2014	DO	Dissolved oxygen	10,000	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-0A	AT	3/8/2010	16984-48-8	Fluoride	67.8	µg/L	N	U			222-S	9056_ANIONS_IC
N116mArray-0A	AT	6/28/2010	16984-48-8	Fluoride	60	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/16/2010	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/8/2011	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/15/2011	16984-48-8	Fluoride	72	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/1/2011	16984-48-8	Fluoride	72	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/2/2011	16984-48-8	Fluoride	72	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/1/2012	16984-48-8	Fluoride	75	µg/L	N	BD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	3/27/2012	16984-48-8	Fluoride	86.5	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/22/2012	16984-48-8	Fluoride	74.4	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/17/2012	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	1/14/2013	16984-48-8	Fluoride	59.4	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/20/2013	16984-48-8	Fluoride	69	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/3/2013	16984-48-8	Fluoride	85.9	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/20/2013	16984-48-8	Fluoride	135	µg/L	N	B			GEL	9056_ANIONS_IC
N116mArray-0A	AT	9/4/2013	16984-48-8	Fluoride	108	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	12/19/2013	16984-48-8	Fluoride	157	µg/L	N	B			GEL	9056_ANIONS_IC
N116mArray-0A	AT	12/19/2013	16984-48-8	Fluoride	119	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/28/2014	16984-48-8	Fluoride	98	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/4/2013	12587-46-1	Gross alpha	-0.8	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-0A	AT	3/28/2014	12587-46-1	Gross alpha	-0.83	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-0A	AT	3/8/2010	12587-47-2	Gross beta	2.9	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	6/28/2010	12587-47-2	Gross beta	3.2	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	9/16/2010	12587-47-2	Gross beta	3.1	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-0A	AT	2/8/2011	12587-47-2	Gross beta	2.7	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-0A	AT	3/15/2011	12587-47-2	Gross beta	4.6	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	6/1/2011	12587-47-2	Gross beta	2.8	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	9/2/2011	12587-47-2	Gross beta	4.1	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	2/1/2012	12587-47-2	Gross beta	2.1	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-0A	AT	3/27/2012	12587-47-2	Gross beta	2.9	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	6/22/2012	12587-47-2	Gross beta	3.4	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	9/17/2012	12587-47-2	Gross beta	3.3	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-0A	AT	1/14/2013	12587-47-2	Gross beta	6.9	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	3/20/2013	12587-47-2	Gross beta	17	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	6/3/2013	12587-47-2	Gross beta	2.9	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-0A	AT	9/4/2013	12587-47-2	Gross beta	6.1	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	12/19/2013	12587-47-2	Gross beta	3	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	3/28/2014	12587-47-2	Gross beta	4.3	pCi/L	N				WSCF	BETA_GPC
N116mArray-0A	AT	2/8/2011	7439-89-6	Iron	1,530	µg/L	Y		Y		WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7439-89-6	Iron	557	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7439-89-6	Iron	768	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7439-89-6	Iron	1,140	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7439-89-6	Iron	1,880	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7439-89-6	Iron	1,940	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7439-89-6	Iron	2,960	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7439-89-6	Iron	2,620	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7439-89-6	Iron	2,580	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7439-89-6	Iron	424	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7439-89-6	Iron	235	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7439-89-6	Iron	349	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7439-92-1	Lead	3.3	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7439-92-1	Lead	3.3	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7439-93-2	Lithium	2.83	µg/L	N	B			GEL	6020_METALS_ICPMS
N116mArray-0A	AT	12/19/2013	7439-93-2	Lithium	2	µg/L	N	U			GEL	6020_METALS_ICPMS
N116mArray-0A	AT	2/8/2011	7439-95-4	Magnesium	4,990	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7439-95-4	Magnesium	5,380	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7439-95-4	Magnesium	3,470	µg/L	N		Q		WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7439-95-4	Magnesium	3,470	µg/L	Y		Q		WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	1/14/2013	7439-95-4	Magnesium	5,700	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7439-95-4	Magnesium	5,690	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7439-95-4	Magnesium	7,260	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7439-95-4	Magnesium	5,490	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7439-95-4	Magnesium	5,460	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7439-95-4	Magnesium	5,450	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7439-95-4	Magnesium	4,780	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7439-95-4	Magnesium	4,730	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7439-96-5	Manganese	3,880	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7439-96-5	Manganese	3,620	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7439-96-5	Manganese	2,610	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7439-96-5	Manganese	2,690	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7439-96-5	Manganese	4,390	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7439-96-5	Manganese	4,430	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7439-96-5	Manganese	5,480	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7439-96-5	Manganese	4,380	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7439-96-5	Manganese	4,360	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7439-96-5	Manganese	104	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7439-96-5	Manganese	89.5	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7439-96-5	Manganese	91.4	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7439-98-7	Molybdenum	2	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7439-98-7	Molybdenum	2	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	2/1/2012	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-02-0	Nickel	1.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-02-0	Nickel	1.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/8/2010	14797-55-8	Nitrate	178	µg/L	N	U	H		222-S	9056_ANIONS_IC
N116mArray-0A	AT	6/28/2010	14797-55-8	Nitrate	274	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/16/2010	14797-55-8	Nitrate	84.1	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/8/2011	14797-55-8	Nitrate	84.1	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/15/2011	14797-55-8	Nitrate	202	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/1/2011	14797-55-8	Nitrate	168	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/2/2011	14797-55-8	Nitrate	168	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/1/2012	14797-55-8	Nitrate	168	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/27/2012	14797-55-8	Nitrate	168	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/22/2012	14797-55-8	Nitrate	168	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/17/2012	14797-55-8	Nitrate	168	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	1/14/2013	14797-55-8	Nitrate	168	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/20/2013	14797-55-8	Nitrate	252	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/3/2013	14797-55-8	Nitrate	177	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/20/2013	14797-55-8	Nitrate	146	µg/L	N	UX			GEL	9056_ANIONS_IC
N116mArray-0A	AT	9/4/2013	14797-55-8	Nitrate	177	µg/L	N	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	12/19/2013	14797-55-8	Nitrate	708	µg/L	N				GEL	9056_ANIONS_IC
N116mArray-0A	AT	12/19/2013	14797-55-8	Nitrate	602	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/28/2014	14797-55-8	Nitrate	1,030	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/8/2010	14797-65-0	Nitrite	40	µg/L	N	U	H		222-S	9056_ANIONS_IC
N116mArray-0A	AT	6/28/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/16/2010	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/8/2011	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/15/2011	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/1/2011	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/2/2011	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/1/2012	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/27/2012	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/22/2012	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/17/2012	14797-65-0	Nitrite	394	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	1/14/2013	14797-65-0	Nitrite	292	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/20/2013	14797-65-0	Nitrite	187	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/3/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/20/2013	14797-65-0	Nitrite	125	µg/L	N	UX			GEL	9056_ANIONS_IC
N116mArray-0A	AT	9/4/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	12/19/2013	14797-65-0	Nitrite	125	µg/L	N	U			GEL	9056_ANIONS_IC
N116mArray-0A	AT	12/19/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/28/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/20/2013	OIL/GREASE	Oil and grease	1,380	µg/L	N	U			GEL	1664A_OILGREASE
N116mArray-0A	AT	12/19/2013	OIL/GREASE	Oil and grease	2,020	µg/L	N	B			GEL	1664A_OILGREASE
N116mArray-0A	AT	3/8/2010	EH	Oxidation Reduction Potential	-7	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	6/28/2010	EH	Oxidation Reduction Potential	-47	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	9/16/2010	EH	Oxidation Reduction Potential	15	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	2/8/2011	EH	Oxidation Reduction Potential	43	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	3/15/2011	EH	Oxidation Reduction Potential	64	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	6/1/2011	EH	Oxidation Reduction Potential	7	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	9/2/2011	EH	Oxidation Reduction Potential	-17	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	2/1/2012	EH	Oxidation Reduction Potential	-41	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	3/27/2012	EH	Oxidation Reduction Potential	-14	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	6/22/2012	EH	Oxidation Reduction Potential	-25	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	9/17/2012	EH	Oxidation Reduction Potential	-62	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	1/14/2013	EH	Oxidation Reduction Potential	-34	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	3/20/2013	EH	Oxidation Reduction Potential	-26	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	6/3/2013	EH	Oxidation Reduction Potential	-71	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	6/20/2013	EH	Oxidation Reduction Potential	-70	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	9/4/2013	EH	Oxidation Reduction Potential	-38	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	12/19/2013	EH	Oxidation Reduction Potential	88	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	12/19/2013	EH	Oxidation Reduction Potential	60	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	3/28/2014	EH	Oxidation Reduction Potential	109	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-0A	AT	3/8/2010	PH	pH Measurement	6.75	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	6/28/2010	PH	pH Measurement	7.25	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	9/16/2010	PH	pH Measurement	6.8	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	2/8/2011	PH	pH Measurement	8.22	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	3/15/2011	PH	pH Measurement	7.43	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	6/1/2011	PH	pH Measurement	7.25	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	9/2/2011	PH	pH Measurement	7.06	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	2/1/2012	PH	pH Measurement	7.25	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	3/27/2012	PH	pH Measurement	7.47	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	6/22/2012	PH	pH Measurement	7.31	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	9/17/2012	PH	pH Measurement	7.94	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	1/14/2013	PH	pH Measurement	7.27	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	3/20/2013	PH	pH Measurement	6.76	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	6/3/2013	PH	pH Measurement	7.51	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	6/20/2013	PH	pH Measurement	7.57	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	9/4/2013	PH	pH Measurement	7.16	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	12/19/2013	PH	pH Measurement	7.41	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	12/19/2013	PH	pH Measurement	7.01	unitless	N				FIELD	PH_ELECT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	3/28/2014	PH	pH Measurement	7.24	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-0A	AT	3/8/2010	14265-44-2	Phosphate	419	µg/L	N	U	H		222-S	9056_ANIONS_IC
N116mArray-0A	AT	6/20/2013	14265-44-2	Phosphate	205	µg/L	N	UX			GEL	9056_ANIONS_IC
N116mArray-0A	AT	9/4/2013	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	12/19/2013	14265-44-2	Phosphate	205	µg/L	N	U			GEL	9056_ANIONS_IC
N116mArray-0A	AT	12/19/2013	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/28/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/20/2013	7723-14-0	Phosphorus	75.1	µg/L	N	B			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7723-14-0	Phosphorus	60	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	2/8/2011	9/7/7440	Potassium	1,750	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	9/7/7440	Potassium	1,900	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	9/7/7440	Potassium	1,680	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	9/7/7440	Potassium	1,700	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	9/7/7440	Potassium	2,000	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	9/7/7440	Potassium	2,100	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	9/7/7440	Potassium	2,390	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	9/7/7440	Potassium	2,520	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	9/7/7440	Potassium	2,500	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	9/7/7440	Potassium	972	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	9/7/7440	Potassium	807	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	9/7/7440	Potassium	817	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7782-49-2	Selenium	6	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7782-49-2	Selenium	6	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	6/20/2013	7440-21-3	Silicon	13,300	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7440-21-3	Silicon	5,410	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	2/8/2011	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	2/8/2011	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-22-4	Silver	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-22-4	Silver	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-23-5	Sodium	2,130	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-23-5	Sodium	2,140	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-23-5	Sodium	3,950	µg/L	N		Q		WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-23-5	Sodium	4,100	µg/L	Y		Q		WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-23-5	Sodium	4,560	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-23-5	Sodium	4,600	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-23-5	Sodium	6,550	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-23-5	Sodium	7,770	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-23-5	Sodium	7,730	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-23-5	Sodium	2,050	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-23-5	Sodium	2,150	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-23-5	Sodium	2,130	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/8/2010	CONDUCT	Specific Conductance	206	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	6/28/2010	CONDUCT	Specific Conductance	154	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	9/16/2010	CONDUCT	Specific Conductance	234	µS/cm	N				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	2/8/2011	CONDUCT	Specific Conductance	202	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	3/15/2011	CONDUCT	Specific Conductance	185	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	6/1/2011	CONDUCT	Specific Conductance	154	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	9/2/2011	CONDUCT	Specific Conductance	194	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	2/1/2012	CONDUCT	Specific Conductance	147	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	3/27/2012	CONDUCT	Specific Conductance	166	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	6/22/2012	CONDUCT	Specific Conductance	150	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	9/17/2012	CONDUCT	Specific Conductance	261	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	1/14/2013	CONDUCT	Specific Conductance	241	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	3/20/2013	CONDUCT	Specific Conductance	782	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	6/3/2013	CONDUCT	Specific Conductance	177	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	6/20/2013	CONDUCT	Specific Conductance	234	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	9/4/2013	CONDUCT	Specific Conductance	242	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	12/19/2013	CONDUCT	Specific Conductance	135	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	12/19/2013	CONDUCT	Specific Conductance	132	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	3/28/2014	CONDUCT	Specific Conductance	117	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-0A	AT	2/8/2011	7440-24-6	Strontium	137	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-24-6	Strontium	148	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-24-6	Strontium	96.1	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-24-6	Strontium	89.3	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-24-6	Strontium	142	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-24-6	Strontium	147	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-24-6	Strontium	180	µg/L	N				GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7440-24-6	Strontium	68.4	µg/L	N				GEL	6010_METALS_ICP_TR

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	3/28/2014	7440-24-6	Strontium	60	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-24-6	Strontium	59.5	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/8/2010	10098-97-2	Strontium-90	1.2	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	6/28/2010	10098-97-2	Strontium-90	-1.9	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	9/16/2010	10098-97-2	Strontium-90	-6.3	pCi/L	N	U	GQ		WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	2/8/2011	10098-97-2	Strontium-90	0.77	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	3/15/2011	10098-97-2	Strontium-90	-0.42	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	6/1/2011	10098-97-2	Strontium-90	1.4	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	9/2/2011	10098-97-2	Strontium-90	0.721	pCi/L	N	U			TARL	SRISO_SEP_PRECIP_GPC
N116mArray-0A	AT	2/1/2012	10098-97-2	Strontium-90	0.92	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	3/27/2012	10098-97-2	Strontium-90	0.78	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	6/22/2012	10098-97-2	Strontium-90	0.87	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	9/17/2012	10098-97-2	Strontium-90	1.2	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	1/14/2013	10098-97-2	Strontium-90	0.33	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	3/20/2013	10098-97-2	Strontium-90	3	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	6/3/2013	10098-97-2	Strontium-90	2.9	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	9/4/2013	10098-97-2	Strontium-90	1.3	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	12/19/2013	10098-97-2	Strontium-90	0.5	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	3/28/2014	10098-97-2	Strontium-90	0.36	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-0A	AT	3/8/2010	14808-79-8	Sulfate	33,100	µg/L	N				222-S	9056_ANIONS_IC
N116mArray-0A	AT	6/28/2010	14808-79-8	Sulfate	9,980	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/16/2010	14808-79-8	Sulfate	25,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/8/2011	14808-79-8	Sulfate	26,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/15/2011	14808-79-8	Sulfate	22,700	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	6/1/2011	14808-79-8	Sulfate	10,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/2/2011	14808-79-8	Sulfate	20,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	2/1/2012	14808-79-8	Sulfate	11,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/27/2012	14808-79-8	Sulfate	13,300	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/22/2012	14808-79-8	Sulfate	7,530	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	9/17/2012	14808-79-8	Sulfate	7,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	1/14/2013	14808-79-8	Sulfate	21,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/20/2013	14808-79-8	Sulfate	27,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/3/2013	14808-79-8	Sulfate	8,980	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	6/20/2013	14808-79-8	Sulfate	10,800	µg/L	N				GEL	9056_ANIONS_IC
N116mArray-0A	AT	9/4/2013	14808-79-8	Sulfate	17,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	12/19/2013	14808-79-8	Sulfate	13,000	µg/L	N				GEL	9056_ANIONS_IC
N116mArray-0A	AT	12/19/2013	14808-79-8	Sulfate	13,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/28/2014	14808-79-8	Sulfate	10,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-0A	AT	3/8/2010	TEMPERATURE	Temperature	8.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	6/28/2010	TEMPERATURE	Temperature	16.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	9/16/2010	TEMPERATURE	Temperature	18.9	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	2/8/2011	TEMPERATURE	Temperature	6.7	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	3/15/2011	TEMPERATURE	Temperature	5.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	6/1/2011	TEMPERATURE	Temperature	11.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	9/2/2011	TEMPERATURE	Temperature	17	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	2/1/2012	TEMPERATURE	Temperature	6.7	Deg C	N				FIELD	TEMP_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	3/27/2012	TEMPERATURE	Temperature	8.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	6/22/2012	TEMPERATURE	Temperature	17.9	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	9/17/2012	TEMPERATURE	Temperature	26.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	1/14/2013	TEMPERATURE	Temperature	7.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	3/20/2013	TEMPERATURE	Temperature	10	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	6/3/2013	TEMPERATURE	Temperature	18	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	6/20/2013	TEMPERATURE	Temperature	15.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	9/4/2013	TEMPERATURE	Temperature	26.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	12/19/2013	TEMPERATURE	Temperature	6.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	12/19/2013	TEMPERATURE	Temperature	7.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	3/28/2014	TEMPERATURE	Temperature	7.7	Deg C	N				FIELD	TEMP_FLD
N116mArray-0A	AT	6/20/2013	7440-28-0	Thallium	5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7440-28-0	Thallium	5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	6/20/2013	7440-31-5	Tin	2.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7440-31-5	Tin	2.5	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/8/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	440	µg/L	N				WSCF	WTPH_DIESEL
N116mArray-0A	AT	6/28/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	400	µg/L	N				WSCF	WTPH_DIESEL
N116mArray-0A	AT	9/16/2010	TPHDIESEL	Total petroleum hydrocarbons - diesel range	570	µg/L	N				WSCF	WTPH_DIESEL

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	2/8/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	700	µg/L	N	N			WSCF	WTPH_DIESEL
N116mArray-0A	AT	3/15/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	UN			WSCF	WTPH_DIESEL
N116mArray-0A	AT	6/1/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-0A	AT	9/2/2011	TPHDIESEL	Total petroleum hydrocarbons - diesel range	360	µg/L	N				WSCF	WTPH_DIESEL
N116mArray-0A	AT	2/1/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	360	µg/L	N	X			WSCF	WTPH_DIESEL
N116mArray-0A	AT	3/27/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	440	µg/L	N	X			WSCF	WTPH_DIESEL
N116mArray-0A	AT	6/22/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	360	µg/L	N				WSCF	WTPH_DIESEL
N116mArray-0A	AT	9/17/2012	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-0A	AT	1/14/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	880	µg/L	N				WSCF	WTPH_DIESEL
N116mArray-0A	AT	3/20/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-0A	AT	6/3/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	80	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-0A	AT	6/20/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	772	µg/L	N	X			GEL	WTPH_DIESEL
N116mArray-0A	AT	9/4/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-0A	AT	12/19/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	89.6	µg/L	N	J			GEL	WTPH_DIESEL
N116mArray-0A	AT	12/19/2013	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	3/28/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-0A	AT	6/20/2013	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	16.7	µg/L	N	U			GEL	WTPH_GASOLINE
N116mArray-0A	AT	12/19/2013	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range	17.4	µg/L	N	J			GEL	WTPH_GASOLINE
N116mArray-0A	AT	6/20/2013	TPH/OILH	Total petroleum hydrocarbons - motor oil (high boiling)	692	µg/L	N	X			GEL	WTPH_DIESEL
N116mArray-0A	AT	12/19/2013	TPH/OILH	Total petroleum hydrocarbons - motor oil (high boiling)	90	µg/L	N	J			GEL	WTPH_DIESEL
N116mArray-0A	AT	3/8/2010	TURBIDITY	Turbidity	1.01	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	6/28/2010	TURBIDITY	Turbidity	1.55	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	9/16/2010	TURBIDITY	Turbidity	0.9	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	2/8/2011	TURBIDITY	Turbidity	2.31	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	3/15/2011	TURBIDITY	Turbidity	1.64	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	6/1/2011	TURBIDITY	Turbidity	2.81	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	9/2/2011	TURBIDITY	Turbidity	0.55	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	2/1/2012	TURBIDITY	Turbidity	1.07	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	3/27/2012	TURBIDITY	Turbidity	0.49	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	6/22/2012	TURBIDITY	Turbidity	0.39	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	9/17/2012	TURBIDITY	Turbidity	0.73	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	1/14/2013	TURBIDITY	Turbidity	0.96	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	3/20/2013	TURBIDITY	Turbidity	6.97	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	6/3/2013	TURBIDITY	Turbidity	0.53	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	6/20/2013	TURBIDITY	Turbidity	0.7	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	9/4/2013	TURBIDITY	Turbidity	0.63	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	12/19/2013	TURBIDITY	Turbidity	0.85	NTU	N				FIELD	TURBIDITY_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	12/19/2013	TURBIDITY	Turbidity	0.55	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	3/28/2014	TURBIDITY	Turbidity	4.53	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-0A	AT	6/20/2013	7440-61-1	Uranium	22.4	µg/L	N	B			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	12/19/2013	7440-61-1	Uranium	10	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	2/8/2011	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-62-2	Vanadium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-62-2	Vanadium	1	µg/L	N	U			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	3/28/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/8/2011	7440-66-6	Zinc	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-66-6	Zinc	5	µg/L	N	U	Q		WSCF	6010_METALS_ICP
N116mArray-0A	AT	2/1/2012	7440-66-6	Zinc	5	µg/L	Y	U	Q		WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	1/14/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	6/20/2013	7440-66-6	Zinc	5.79	µg/L	N	B			GEL	6010_METALS_ICP_TR
N116mArray-0A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	12/19/2013	7440-66-6	Zinc	3.3	µg/L	N	U			GEL	6010_METALS_ICP_TR

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-0A	AT	3/28/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-0A	AT	3/28/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-39-3	Barium	12	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-39-3	Barium	12	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-39-3	Barium	11.8	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-39-3	Barium	11.5	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-39-3	Barium	12.5	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-39-3	Barium	11.9	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-39-3	Barium	19.6	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-39-3	Barium	19.1	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-39-3	Barium	12.4	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-39-3	Barium	13.1	µg/L	N	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-70-2	Calcium	19,000	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-70-2	Calcium	18,400	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-70-2	Calcium	18,000	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-70-2	Calcium	18,400	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-70-2	Calcium	18,800	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-70-2	Calcium	18,500	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-70-2	Calcium	21,900	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-70-2	Calcium	22,000	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	3/31/2014	7440-70-2	Calcium	20,000	µg/L	Y	N			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-70-2	Calcium	20,400	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	16887-00-6	Chloride	1,000	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/30/2012	16887-00-6	Chloride	917	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/8/2013	16887-00-6	Chloride	750	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	9/4/2013	16887-00-6	Chloride	945	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	3/31/2014	16887-00-6	Chloride	1,180	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/16/2010	DO	Dissolved oxygen	10,500	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	6/28/2010	DO	Dissolved oxygen	3,920	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	9/19/2010	DO	Dissolved oxygen	7,550	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	2/7/2011	DO	Dissolved oxygen	8,570	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	3/10/2011	DO	Dissolved oxygen	7,320	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	1/30/2012	DO	Dissolved oxygen	10,580	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	3/21/2012	DO	Dissolved oxygen	10,280	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	9/17/2012	DO	Dissolved oxygen	9,040	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	1/8/2013	DO	Dissolved oxygen	9,240	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	3/18/2013	DO	Dissolved oxygen	9,860	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	6/4/2013	DO	Dissolved oxygen	6,150	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	9/4/2013	DO	Dissolved oxygen	7,950	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	1/24/2014	DO	Dissolved oxygen	10,980	µg/L	N				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	3/31/2014	DO	Dissolved oxygen	9,860	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-10A	AT	2/7/2011	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/30/2012	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/8/2013	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	9/4/2013	16984-48-8	Fluoride	57.9	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	9/4/2013	12587-46-1	Gross alpha	-0.93	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-10A	AT	3/31/2014	12587-46-1	Gross alpha	0.59	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-10A	AT	3/16/2010	12587-47-2	Gross beta	220	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	6/28/2010	12587-47-2	Gross beta	210	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	9/19/2010	12587-47-2	Gross beta	230	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	2/7/2011	12587-47-2	Gross beta	190	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	3/10/2011	12587-47-2	Gross beta	150	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	1/30/2012	12587-47-2	Gross beta	140	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	3/21/2012	12587-47-2	Gross beta	200	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	9/17/2012	12587-47-2	Gross beta	280	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	1/8/2013	12587-47-2	Gross beta	150	pCi/L	N		G		WSCF	BETA_GPC
N116mArray-10A	AT	3/18/2013	12587-47-2	Gross beta	200	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	6/4/2013	12587-47-2	Gross beta	240	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	9/4/2013	12587-47-2	Gross beta	190	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	1/24/2014	12587-47-2	Gross beta	200	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	3/31/2014	12587-47-2	Gross beta	210	pCi/L	N				WSCF	BETA_GPC
N116mArray-10A	AT	2/7/2011	7439-89-6	Iron	38	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7439-89-6	Iron	108	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7439-89-6	Iron	28.3	µg/L	N	BC			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7439-89-6	Iron	20.9	µg/L	Y	BC			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	1/8/2013	7439-89-6	Iron	22.2	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7439-89-6	Iron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7439-89-6	Iron	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7439-89-6	Iron	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7439-95-4	Magnesium	4,030	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7439-95-4	Magnesium	4,030	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7439-95-4	Magnesium	3,860	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7439-95-4	Magnesium	3,910	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7439-95-4	Magnesium	4,000	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7439-95-4	Magnesium	3,880	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7439-95-4	Magnesium	4,510	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7439-95-4	Magnesium	4,530	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-95-4	Magnesium	4,210	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-95-4	Magnesium	4,230	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	3/31/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-02-0	Nickel	4.1	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	14797-55-8	Nitrate	1,130	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/30/2012	14797-55-8	Nitrate	1,080	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/8/2013	14797-55-8	Nitrate	1,280	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	9/4/2013	14797-55-8	Nitrate	2,190	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	3/31/2014	14797-55-8	Nitrate	1,760	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	2/7/2011	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/30/2012	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/8/2013	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	9/4/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	3/16/2010	EH	Oxidation Reduction Potential	181	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	6/28/2010	EH	Oxidation Reduction Potential	123	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	9/19/2010	EH	Oxidation Reduction Potential	99	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	2/7/2011	EH	Oxidation Reduction Potential	272	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	3/10/2011	EH	Oxidation Reduction Potential	110	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	1/30/2012	EH	Oxidation Reduction Potential	115	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	3/21/2012	EH	Oxidation Reduction Potential	226	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	9/17/2012	EH	Oxidation Reduction Potential	174	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	1/8/2013	EH	Oxidation Reduction Potential	242	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	3/18/2013	EH	Oxidation Reduction Potential	237	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	6/4/2013	EH	Oxidation Reduction Potential	223	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	9/4/2013	EH	Oxidation Reduction Potential	88	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	1/24/2014	EH	Oxidation Reduction Potential	153	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	3/31/2014	EH	Oxidation Reduction Potential	221	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-10A	AT	3/16/2010	PH	pH Measurement	7.13	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	6/28/2010	PH	pH Measurement	7.63	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	9/19/2010	PH	pH Measurement	7.48	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	2/7/2011	PH	pH Measurement	7.9	unitless	N				FIELD	PH_ELECT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	3/10/2011	PH	pH Measurement	6.73	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	1/30/2012	PH	pH Measurement	7.66	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	3/21/2012	PH	pH Measurement	7.95	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	9/17/2012	PH	pH Measurement	7.3	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	1/8/2013	PH	pH Measurement	7.92	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	3/18/2013	PH	pH Measurement	8.01	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	6/4/2013	PH	pH Measurement	8.11	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	9/4/2013	PH	pH Measurement	7.69	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	1/24/2014	PH	pH Measurement	7.94	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	3/31/2014	PH	pH Measurement	8.52	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-10A	AT	9/4/2013	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	2/7/2011	9/7/7440	Potassium	829	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	9/7/7440	Potassium	797	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	9/7/7440	Potassium	797	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	9/7/7440	Potassium	767	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	9/7/7440	Potassium	844	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	9/7/7440	Potassium	858	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	9/7/7440	Potassium	1,290	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	9/7/7440	Potassium	1,270	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	9/7/7440	Potassium	768	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	9/7/7440	Potassium	825	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	1/30/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-23-5	Sodium	2,030	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-23-5	Sodium	2,000	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-23-5	Sodium	2,050	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-23-5	Sodium	2,080	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-23-5	Sodium	2,080	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-23-5	Sodium	2,040	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-23-5	Sodium	2,830	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-23-5	Sodium	2,870	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-23-5	Sodium	2,100	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-23-5	Sodium	2,100	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/16/2010	CONDUCT	Specific Conductance	138	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	6/28/2010	CONDUCT	Specific Conductance	150.5	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	9/19/2010	CONDUCT	Specific Conductance	141	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	2/7/2011	CONDUCT	Specific Conductance	134	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	3/10/2011	CONDUCT	Specific Conductance	138	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	1/30/2012	CONDUCT	Specific Conductance	129	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	3/21/2012	CONDUCT	Specific Conductance	130	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	9/17/2012	CONDUCT	Specific Conductance	168	µS/cm	N				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	1/8/2013	CONDUCT	Specific Conductance	124	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	3/18/2013	CONDUCT	Specific Conductance	141	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	6/4/2013	CONDUCT	Specific Conductance	162	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	9/4/2013	CONDUCT	Specific Conductance	149	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	1/24/2014	CONDUCT	Specific Conductance	128	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	3/31/2014	CONDUCT	Specific Conductance	135	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-10A	AT	2/7/2011	7440-24-6	Strontium	84	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-24-6	Strontium	84	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-24-6	Strontium	75.6	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-24-6	Strontium	80.3	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-24-6	Strontium	75	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-24-6	Strontium	74.2	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-24-6	Strontium	86.7	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-24-6	Strontium	86.4	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	10098-97-2	Strontium-90	96	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-10A	AT	1/30/2012	10098-97-2	Strontium-90	110	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-10A	AT	1/8/2013	10098-97-2	Strontium-90	97	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-10A	AT	9/4/2013	10098-97-2	Strontium-90	110	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-10A	AT	3/31/2014	10098-97-2	Strontium-90	96	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-10A	AT	2/7/2011	14808-79-8	Sulfate	9,550	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/30/2012	14808-79-8	Sulfate	8,810	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	1/8/2013	14808-79-8	Sulfate	8,380	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	9/4/2013	14808-79-8	Sulfate	8,260	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-10A	AT	3/31/2014	14808-79-8	Sulfate	9,310	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	3/16/2010	TEMPERATURE	Temperature	7.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	6/28/2010	TEMPERATURE	Temperature	15.6	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	9/19/2010	TEMPERATURE	Temperature	17.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	2/7/2011	TEMPERATURE	Temperature	6.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	3/10/2011	TEMPERATURE	Temperature	5.7	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	1/30/2012	TEMPERATURE	Temperature	9.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	3/21/2012	TEMPERATURE	Temperature	7.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	9/17/2012	TEMPERATURE	Temperature	14.7	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	1/8/2013	TEMPERATURE	Temperature	10.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	3/18/2013	TEMPERATURE	Temperature	11.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	6/4/2013	TEMPERATURE	Temperature	20.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	9/4/2013	TEMPERATURE	Temperature	29.7	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	1/24/2014	TEMPERATURE	Temperature	6.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	3/31/2014	TEMPERATURE	Temperature	8.9	Deg C	N				FIELD	TEMP_FLD
N116mArray-10A	AT	3/31/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	80	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-10A	AT	3/16/2010	TURBIDITY	Turbidity	3.01	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	6/28/2010	TURBIDITY	Turbidity	1.83	NTU	N				FIELD	TURBIDITY_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	9/19/2010	TURBIDITY	Turbidity	1.83	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	2/7/2011	TURBIDITY	Turbidity	11.03	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	3/10/2011	TURBIDITY	Turbidity	7.88	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	1/30/2012	TURBIDITY	Turbidity	3.06	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	3/21/2012	TURBIDITY	Turbidity	2.07	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	9/17/2012	TURBIDITY	Turbidity	0.5	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	1/8/2013	TURBIDITY	Turbidity	1.16	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	3/18/2013	TURBIDITY	Turbidity	1.74	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	6/4/2013	TURBIDITY	Turbidity	0.57	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	9/4/2013	TURBIDITY	Turbidity	2.07	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	1/24/2014	TURBIDITY	Turbidity	2.43	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	3/31/2014	TURBIDITY	Turbidity	4.33	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-10A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/30/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-10A	AT	1/8/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	1/8/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-10A	AT	3/31/2014	7440-66-6	Zinc	5.98	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-39-3	Barium	17	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-39-3	Barium	18	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-39-3	Barium	28.6	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-39-3	Barium	28.2	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-39-3	Barium	18.5	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-39-3	Barium	17.6	µg/L	Y	B			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	9/4/2013	7440-39-3	Barium	34.2	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-39-3	Barium	34.3	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-39-3	Barium	18	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-39-3	Barium	20.1	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-70-2	Calcium	27,300	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-70-2	Calcium	27,800	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-70-2	Calcium	43,400	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-70-2	Calcium	42,800	µg/L	Y				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	1/8/2013	7440-70-2	Calcium	29,300	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-70-2	Calcium	29,100	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-70-2	Calcium	43,200	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-70-2	Calcium	44,200	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-70-2	Calcium	31,500	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-70-2	Calcium	30,000	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	16887-00-6	Chloride	3,260	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/27/2012	16887-00-6	Chloride	8,600	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/8/2013	16887-00-6	Chloride	2,850	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	9/4/2013	16887-00-6	Chloride	7,050	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/28/2014	16887-00-6	Chloride	14,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	1/8/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/16/2010	DO	Dissolved oxygen	8,680	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	6/28/2010	DO	Dissolved oxygen	2,410	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	9/19/2010	DO	Dissolved oxygen	7,670	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	2/7/2011	DO	Dissolved oxygen	8,090	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	3/10/2011	DO	Dissolved oxygen	7,060	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	6/2/2011	DO	Dissolved oxygen	1,890	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	8/31/2011	DO	Dissolved oxygen	6,930	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	1/27/2012	DO	Dissolved oxygen	9,490	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	3/21/2012	DO	Dissolved oxygen	7,940	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	6/11/2012	DO	Dissolved oxygen	2,790	µg/L	N				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	9/11/2012	DO	Dissolved oxygen	8,440	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	1/8/2013	DO	Dissolved oxygen	8,140	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	3/18/2013	DO	Dissolved oxygen	8,070	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	6/4/2013	DO	Dissolved oxygen	3,990	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	9/4/2013	DO	Dissolved oxygen	7,020	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	1/24/2014	DO	Dissolved oxygen	8,180	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	3/28/2014	DO	Dissolved oxygen	9,850	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-11A	AT	2/7/2011	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/27/2012	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/8/2013	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	9/4/2013	16984-48-8	Fluoride	50.7	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/28/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	9/4/2013	12587-46-1	Gross alpha	-1.7	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-11A	AT	3/28/2014	12587-46-1	Gross alpha	-0.38	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-11A	AT	3/16/2010	12587-47-2	Gross beta	1,700	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	6/28/2010	12587-47-2	Gross beta	740	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	9/19/2010	12587-47-2	Gross beta	1,700	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	2/7/2011	12587-47-2	Gross beta	830	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	3/10/2011	12587-47-2	Gross beta	540	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	6/2/2011	12587-47-2	Gross beta	840	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	8/31/2011	12587-47-2	Gross beta	1,100	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	1/27/2012	12587-47-2	Gross beta	1,200	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	3/21/2012	12587-47-2	Gross beta	1,500	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	6/11/2012	12587-47-2	Gross beta	830	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	9/11/2012	12587-47-2	Gross beta	1,100	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	1/8/2013	12587-47-2	Gross beta	670	pCi/L	N		G		WSCF	BETA_GPC
N116mArray-11A	AT	3/18/2013	12587-47-2	Gross beta	1,600	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	6/4/2013	12587-47-2	Gross beta	620	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	9/4/2013	12587-47-2	Gross beta	900	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	1/24/2014	12587-47-2	Gross beta	1,300	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	1/24/2014	12587-47-2	Gross beta	740	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	3/28/2014	12587-47-2	Gross beta	640	pCi/L	N				WSCF	BETA_GPC
N116mArray-11A	AT	2/7/2011	7439-89-6	Iron	91	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7439-89-6	Iron	82	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7439-89-6	Iron	159	µg/L	N	C			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7439-89-6	Iron	146	µg/L	Y	C			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7439-89-6	Iron	38.1	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7439-89-6	Iron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7439-89-6	Iron	30.6	µg/L	N	BC			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7439-89-6	Iron	38	µg/L	Y	BC			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-89-6	Iron	117	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-89-6	Iron	222	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7439-95-4	Magnesium	5,060	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7439-95-4	Magnesium	5,170	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7439-95-4	Magnesium	8,210	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7439-95-4	Magnesium	8,190	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7439-95-4	Magnesium	5,370	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7439-95-4	Magnesium	5,310	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7439-95-4	Magnesium	7,820	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	9/4/2013	7439-95-4	Magnesium	7,990	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-95-4	Magnesium	5,620	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-95-4	Magnesium	5,340	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7439-96-5	Manganese	8	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7439-96-5	Manganese	15	µg/L	N	BC			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7439-96-5	Manganese	14.1	µg/L	Y	BC			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7439-96-5	Manganese	6	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7439-96-5	Manganese	5.6	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-96-5	Manganese	12.8	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-96-5	Manganese	28.2	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	14797-55-8	Nitrate	11,000	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	1/27/2012	14797-55-8	Nitrate	36,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/8/2013	14797-55-8	Nitrate	11,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	9/4/2013	14797-55-8	Nitrate	32,700	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/28/2014	14797-55-8	Nitrate	46,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	2/7/2011	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/27/2012	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/8/2013	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	9/4/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/28/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/16/2010	EH	Oxidation Reduction Potential	90	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	6/28/2010	EH	Oxidation Reduction Potential	92	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	9/19/2010	EH	Oxidation Reduction Potential	109	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	2/7/2011	EH	Oxidation Reduction Potential	326	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	3/10/2011	EH	Oxidation Reduction Potential	98	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	6/2/2011	EH	Oxidation Reduction Potential	216	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	8/31/2011	EH	Oxidation Reduction Potential	194	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	1/27/2012	EH	Oxidation Reduction Potential	93	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	3/21/2012	EH	Oxidation Reduction Potential	79	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	6/11/2012	EH	Oxidation Reduction Potential	231	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	9/11/2012	EH	Oxidation Reduction Potential	99	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	1/8/2013	EH	Oxidation Reduction Potential	264	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	3/18/2013	EH	Oxidation Reduction Potential	68	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	6/4/2013	EH	Oxidation Reduction Potential	104	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	9/4/2013	EH	Oxidation Reduction Potential	58	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	1/24/2014	EH	Oxidation Reduction Potential	148	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	3/28/2014	EH	Oxidation Reduction Potential	165	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-11A	AT	3/16/2010	PH	pH Measurement	6.45	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	6/28/2010	PH	pH Measurement	7.47	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	9/19/2010	PH	pH Measurement	7.29	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	2/7/2011	PH	pH Measurement	8.18	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	3/10/2011	PH	pH Measurement	7.43	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	6/2/2011	PH	pH Measurement	7.46	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	8/31/2011	PH	pH Measurement	8.14	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	1/27/2012	PH	pH Measurement	7.46	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	3/21/2012	PH	pH Measurement	7.82	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	6/11/2012	PH	pH Measurement	7.51	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	9/11/2012	PH	pH Measurement	7.92	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	1/8/2013	PH	pH Measurement	7.76	unitless	N				FIELD	PH_ELECT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	3/18/2013	PH	pH Measurement	7.76	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	6/4/2013	PH	pH Measurement	8.34	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	9/4/2013	PH	pH Measurement	7.64	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	1/24/2014	PH	pH Measurement	7.73	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	3/28/2014	PH	pH Measurement	7.81	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-11A	AT	9/4/2013	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/28/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	2/7/2011	9/7/7440	Potassium	983	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	9/7/7440	Potassium	1,020	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	9/7/7440	Potassium	1,330	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	9/7/7440	Potassium	1,340	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	9/7/7440	Potassium	1,120	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	9/7/7440	Potassium	1,150	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	9/7/7440	Potassium	1,730	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	9/7/7440	Potassium	1,800	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	9/7/7440	Potassium	1,030	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	9/7/7440	Potassium	1,010	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-22-4	Silver	5.6	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	3/28/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-23-5	Sodium	2,530	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-23-5	Sodium	2,550	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-23-5	Sodium	3,590	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-23-5	Sodium	3,660	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-23-5	Sodium	2,870	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-23-5	Sodium	2,860	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-23-5	Sodium	4,090	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-23-5	Sodium	4,180	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-23-5	Sodium	2,960	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-23-5	Sodium	2,810	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/16/2010	CONDUCT	Specific Conductance	340	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	6/28/2010	CONDUCT	Specific Conductance	162	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	9/19/2010	CONDUCT	Specific Conductance	348	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	2/7/2011	CONDUCT	Specific Conductance	200	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	3/10/2011	CONDUCT	Specific Conductance	167	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	6/2/2011	CONDUCT	Specific Conductance	183	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	8/31/2011	CONDUCT	Specific Conductance	230	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	1/27/2012	CONDUCT	Specific Conductance	317	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	3/21/2012	CONDUCT	Specific Conductance	328	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	6/11/2012	CONDUCT	Specific Conductance	175	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	9/11/2012	CONDUCT	Specific Conductance	253	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	1/8/2013	CONDUCT	Specific Conductance	193	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	3/18/2013	CONDUCT	Specific Conductance	392	µS/cm	N				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	6/4/2013	CONDUCT	Specific Conductance	170	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	9/4/2013	CONDUCT	Specific Conductance	302	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	1/24/2014	CONDUCT	Specific Conductance	327	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	3/28/2014	CONDUCT	Specific Conductance	186	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-11A	AT	2/7/2011	7440-24-6	Strontium	112	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-24-6	Strontium	115	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-24-6	Strontium	176	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-24-6	Strontium	172	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-24-6	Strontium	119	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-24-6	Strontium	112	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-24-6	Strontium	127	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-24-6	Strontium	122	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	10098-97-2	Strontium-90	400	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-11A	AT	1/27/2012	10098-97-2	Strontium-90	600	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-11A	AT	1/8/2013	10098-97-2	Strontium-90	370	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-11A	AT	9/4/2013	10098-97-2	Strontium-90	570	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-11A	AT	3/28/2014	10098-97-2	Strontium-90	440	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-11A	AT	2/7/2011	14808-79-8	Sulfate	20,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/27/2012	14808-79-8	Sulfate	43,900	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	1/8/2013	14808-79-8	Sulfate	20,500	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	9/4/2013	14808-79-8	Sulfate	42,800	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/28/2014	14808-79-8	Sulfate	59,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-11A	AT	3/16/2010	TEMPERATURE	Temperature	8.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	6/28/2010	TEMPERATURE	Temperature	16	Deg C	N				FIELD	TEMP_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	9/19/2010	TEMPERATURE	Temperature	17.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	2/7/2011	TEMPERATURE	Temperature	6.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	3/10/2011	TEMPERATURE	Temperature	5.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	6/2/2011	TEMPERATURE	Temperature	11.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	8/31/2011	TEMPERATURE	Temperature	19.9	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	1/27/2012	TEMPERATURE	Temperature	5	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	3/21/2012	TEMPERATURE	Temperature	8.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	6/11/2012	TEMPERATURE	Temperature	15	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	9/11/2012	TEMPERATURE	Temperature	14.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	1/8/2013	TEMPERATURE	Temperature	9.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	3/18/2013	TEMPERATURE	Temperature	11.9	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	6/4/2013	TEMPERATURE	Temperature	16	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	9/4/2013	TEMPERATURE	Temperature	23.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	1/24/2014	TEMPERATURE	Temperature	6.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	3/28/2014	TEMPERATURE	Temperature	7.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-11A	AT	3/28/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	70	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-11A	AT	3/16/2010	TURBIDITY	Turbidity	2.14	NTU	N				FIELD	TURBIDITY_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	6/28/2010	TURBIDITY	Turbidity	0.84	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	9/19/2010	TURBIDITY	Turbidity	6.95	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	2/7/2011	TURBIDITY	Turbidity	5.36	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	3/10/2011	TURBIDITY	Turbidity	8.23	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	6/2/2011	TURBIDITY	Turbidity	14	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	8/31/2011	TURBIDITY	Turbidity	1.47	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	1/27/2012	TURBIDITY	Turbidity	0.5	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	3/21/2012	TURBIDITY	Turbidity	0.9	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	6/11/2012	TURBIDITY	Turbidity	0.34	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	9/11/2012	TURBIDITY	Turbidity	0.58	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	1/8/2013	TURBIDITY	Turbidity	1.34	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	3/18/2013	TURBIDITY	Turbidity	0.51	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	6/4/2013	TURBIDITY	Turbidity	2.14	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	9/4/2013	TURBIDITY	Turbidity	0.4	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	1/24/2014	TURBIDITY	Turbidity	1.16	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	3/28/2014	TURBIDITY	Turbidity	0.9	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-11A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-11A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/27/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	1/8/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-11A	AT	3/28/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-39-3	Barium	24	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-39-3	Barium	25	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	1/18/2012	7440-39-3	Barium	36	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-39-3	Barium	35	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-39-3	Barium	23.7	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-39-3	Barium	23.4	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-39-3	Barium	32.6	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-39-3	Barium	30.6	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-39-3	Barium	23.4	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-39-3	Barium	23.2	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	2/7/2011	7440-70-2	Calcium	18,900	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-70-2	Calcium	18,500	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-70-2	Calcium	28,400	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-70-2	Calcium	28,100	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-70-2	Calcium	19,500	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-70-2	Calcium	19,600	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-70-2	Calcium	24,200	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-70-2	Calcium	23,000	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-70-2	Calcium	20,700	µg/L	Y	N			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-70-2	Calcium	21,400	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	16887-00-6	Chloride	1,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/18/2012	16887-00-6	Chloride	4,470	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/8/2013	16887-00-6	Chloride	939	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	9/4/2013	16887-00-6	Chloride	1,270	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	3/31/2014	16887-00-6	Chloride	1,270	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/16/2010	DO	Dissolved oxygen	10,110	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	6/28/2010	DO	Dissolved oxygen	3,580	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	9/19/2010	DO	Dissolved oxygen	8,780	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	2/7/2011	DO	Dissolved oxygen	9,800	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	3/10/2011	DO	Dissolved oxygen	9,540	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	6/2/2011	DO	Dissolved oxygen	4,270	µg/L	N				FIELD	360.1_OXYGEN_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	8/31/2011	DO	Dissolved oxygen	3,500	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	1/18/2012	DO	Dissolved oxygen	8,710	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	3/21/2012	DO	Dissolved oxygen	8,520	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	6/11/2012	DO	Dissolved oxygen	2,720	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	9/10/2012	DO	Dissolved oxygen	5,210	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	1/8/2013	DO	Dissolved oxygen	8,950	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	3/18/2013	DO	Dissolved oxygen	8,860	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	6/4/2013	DO	Dissolved oxygen	3,950	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	9/4/2013	DO	Dissolved oxygen	7,820	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	1/24/2014	DO	Dissolved oxygen	8,770	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	3/31/2014	DO	Dissolved oxygen	10,000	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-15A	AT	2/7/2011	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/18/2012	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/8/2013	16984-48-8	Fluoride	51.4	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	9/4/2013	16984-48-8	Fluoride	64.5	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	9/4/2013	12587-46-1	Gross alpha	-0.64	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-15A	AT	3/31/2014	12587-46-1	Gross alpha	-0.2	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-15A	AT	3/16/2010	12587-47-2	Gross beta	4.4	pCi/L	N				WSCF	BETA_GPC
N116mArray-15A	AT	3/16/2010	12587-47-2	Gross beta	1.5	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	6/28/2010	12587-47-2	Gross beta	4.1	pCi/L	N				WSCF	BETA_GPC
N116mArray-15A	AT	9/19/2010	12587-47-2	Gross beta	2.8	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	2/7/2011	12587-47-2	Gross beta	3.2	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	3/10/2011	12587-47-2	Gross beta	0.64	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	6/2/2011	12587-47-2	Gross beta	3.6	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	8/31/2011	12587-47-2	Gross beta	4.3	pCi/L	N				WSCF	BETA_GPC
N116mArray-15A	AT	1/18/2012	12587-47-2	Gross beta	0.5	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	3/21/2012	12587-47-2	Gross beta	4.6	pCi/L	N				WSCF	BETA_GPC
N116mArray-15A	AT	6/11/2012	12587-47-2	Gross beta	5.7	pCi/L	N				WSCF	BETA_GPC
N116mArray-15A	AT	9/10/2012	12587-47-2	Gross beta	4.7	pCi/L	N				WSCF	BETA_GPC
N116mArray-15A	AT	1/8/2013	12587-47-2	Gross beta	0.96	pCi/L	N	U	G		WSCF	BETA_GPC
N116mArray-15A	AT	3/18/2013	12587-47-2	Gross beta	5.5	pCi/L	N				WSCF	BETA_GPC
N116mArray-15A	AT	6/4/2013	12587-47-2	Gross beta	0.36	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	9/4/2013	12587-47-2	Gross beta	1.6	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	1/24/2014	12587-47-2	Gross beta	3.4	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	3/31/2014	12587-47-2	Gross beta	1.8	pCi/L	N	U			WSCF	BETA_GPC
N116mArray-15A	AT	2/7/2011	7439-89-6	Iron	68	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7439-89-6	Iron	47.9	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7439-89-6	Iron	50.9	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7439-89-6	Iron	23	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7439-89-6	Iron	20.2	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7439-89-6	Iron	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7439-89-6	Iron	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7439-95-4	Magnesium	4,630	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7439-95-4	Magnesium	4,770	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7439-95-4	Magnesium	6,910	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	1/18/2012	7439-95-4	Magnesium	6,830	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7439-95-4	Magnesium	4,610	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7439-95-4	Magnesium	4,600	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7439-95-4	Magnesium	5,690	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7439-95-4	Magnesium	5,430	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-95-4	Magnesium	4,980	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-95-4	Magnesium	5,050	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7439-96-5	Manganese	7.8	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7439-96-5	Manganese	5.2	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	14797-55-8	Nitrate	877	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/18/2012	14797-55-8	Nitrate	15,200	µg/L	N	D	H		WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/8/2013	14797-55-8	Nitrate	1,260	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	9/4/2013	14797-55-8	Nitrate	1,620	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	3/31/2014	14797-55-8	Nitrate	1,310	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	2/7/2011	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/18/2012	14797-65-0	Nitrite	125	µg/L	N	UD	H		WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/8/2013	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	9/4/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	3/16/2010	EH	Oxidation Reduction Potential	165	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	6/28/2010	EH	Oxidation Reduction Potential	143	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	9/19/2010	EH	Oxidation Reduction Potential	217	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	2/7/2011	EH	Oxidation Reduction Potential	203	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	3/10/2011	EH	Oxidation Reduction Potential	153	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	6/2/2011	EH	Oxidation Reduction Potential	198	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	8/31/2011	EH	Oxidation Reduction Potential	194	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	1/18/2012	EH	Oxidation Reduction Potential	118	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	3/21/2012	EH	Oxidation Reduction Potential	197	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	6/11/2012	EH	Oxidation Reduction Potential	278	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	9/10/2012	EH	Oxidation Reduction Potential	49	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	1/8/2013	EH	Oxidation Reduction Potential	237	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	3/18/2013	EH	Oxidation Reduction Potential	248	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	6/4/2013	EH	Oxidation Reduction Potential	212	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	9/4/2013	EH	Oxidation Reduction Potential	57	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	1/24/2014	EH	Oxidation Reduction Potential	181	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	3/31/2014	EH	Oxidation Reduction Potential	228	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-15A	AT	3/16/2010	PH	pH Measurement	7.61	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	6/28/2010	PH	pH Measurement	7.9	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	9/19/2010	PH	pH Measurement	7.5	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	2/7/2011	PH	pH Measurement	8.39	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	3/10/2011	PH	pH Measurement	8.19	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	6/2/2011	PH	pH Measurement	7.57	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	8/31/2011	PH	pH Measurement	7.6	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	1/18/2012	PH	pH Measurement	7.64	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	3/21/2012	PH	pH Measurement	7.8	unitless	N				FIELD	PH_ELECT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	6/11/2012	PH	pH Measurement	7.28	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	9/10/2012	PH	pH Measurement	7.97	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	1/8/2013	PH	pH Measurement	7.7	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	3/18/2013	PH	pH Measurement	7.7	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	6/4/2013	PH	pH Measurement	8.4	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	9/4/2013	PH	pH Measurement	7.5	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	1/24/2014	PH	pH Measurement	7.19	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	3/31/2014	PH	pH Measurement	7.83	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-15A	AT	9/4/2013	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	2/7/2011	9/7/7440	Potassium	926	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	9/7/7440	Potassium	948	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	9/7/7440	Potassium	1,160	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	9/7/7440	Potassium	1,130	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	9/7/7440	Potassium	893	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	9/7/7440	Potassium	834	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	9/7/7440	Potassium	1,090	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	9/7/7440	Potassium	1,030	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	9/7/7440	Potassium	751	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	9/7/7440	Potassium	789	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	1/8/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-22-4	Silver	4.28	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-23-5	Sodium	2,080	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-23-5	Sodium	2,060	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-23-5	Sodium	3,220	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-23-5	Sodium	3,200	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-23-5	Sodium	2,380	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-23-5	Sodium	2,390	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-23-5	Sodium	2,750	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-23-5	Sodium	2,660	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-23-5	Sodium	2,330	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-23-5	Sodium	2,350	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/16/2010	CONDUCT	Specific Conductance	194	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	6/28/2010	CONDUCT	Specific Conductance	144.3	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	9/19/2010	CONDUCT	Specific Conductance	171	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	2/7/2011	CONDUCT	Specific Conductance	140	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	3/10/2011	CONDUCT	Specific Conductance	140	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	6/2/2011	CONDUCT	Specific Conductance	167	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	8/31/2011	CONDUCT	Specific Conductance	162	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	1/18/2012	CONDUCT	Specific Conductance	213	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	3/21/2012	CONDUCT	Specific Conductance	176	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	6/11/2012	CONDUCT	Specific Conductance	159	µS/cm	N				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	9/10/2012	CONDUCT	Specific Conductance	140	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	1/8/2013	CONDUCT	Specific Conductance	133	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	3/18/2013	CONDUCT	Specific Conductance	209	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	6/4/2013	CONDUCT	Specific Conductance	150	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	9/4/2013	CONDUCT	Specific Conductance	163	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	1/24/2014	CONDUCT	Specific Conductance	255	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	3/31/2014	CONDUCT	Specific Conductance	143	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-15A	AT	2/7/2011	7440-24-6	Strontium	98	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-24-6	Strontium	99	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-24-6	Strontium	144	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-24-6	Strontium	141	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-24-6	Strontium	90.2	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-24-6	Strontium	91.7	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-24-6	Strontium	105	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-24-6	Strontium	106	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	10098-97-2	Strontium-90	-1.8	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-15A	AT	1/18/2012	10098-97-2	Strontium-90	0.72	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-15A	AT	1/8/2013	10098-97-2	Strontium-90	0.09	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-15A	AT	9/4/2013	10098-97-2	Strontium-90	0.94	pCi/L	N	U			WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-15A	AT	3/31/2014	10098-97-2	Strontium-90	1	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-15A	AT	2/7/2011	14808-79-8	Sulfate	9,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/18/2012	14808-79-8	Sulfate	2,5900	µg/L	N	DN			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	1/8/2013	14808-79-8	Sulfate	9,210	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	9/4/2013	14808-79-8	Sulfate	9,890	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-15A	AT	3/31/2014	14808-79-8	Sulfate	10,500	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	3/16/2010	TEMPERATURE	Temperature	9.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	6/28/2010	TEMPERATURE	Temperature	16.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	9/19/2010	TEMPERATURE	Temperature	17.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	2/7/2011	TEMPERATURE	Temperature	6.7	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	3/10/2011	TEMPERATURE	Temperature	6.6	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	6/2/2011	TEMPERATURE	Temperature	10.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	8/31/2011	TEMPERATURE	Temperature	16.7	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	1/18/2012	TEMPERATURE	Temperature	6.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	3/21/2012	TEMPERATURE	Temperature	9.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	6/11/2012	TEMPERATURE	Temperature	13	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	9/10/2012	TEMPERATURE	Temperature	18	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	1/8/2013	TEMPERATURE	Temperature	8.9	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	3/18/2013	TEMPERATURE	Temperature	11.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	6/4/2013	TEMPERATURE	Temperature	16.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	9/4/2013	TEMPERATURE	Temperature	20.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	1/24/2014	TEMPERATURE	Temperature	6.6	Deg C	N				FIELD	TEMP_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	3/31/2014	TEMPERATURE	Temperature	6.6	Deg C	N				FIELD	TEMP_FLD
N116mArray-15A	AT	3/31/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	80	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-15A	AT	2/7/2011	10028-17-8	Tritium	-67	pCi/L	N	U			WSCF	TRITIUM_EIE_LSC
N116mArray-15A	AT	1/18/2012	10028-17-8	Tritium	5,600	pCi/L	N				WSCF	TRITIUM_EIE_LSC
N116mArray-15A	AT	1/8/2013	10028-17-8	Tritium	-9	pCi/L	N	U			WSCF	TRITIUM_EIE_LSC
N116mArray-15A	AT	9/4/2013	10028-17-8	Tritium	120	pCi/L	N	U			WSCF	TRITIUM_EIE_LSC
N116mArray-15A	AT	3/16/2010	TURBIDITY	Turbidity	1.36	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	6/28/2010	TURBIDITY	Turbidity	0.72	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	9/19/2010	TURBIDITY	Turbidity	1.54	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	2/7/2011	TURBIDITY	Turbidity	0.93	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	3/10/2011	TURBIDITY	Turbidity	13.2	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	6/2/2011	TURBIDITY	Turbidity	1.67	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	8/31/2011	TURBIDITY	Turbidity	2.3	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	1/18/2012	TURBIDITY	Turbidity	0.37	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	3/21/2012	TURBIDITY	Turbidity	0.87	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	6/11/2012	TURBIDITY	Turbidity	0.39	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	9/10/2012	TURBIDITY	Turbidity	0.58	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	1/8/2013	TURBIDITY	Turbidity	0.29	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	3/18/2013	TURBIDITY	Turbidity	0.33	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	6/4/2013	TURBIDITY	Turbidity	0.49	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	9/4/2013	TURBIDITY	Turbidity	0.45	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	1/24/2014	TURBIDITY	Turbidity	1.04	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	3/31/2014	TURBIDITY	Turbidity	143	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-15A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-15A	AT	1/18/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/18/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	1/8/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-15A	AT	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-39-3	Barium	18	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-39-3	Barium	19	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-39-3	Barium	21	µg/L	N				WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	1/30/2012	7440-39-3	Barium	20.6	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-70-2	Calcium	20,000	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-70-2	Calcium	20,700	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-70-2	Calcium	23,000	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-70-2	Calcium	22,700	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	16887-00-6	Chloride	1,130	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	1/30/2012	16887-00-6	Chloride	1,910	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	3/9/2010	DO	Dissolved oxygen	9,810	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	6/28/2010	DO	Dissolved oxygen	3,270	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	9/19/2010	DO	Dissolved oxygen	9,090	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	2/7/2011	DO	Dissolved oxygen	9,510	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	3/10/2011	DO	Dissolved oxygen	10,860	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	6/2/2011	DO	Dissolved oxygen	4,870	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	8/31/2011	DO	Dissolved oxygen	6,160	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	1/30/2012	DO	Dissolved oxygen	10,010	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	3/21/2012	DO	Dissolved oxygen	10,940	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	6/20/2012	DO	Dissolved oxygen	4,010	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	9/18/2012	DO	Dissolved oxygen	8,370	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	3/19/2013	DO	Dissolved oxygen	9,720	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	6/4/2013	DO	Dissolved oxygen	7,680	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-8.5A	AT	2/7/2011	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	1/30/2012	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	3/9/2010	12587-47-2	Gross beta	140	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	6/28/2010	12587-47-2	Gross beta	120	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	9/19/2010	12587-47-2	Gross beta	150	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	2/7/2011	12587-47-2	Gross beta	140	pCi/L	N				WSCF	BETA_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	3/10/2011	12587-47-2	Gross beta	91	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	6/2/2011	12587-47-2	Gross beta	180	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	8/31/2011	12587-47-2	Gross beta	170	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	1/30/2012	12587-47-2	Gross beta	120	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	3/21/2012	12587-47-2	Gross beta	190	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	6/20/2012	12587-47-2	Gross beta	190	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	9/18/2012	12587-47-2	Gross beta	170	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	3/19/2013	12587-47-2	Gross beta	210	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	6/4/2013	12587-47-2	Gross beta	180	pCi/L	N				WSCF	BETA_GPC
N116mArray-8.5A	AT	2/7/2011	7439-89-6	Iron	38	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7439-89-6	Iron	38	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7439-89-6	Iron	19	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7439-89-6	Iron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7439-95-4	Magnesium	3,980	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7439-95-4	Magnesium	4,130	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7439-95-4	Magnesium	4,690	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7439-95-4	Magnesium	4,590	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	1/30/2012	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	14797-55-8	Nitrate	921	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	1/30/2012	14797-55-8	Nitrate	5,530	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	2/7/2011	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	1/30/2012	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	3/9/2010	EH	Oxidation Reduction Potential	148	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	6/28/2010	EH	Oxidation Reduction Potential	96	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	9/19/2010	EH	Oxidation Reduction Potential	104	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	2/7/2011	EH	Oxidation Reduction Potential	180	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	3/10/2011	EH	Oxidation Reduction Potential	101	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	6/2/2011	EH	Oxidation Reduction Potential	120	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	8/31/2011	EH	Oxidation Reduction Potential	151	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	3/21/2012	EH	Oxidation Reduction Potential	286	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	6/20/2012	EH	Oxidation Reduction Potential	80	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	9/18/2012	EH	Oxidation Reduction Potential	203	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	3/19/2013	EH	Oxidation Reduction Potential	239	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	6/4/2013	EH	Oxidation Reduction Potential	211	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-8.5A	AT	3/9/2010	PH	pH Measurement	7.96	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	6/28/2010	PH	pH Measurement	7.73	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	9/19/2010	PH	pH Measurement	7.55	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	2/7/2011	PH	pH Measurement	6.72	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	3/10/2011	PH	pH Measurement	6.99	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	6/2/2011	PH	pH Measurement	7.77	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	8/31/2011	PH	pH Measurement	7.76	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	1/30/2012	PH	pH Measurement	7.87	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	3/21/2012	PH	pH Measurement	8.03	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	6/20/2012	PH	pH Measurement	7.63	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	9/18/2012	PH	pH Measurement	7.99	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	3/19/2013	PH	pH Measurement	8.24	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	6/4/2013	PH	pH Measurement	7.9	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-8.5A	AT	2/7/2011	9/7/7440	Potassium	923	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	9/7/7440	Potassium	926	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	9/7/7440	Potassium	1,070	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	9/7/7440	Potassium	976	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	2/7/2011	7440-23-5	Sodium	2,120	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-23-5	Sodium	2,140	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-23-5	Sodium	2,500	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-23-5	Sodium	2,470	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	3/9/2010	CONDUCT	Specific Conductance	160	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	6/28/2010	CONDUCT	Specific Conductance	148.6	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	9/19/2010	CONDUCT	Specific Conductance	148	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	2/7/2011	CONDUCT	Specific Conductance	148	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	3/10/2011	CONDUCT	Specific Conductance	149	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	6/2/2011	CONDUCT	Specific Conductance	185	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	8/31/2011	CONDUCT	Specific Conductance	163	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	1/30/2012	CONDUCT	Specific Conductance	159	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	3/21/2012	CONDUCT	Specific Conductance	188	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	6/20/2012	CONDUCT	Specific Conductance	196	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	9/18/2012	CONDUCT	Specific Conductance	140	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	3/19/2013	CONDUCT	Specific Conductance	190	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	6/4/2013	CONDUCT	Specific Conductance	146	µS/cm	N		P		FIELD	CONDUCT_FLD
N116mArray-8.5A	AT	2/7/2011	7440-24-6	Strontium	84	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-24-6	Strontium	87	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-24-6	Strontium	98.8	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-24-6	Strontium	95.8	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	10098-97-2	Strontium-90	81	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-8.5A	AT	1/30/2012	10098-97-2	Strontium-90	64	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	2/7/2011	14808-79-8	Sulfate	9,670	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	1/30/2012	14808-79-8	Sulfate	12,400	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-8.5A	AT	3/9/2010	TEMPERATURE	Temperature	6.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	6/28/2010	TEMPERATURE	Temperature	16.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	9/19/2010	TEMPERATURE	Temperature	18.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	2/7/2011	TEMPERATURE	Temperature	8.9	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	3/10/2011	TEMPERATURE	Temperature	8.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	6/2/2011	TEMPERATURE	Temperature	12.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	8/31/2011	TEMPERATURE	Temperature	23.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	1/30/2012	TEMPERATURE	Temperature	12.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	3/21/2012	TEMPERATURE	Temperature	12.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	6/20/2012	TEMPERATURE	Temperature	18.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	9/18/2012	TEMPERATURE	Temperature	23.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	3/19/2013	TEMPERATURE	Temperature	18.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	6/4/2013	TEMPERATURE	Temperature	26.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-8.5A	AT	3/9/2010	TURBIDITY	Turbidity	1.79	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	6/28/2010	TURBIDITY	Turbidity	0.86	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	9/19/2010	TURBIDITY	Turbidity	1.96	NTU	N				FIELD	TURBIDITY_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-8.5A	AT	2/7/2011	TURBIDITY	Turbidity	2.95	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	3/10/2011	TURBIDITY	Turbidity	2.39	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	6/2/2011	TURBIDITY	Turbidity	0.94	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	8/31/2011	TURBIDITY	Turbidity	1.12	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	1/30/2012	TURBIDITY	Turbidity	1.02	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	3/21/2012	TURBIDITY	Turbidity	3.58	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	6/20/2012	TURBIDITY	Turbidity	2.52	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	9/18/2012	TURBIDITY	Turbidity	1.74	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	3/19/2013	TURBIDITY	Turbidity	7.53	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	6/4/2013	TURBIDITY	Turbidity	4.19	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-8.5A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-8.5A	AT	1/30/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-36-0	Antimony	47	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-36-0	Antimony	36	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-36-0	Antimony	36	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-36-0	Antimony	20	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-36-0	Antimony	20	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-38-2	Arsenic	30	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-38-2	Arsenic	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-38-2	Arsenic	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-39-3	Barium	13	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-39-3	Barium	13	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-39-3	Barium	14.5	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-39-3	Barium	13.8	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-39-3	Barium	16.3	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-39-3	Barium	14.3	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-39-3	Barium	25.7	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-39-3	Barium	22.1	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-39-3	Barium	13.4	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-39-3	Barium	14.2	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-41-7	Beryllium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-41-7	Beryllium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-41-7	Beryllium	2	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-41-7	Beryllium	2	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-43-9	Cadmium	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-43-9	Cadmium	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-70-2	Calcium	18,800	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-70-2	Calcium	18,300	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-70-2	Calcium	18,900	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-70-2	Calcium	18,500	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-70-2	Calcium	20,300	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-70-2	Calcium	19,900	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-70-2	Calcium	22,200	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-70-2	Calcium	22,600	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-70-2	Calcium	20,300	µg/L	Y	N			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-70-2	Calcium	20,500	µg/L	N	N			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	16887-00-6	Chloride	1,160	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/27/2012	16887-00-6	Chloride	1,020	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/9/2013	16887-00-6	Chloride	1,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	9/4/2013	16887-00-6	Chloride	1,040	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/31/2014	16887-00-6	Chloride	1,150	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	2/7/2011	7440-47-3	Chromium	14	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-47-3	Chromium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-47-3	Chromium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-48-4	Cobalt	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-48-4	Cobalt	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-50-8	Copper	5	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	9/4/2013	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-50-8	Copper	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-50-8	Copper	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/9/2010	DO	Dissolved oxygen	10,610	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	6/28/2010	DO	Dissolved oxygen	3,720	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	2/7/2011	DO	Dissolved oxygen	9,210	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	3/10/2011	DO	Dissolved oxygen	8,980	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	6/2/2011	DO	Dissolved oxygen	6,660	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	8/31/2011	DO	Dissolved oxygen	6,810	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	1/27/2012	DO	Dissolved oxygen	10,570	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	3/21/2012	DO	Dissolved oxygen	9,330	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	6/11/2012	DO	Dissolved oxygen	3,290	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	9/11/2012	DO	Dissolved oxygen	8,790	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	1/9/2013	DO	Dissolved oxygen	9,440	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	3/18/2013	DO	Dissolved oxygen	8,830	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	6/4/2013	DO	Dissolved oxygen	5,380	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	9/4/2013	DO	Dissolved oxygen	7,650	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	1/24/2014	DO	Dissolved oxygen	9,550	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	3/31/2014	DO	Dissolved oxygen	8,550	µg/L	N				FIELD	360.1_OXYGEN_FLD
N116mArray-9A	AT	2/7/2011	16984-48-8	Fluoride	88	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/27/2012	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/9/2013	16984-48-8	Fluoride	46	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	9/4/2013	16984-48-8	Fluoride	61.7	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/31/2014	16984-48-8	Fluoride	50	µg/L	N	UD			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	9/4/2013	12587-46-1	Gross alpha	-0.42	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-9A	AT	3/31/2014	12587-46-1	Gross alpha	0.098	pCi/L	N	U			WSCF	ALPHA_GPC
N116mArray-9A	AT	3/9/2010	12587-47-2	Gross beta	380	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	6/28/2010	12587-47-2	Gross beta	260	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	2/7/2011	12587-47-2	Gross beta	350	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	3/10/2011	12587-47-2	Gross beta	220	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	6/2/2011	12587-47-2	Gross beta	330	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	8/31/2011	12587-47-2	Gross beta	410	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	1/27/2012	12587-47-2	Gross beta	320	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	3/21/2012	12587-47-2	Gross beta	420	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	6/11/2012	12587-47-2	Gross beta	370	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	9/11/2012	12587-47-2	Gross beta	450	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	1/9/2013	12587-47-2	Gross beta	300	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	3/18/2013	12587-47-2	Gross beta	410	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	6/4/2013	12587-47-2	Gross beta	320	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	9/4/2013	12587-47-2	Gross beta	360	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	1/24/2014	12587-47-2	Gross beta	370	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	3/31/2014	12587-47-2	Gross beta	390	pCi/L	N				WSCF	BETA_GPC
N116mArray-9A	AT	2/7/2011	7439-89-6	Iron	59	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7439-89-6	Iron	39	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7439-89-6	Iron	19	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7439-89-6	Iron	23.4	µg/L	Y	BC			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7439-89-6	Iron	97.2	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7439-89-6	Iron	19	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7439-89-6	Iron	216	µg/L	N	C			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7439-89-6	Iron	20	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	3/31/2014	7439-89-6	Iron	40	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-89-6	Iron	40	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-92-1	Lead	25	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-92-1	Lead	25	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7439-95-4	Magnesium	4,290	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7439-95-4	Magnesium	4,170	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7439-95-4	Magnesium	4,380	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7439-95-4	Magnesium	4,300	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7439-95-4	Magnesium	4,950	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7439-95-4	Magnesium	4,820	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7439-95-4	Magnesium	5,010	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7439-95-4	Magnesium	5,090	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-95-4	Magnesium	4,710	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-95-4	Magnesium	4,750	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7439-96-5	Manganese	6	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7439-96-5	Manganese	11.5	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-96-5	Manganese	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-96-5	Manganese	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-98-7	Molybdenum	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7439-98-7	Molybdenum	4	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-02-0	Nickel	4.6	µg/L	N	BC			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-02-0	Nickel	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-02-0	Nickel	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-02-0	Nickel	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-02-0	Nickel	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-02-0	Nickel	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	14797-55-8	Nitrate	877	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/27/2012	14797-55-8	Nitrate	1,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/9/2013	14797-55-8	Nitrate	841	µg/L	N	BD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	9/4/2013	14797-55-8	Nitrate	1,970	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/31/2014	14797-55-8	Nitrate	1,160	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	2/7/2011	14797-65-0	Nitrite	118	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/27/2012	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/9/2013	14797-65-0	Nitrite	125	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	9/4/2013	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/31/2014	14797-65-0	Nitrite	131	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/9/2010	EH	Oxidation Reduction Potential	145	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	6/28/2010	EH	Oxidation Reduction Potential	184	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	2/7/2011	EH	Oxidation Reduction Potential	274	mV	N				FIELD	REDOX_PROBE_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	3/10/2011	EH	Oxidation Reduction Potential	112	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	6/2/2011	EH	Oxidation Reduction Potential	206	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	8/31/2011	EH	Oxidation Reduction Potential	151	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	1/27/2012	EH	Oxidation Reduction Potential	119	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	3/21/2012	EH	Oxidation Reduction Potential	303	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	6/11/2012	EH	Oxidation Reduction Potential	263	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	9/11/2012	EH	Oxidation Reduction Potential	62	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	1/9/2013	EH	Oxidation Reduction Potential	242	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	3/18/2013	EH	Oxidation Reduction Potential	289	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	6/4/2013	EH	Oxidation Reduction Potential	234	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	9/4/2013	EH	Oxidation Reduction Potential	67	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	1/24/2014	EH	Oxidation Reduction Potential	153	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	3/31/2014	EH	Oxidation Reduction Potential	284	mV	N				FIELD	REDOX_PROBE_FLD
N116mArray-9A	AT	3/9/2010	PH	pH Measurement	7.48	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	6/28/2010	PH	pH Measurement	7.13	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	2/7/2011	PH	pH Measurement	6.35	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	3/10/2011	PH	pH Measurement	7.97	unitless	N				FIELD	PH_ELECT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	6/2/2011	PH	pH Measurement	8.05	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	8/31/2011	PH	pH Measurement	7.45	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	1/27/2012	PH	pH Measurement	7.51	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	3/21/2012	PH	pH Measurement	7.71	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	6/11/2012	PH	pH Measurement	7.46	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	9/11/2012	PH	pH Measurement	7.48	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	1/9/2013	PH	pH Measurement	7.7	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	3/18/2013	PH	pH Measurement	7.78	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	6/4/2013	PH	pH Measurement	8.04	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	9/4/2013	PH	pH Measurement	7.45	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	1/24/2014	PH	pH Measurement	7.77	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	3/31/2014	PH	pH Measurement	8.11	unitless	N				FIELD	PH_ELECT_FLD
N116mArray-9A	AT	9/4/2013	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/31/2014	14265-44-2	Phosphate	307	µg/L	N	UD			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	2/7/2011	9/7/7440	Potassium	724	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	9/7/7440	Potassium	775	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	9/7/7440	Potassium	754	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	9/7/7440	Potassium	749	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	9/7/7440	Potassium	769	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	9/7/7440	Potassium	770	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	9/7/7440	Potassium	1,150	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	9/7/7440	Potassium	1,160	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	9/7/7440	Potassium	752	µg/L	Y	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	9/7/7440	Potassium	758	µg/L	N	B			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	Y	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	2/7/2011	7440-22-4	Silver	7	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-22-4	Silver	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-22-4	Silver	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-22-4	Silver	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-23-5	Sodium	2,110	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-23-5	Sodium	2,070	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-23-5	Sodium	2,340	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-23-5	Sodium	2,260	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-23-5	Sodium	2,280	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-23-5	Sodium	2,260	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-23-5	Sodium	2,860	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-23-5	Sodium	2,920	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-23-5	Sodium	2,330	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-23-5	Sodium	2,350	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/9/2010	CONDUCT	Specific Conductance	145	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	6/28/2010	CONDUCT	Specific Conductance	135.6	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	2/7/2011	CONDUCT	Specific Conductance	140	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	3/10/2011	CONDUCT	Specific Conductance	143	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	6/2/2011	CONDUCT	Specific Conductance	144	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	8/31/2011	CONDUCT	Specific Conductance	144	µS/cm	N				FIELD	CONDUCT_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	1/27/2012	CONDUCT	Specific Conductance	134.7	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	3/21/2012	CONDUCT	Specific Conductance	146	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	6/11/2012	CONDUCT	Specific Conductance	143	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	9/11/2012	CONDUCT	Specific Conductance	153	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	1/9/2013	CONDUCT	Specific Conductance	144	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	3/18/2013	CONDUCT	Specific Conductance	152	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	6/4/2013	CONDUCT	Specific Conductance	140	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	9/4/2013	CONDUCT	Specific Conductance	155	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	1/24/2014	CONDUCT	Specific Conductance	130	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	3/31/2014	CONDUCT	Specific Conductance	142	µS/cm	N				FIELD	CONDUCT_FLD
N116mArray-9A	AT	2/7/2011	7440-24-6	Strontium	79	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-24-6	Strontium	77	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-24-6	Strontium	78.4	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-24-6	Strontium	79	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-24-6	Strontium	80.1	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-24-6	Strontium	78.9	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-24-6	Strontium	86.8	µg/L	Y				WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-24-6	Strontium	86.8	µg/L	N				WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	10098-97-2	Strontium-90	190	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-9A	AT	1/27/2012	10098-97-2	Strontium-90	180	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-9A	AT	1/9/2013	10098-97-2	Strontium-90	160	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-9A	AT	9/4/2013	10098-97-2	Strontium-90	230	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-9A	AT	3/31/2014	10098-97-2	Strontium-90	210	pCi/L	N				WSCF	SRTOT_SEP_PRECIP_GPC
N116mArray-9A	AT	2/7/2011	14808-79-8	Sulfate	9,420	µg/L	N	D			WSCF	300.0_ANIONS_IC

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	1/27/2012	14808-79-8	Sulfate	9,100	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	1/9/2013	14808-79-8	Sulfate	8,980	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	9/4/2013	14808-79-8	Sulfate	9,200	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/31/2014	14808-79-8	Sulfate	9,710	µg/L	N	D			WSCF	300.0_ANIONS_IC
N116mArray-9A	AT	3/9/2010	TEMPERATURE	Temperature	6.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	6/28/2010	TEMPERATURE	Temperature	15.8	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	2/7/2011	TEMPERATURE	Temperature	6.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	3/10/2011	TEMPERATURE	Temperature	5.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	6/2/2011	TEMPERATURE	Temperature	11.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	8/31/2011	TEMPERATURE	Temperature	19.6	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	1/27/2012	TEMPERATURE	Temperature	5.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	3/21/2012	TEMPERATURE	Temperature	7.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	6/11/2012	TEMPERATURE	Temperature	14.4	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	9/11/2012	TEMPERATURE	Temperature	14.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	1/9/2013	TEMPERATURE	Temperature	8.2	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	3/18/2013	TEMPERATURE	Temperature	10.5	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	6/4/2013	TEMPERATURE	Temperature	16.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	9/4/2013	TEMPERATURE	Temperature	23.5	Deg C	N				FIELD	TEMP_FLD

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	1/24/2014	TEMPERATURE	Temperature	5.3	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	3/31/2014	TEMPERATURE	Temperature	8.1	Deg C	N				FIELD	TEMP_FLD
N116mArray-9A	AT	3/31/2014	TPHDIESEL	Total petroleum hydrocarbons - diesel range	80	µg/L	N	U			WSCF	WTPH_DIESEL
N116mArray-9A	AT	3/9/2010	TURBIDITY	Turbidity	0.74	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	6/28/2010	TURBIDITY	Turbidity	0.59	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	2/7/2011	TURBIDITY	Turbidity	1.28	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	3/10/2011	TURBIDITY	Turbidity	1.58	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	6/2/2011	TURBIDITY	Turbidity	2.17	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	8/31/2011	TURBIDITY	Turbidity	3.63	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	1/27/2012	TURBIDITY	Turbidity	2.21	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	3/21/2012	TURBIDITY	Turbidity	0.87	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	6/11/2012	TURBIDITY	Turbidity	1.42	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	9/11/2012	TURBIDITY	Turbidity	0.69	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	1/9/2013	TURBIDITY	Turbidity	0.37	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	3/18/2013	TURBIDITY	Turbidity	0.29	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	6/4/2013	TURBIDITY	Turbidity	0.52	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	9/4/2013	TURBIDITY	Turbidity	0.35	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	1/24/2014	TURBIDITY	Turbidity	0.78	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	3/31/2014	TURBIDITY	Turbidity	2.89	NTU	N				FIELD	TURBIDITY_FLD
N116mArray-9A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-62-2	Vanadium	17	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP

Table A2-12. Monitoring Well and Aquifer Tube Sample Data for Untreated Portions of the Apatite Permeable Reactive Barrier

Well Name	Type	Sample Date	Chemical Abstracts Service No.	Constituent Name	Value	Units	Filter Flag	Lab Qualifier	Review Qualifier	Validation Qualifier	Lab	Analytical Method
N116mArray-9A	AT	1/9/2013	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-62-2	Vanadium	10	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-62-2	Vanadium	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-62-2	Vanadium	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	2/7/2011	7440-66-6	Zinc	4	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/27/2012	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	1/9/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	9/4/2013	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-66-6	Zinc	5	µg/L	Y	U			WSCF	6010_METALS_ICP
N116mArray-9A	AT	3/31/2014	7440-66-6	Zinc	5	µg/L	N	U			WSCF	6010_METALS_ICP

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Insert A3

Sampling Interval Information for Wells and Aquifer Tubes within the 100-NR-2 Groundwater Operable Unit

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Table

Table A3-1. Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit.....1

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A3.1 Introduction

This appendix provides and defines the saturated interval(s) within the aquifer system at the 100-NR-2 Operable Unit (OU) that is being monitored by the network. Variations in well construction over the years (e.g., screen placement depth and overall screen length) within the unconfined and select confined aquifer wells can create differences in the groundwater sample data results. The monitoring network defined herein has been reviewed to determine and select best available wells to consistently interpret the groundwater chemistry results. Sampling interval information for the wells within the 100-NR-2 Groundwater OU is provided in Table A3-1 and includes the following:

- Well name/aquifer tube name or identification number
- Aquifer interval monitored what defines which portion of the unconfined or confined aquifer is being monitored
- Elevation at the top of the screen or perforated interval
- Elevation at the bottom of the screen or perforated interval
- Open interval length (i.e., difference between elevations of top and bottom of the screen or perforated interval)
- Water level elevation
- Saturated thickness of the open sample interval at the time of the most recent water level measurement
- Water level date (i.e., date of water level elevation)

Table A3-1. Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation		Open Interval Length (m)	Water Level Elevation (m NAVD88)	Screen Open to Aquifer (m)	Water Level Date
		Top of Open Interval (m NAVD88)	Bottom of Open Interval (m NAVD88)				
199-N-3	TU	130.68	112.09	18.59	117.97	5.88	10/3/2014
199-N-14	TU	125.50	115.44	10.06	117.91	2.47	10/3/2014
199-N-19	TU	135.88	115.76	20.12	117.87	2.11	10/3/2014
199-N-21	TU	136.80	116.81	19.99	117.99	1.18	10/3/2014
199-N-27	TU	128.31	117.03	11.27	117.07	0.04	10/3/2014
199-N-28	TU	128.35	117.38	10.97	119.19	1.82	10/3/2014
199-N-34	TU	130.91	117.50	13.41	119.03	1.53	10/3/2014
199-N-41	TU	124.50	118.41	6.10	118.29	-0.11	10/3/2014
199-N-46	TU	122.20	116.41	5.79	118.91	2.50	3/20/2014
199-N-50	TU	122.31	116.21	6.1	117.90	1.69	10/3/2014

Table A3-1. Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation		Open Interval Length (m)	Water Level Elevation (m NAVD88)	Screen Open to Aquifer (m)	Water Level Date
		Top of Open Interval (m NAVD88)	Bottom of Open Interval (m NAVD88)				
199-N-51	TU	121.94	115.85	6.1	117.76	1.92	10/3/2014
199-N-56	TU	122.82	118.25	4.57	118.37	0.12	10/3/2014
199-N-57	TU	123.02	118.45	4.57	118.90	0.45	10/3/2014
199-N-64	TU	123.30	118.72	4.57	119.29	0.57	9/2/2014
199-N-67	TU	122.48	117.75	4.72	118.44	0.69	10/3/2014
199-N-72	TU	122.26	115.93	6.33	119.06	3.1	10/3/2014
199-N-73	TU	122.23	115.98	6.25	119.22	3.24	10/3/2014
199-N-75	TU	120.66	114.53	6.12	118.71	4.18	10/3/2014
199-N-76	TU	120.23	114.14	6.1	117.79	3.64	10/3/2014
199-N-77	LU	114.23	111.19	3.04	118.79	3.04	03/10/14
199-N-80	Confined aquifer	106.81	103.77	3.04	117.65	3.04	10/3/2014
199-N-81	TU	120.82	114.79	6.03	118.80	4.02	10/3/2014
199-N-92A	TU	121.88	112.73	9.1	117.58	4.84	10/3/2014
199-N-96A	TU	119.22	110.38	8.84	117.64	7.26	10/3/2014
199-N-99A	TU	119.06	112.97	6.1	117.54	4.57	10/3/2014
199-N-103A	TU	120.35	111.21	9.1	118.00	6.80	10/3/2014
199-N-104A	TU	122.71	115.09	7.62	119.18	4.09	10/3/2014
199-N-105A	TU	119.04	111.42	7.62	118.05	6.63	10/3/2014
199-N-122	TU	120.18	114.13	6.05	117.64	3.51	10/3/2014
199-N-123	TU	120.05	113.97	6.09	120.03	6.07	6/4/2014
199-N-136	TU	119.93	114.75	5.18	No data	No data	No data
199-N-146	TU	120.28	115.09	5.18	117.604	2.5	10/3/2014
199-N-147	TU	120.11	114.	5.18	117.644	2.72	10/3/2014
199-N-159	TU	116.83	114.69	2.13	No data	No data	No data
199-N-167	TU	124.57	116.96	7.61	119.40	2.44	6/17/2014
199-N-169	TU	124.46	116.86	7.60	119.40	2.53	6/17/2014
199-N-171	TU	124.26	116.67	7.59	119.36	2.69	6/17/2014

Table A3-1. Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation		Open Interval Length (m)	Water Level Elevation (m NAVD88)	Screen Open to Aquifer (m)	Water Level Date
		Top of Open Interval (m NAVD88)	Bottom of Open Interval (m NAVD88)				
199-N-172	TU	123.14	117.05	6.09	119.28	2.23	6/17/2014
199-N-173	TU	120.38	115.81	4.60	117.64	1.83	9/11/2014
199-N-182	LU	115.57	109.48	6.10	118.47	6.10	9/15/2014
199-N-183	TU	120.84	114.74	6.10	118.04	3.3	9/16/2014
199-N-184	TU	122.44	116.32	6.13	118.64	2.3	9/9/2014
199-N-185	TU	110.95	109.43	1.52	117.53	1.52	9/11/2014
199-N-186	TU	121.22	115.13	6.10	118.39	3.26	11/12/2014
199-N-187	TU	121.27	115.17	6.10	118.22	3.04	11/12/2014
199-N-188	TU	121.58	115.49	6.10	118.901	3.41	11/13/2014
199-N-200	TU	120.39	118.86	1.52	No data	No data	No data
199-N-201	TU	118.12	115.99	2.13	No data	No data	No data
199-N-210	TU	120.43	118.89	1.53	No data	No data	No data
199-N-211	TU	118.25	116.12	2.13	No data	No data	No data
199-N-229	TU	117.88	115.75	2.13	No data	No data	No data
199-N-230	TU	120.13	118.60	1.52	No data	No data	No data
199-N-247	TU	119.21	117. 69	1.52	No data	No data	No data
199-N-248	TU	116.95	114.81	2.13	No data	No data	No data
199-N-268	TU	116.58	114.45	2.13	118.64	21.3	3/27/2014
199-N-269	TU	118.79	117.27	1.52	118.62	1.35	3/27/2014
199-N-280	TU	116.21	114.08	2.13	118.63	21.3	3/27/2014
199-N-281	TU	118.40	116.87	1.52	118.58	1.52	3/27/2014
199-N-297	TU	118.90	117.38	1.52	118.79	1.42	3/26/2014
199-N-298	TU	116.75	114.61	2.13	118.80	2.13	3/26/2014
199-N-315	TU	118.91	117.39	1.52	118.71	1.32	3/26/2014
199-N-316	TU	116.42	114.29	2.13	118.68	2.14	3/26/2014
199-N-332	TU	116.86	114.72	2.13	No data	NA	No data
199-N-333	TU	119.18	117.65	1.52	No data	NA	No data
199-N-342	TU	116.99	114.86	2.12	No data	NA	No data

Table A3-1. Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation		Open Interval Length (m)	Water Level Elevation (m NAVD88)	Screen Open to Aquifer (m)	Water Level Date
		Top of Open Interval (m NAVD88)	Bottom of Open Interval (m NAVD88)				
199-N-343	TU	119.21	117.68	1.52	No data	NA	No data
199-N-346	TU	118.31	116.17	2.13	No data	NA	No data
199-N-347	TU	117.84	115.71	2.13	117.43	1.72	9/10/2014
199-N-348	TU	117.86	115.72	2.13	119.88	2.13	6/5/2014
199-N-349	TU	117.83	115.70	2.13	119.81	2.13	6/5/2014
199-N-350	TU	116.92	114.79	2.13	119.80	2.13	6/5/2014
199-N-351	TU	116.99	114.87	2.12	119.78	2.13	6/5/2014
199-N-352	TU	116.76.	114.63	2.13	119.70	2.13	6/5/2014
199-N-353	TU	116.51	114.38	2.13	119.77	2.13	6/5/2014
199-N-354	TU	116.48	114.35	2.13	No data	No data	No data
199-N-355	TU	116.51	114.37	2.13	No data	No data	No data
199-N-356	TU	116.77	114.64	2.13	No data	No data	No data
199-N-357	TU	116.37	114.23	2.13	No data	No data	No data
199-N-358	TU	116.30	114.17	2.13	No data	No data	No data
199-N-359	TU	116.59.	114.46	2.13	No data	No data	No data
199-N-360	TU	116.68	114.55	2.13	No data	No data	No data
199-N-361	TU	116.60	114.46	2.13	No data	No data	No data
199-N-362	TU	116.65	114.51	2.13	No data	No data	No data
199-N-363	TU	116.57	114.44	2.13	No data	No data	No data
199-N-364	TU	116.48	114.35	2.13	No data	No data	No data
199-N-365	TU	116.68	114.55	2.13	No data	No data	No data
199-N-366	TU	116.88	114.75	2.13	No data	No data	No data
199-N-367	TU	116.96	114.83	2.13	No data	No data	No data
199-N-371	TU	NA	NA	NA	NA	NA	NA
199-N-372	TU	NA	NA	NA	NA	NA	NA
199-N-373	TU	NA	NA	NA	NA	NA	NA
199-N-374	TU	NA	NA	NA	NA	NA	NA

Table A3-1. Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation		Open Interval Length (m)	Water Level Elevation (m NAVD88)	Screen Open to Aquifer (m)	Water Level Date
		Top of Open Interval (m NAVD88)	Bottom of Open Interval (m NAVD88)				
199-N-376	LU	NA	NA	NA	NA	NA	NA
199-N-377	TU	NA	NA	NA	NA	NA	NA
APT1	TU	NA data	No data	0.15	No data	No data	No data
APT5	TU	No data	No data	0.15	No data	No data	No data
C6132	TU	No data	No data	0.15	No data	No data	No data
C6135	TU	No data	No data	0.15	No data	No data	No data
C6136	TU	No data	No data	0.15	No data	No data	No data
C6317	TU	No data	No data	0.15	No data	No data	No data
C6318	TU	No data	No data	0.15	No data	No data	No data
C6319	TU	No data	No data	0.15	No data	No data	No data
C6320	TU	No data	No data	0.15	No data	No data	No data
C6324	TU	No data	No data	0.15	No data	No data	No data
C7934	TU	No data	No data	0.15	No data	No data	No data
C7935	TU	No data	No data	0.15	No data	No data	No data
C7936	TU	No data	No data	0.15	No data	No data	No data
C7937	TU	No data	No data	0.15	No data	No data	No data
C7938	TU	No data	No data	0.15	No data	No data	No data
C7939	TU	No data	No data	0.15	No data	No data	No data
C7881	TU	No data	No data	0.15	No data	No data	No data
N116mArray-0A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-2A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-3A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-4A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-6A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-8A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-9A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-10A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-11A	TU	No data	No data	0.15	No data	No data	No data

Table A3-1. Sampling Interval Information for Wells and Aquifer Tubes Within the 100-NR-2 Groundwater Operable Unit

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation		Open Interval Length (m)	Water Level Elevation (m NAVD88)	Screen Open to Aquifer (m)	Water Level Date
		Top of Open Interval (m NAVD88)	Bottom of Open Interval (m NAVD88)				
N116mArray-13A	TU	No data	No data	0.15	No data	No data	No data
N116mArray-15A	TU	No data	No data	0.15	No data	No data	No data
NVP2-116.0	TU	No data	No data	0.15	No data	No data	No data

LU = lower unconfined
NA = not available (planned well or aquifer tube)
TU = top of unconfined

A3.2 Reference

NAVD88, 1988, *North American Vertical Datum of 1988*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.