DOE/RL-2009-32
Revision 0

100-NR-2 Groundwater Operable Unit Sr-90 Plume Riversho re Sampling and Analysis Plan

Date Published
June 2009

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

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

Release Approval Date 06/18/2009

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Approval Page

Title: DOE/RL-2009-32, *100-NR-2 Groundwater Operable Unit Sr-90 Plume Rivershore Sampling and Analysis Plan*

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Terms

ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTR	buyer's technical representative
CAS	Chemical Abstract Services
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CHPRC	CH2M HILL Plateau Remediation Company
COC	chain of custody
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
ECO	environmental compliance officer
Ecology	Washington State Department of Ecology
EDS	energy dispersive x-ray spectroscopy
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSR	Field Sampling Report
FTR	field technical representative
HEIS	Hanford Environmental Information System
ICP	ion chromatography
ID	identification
LWDF	liquid waste disposal facility
N/A	not applicable
NPL	National Priorities List
OU	operable unit

PNNL	Pacific Northwest National Laboratory
POC	point-of-contact
PRB	permeable reactive barrier
PVC	polyvinyl chloride
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
RDL	required detection limit
RL	U.S. Department of Energy, Richland Operations Office
ROD	Record of Decision
RPD	relative percent difference
SAF	Sample Authorization Form
SAP	sampling and analysis plan
SDT	sampling and data tracking
SEM	scanning electron microscope
TPH	total petroleum hydrocarbon
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
WAC	*Washington Administrative Code*
WSCF	Waste Sampling and Characterization Facility
XRD	x-ray diffraction
XRF	x-ray fluorescence

1 Introduction

This sampling and analysis plan (SAP) supports characterization of the 100-NR-2 Groundwater Operable Unit (OU) Sr-90 plume along the Columbia River shoreline. The resulting groundwater data will be used to determine the extent of the 100-NR-2 Sr-90 plume. Three of the wells in this SAP will also be used to determine the effectiveness of an apatite barrier for immobilizing Sr-90 in groundwater, through collection of core samples for laboratory analysis. The wells installed through this SAP may serve multiple purposes in future remedial activities.

1.1 Background

The Hanford Site is a U.S. Department of Energy (DOE) site located in southeastern Washington State near Richland, Washington (Figure 1-1). The 100-N Area is located along the Columbia River and includes nine DOE nuclear reactors previously used for plutonium production, one of which is the 100-N Reactor.

The operation of the 100-N Area nuclear reactor required the disposal of bleed and feed cooling water from the reactor's primary cooling loop, the spent fuel storage basins, and other reactor-related sources. Two crib and trench liquid waste disposal facilities (LWDF) were constructed to receive these waste streams, and disposal consisted of percolation into the soil. The first LWDF (1301-N) was constructed in 1963, about 244 m (800 ft) from the river. Liquid discharges to this facility contained radioactive fission and activation products, including cobalt-60, cesium-137, Sr-90, and tritium. Minor amounts of hazardous wastes such as sodium dichromate, phosphoric acid, lead, and cadmium were also part of the waste stream. When Sr-90 was detected at the shoreline, disposal at the first LWDF was terminated and a second crib and trench (1325-N LWDF) were constructed farther inland in 1983. Wastewater discharges to 1325-N ceased in 1991.

A more complete history of the groundwater contamination at 100-N can be found in the *Hanford 100-N Area Remediation Options Evaluation Summary Report* (TAG 2001). As a result of wastewater disposal practices, soils beneath the LWDFs were contaminated from the surface sediments to the lower boundary of the unconfined aquifer. A portion of the contaminants migrated to the Columbia River via groundwater. To address contamination in the 100-N Area, it was divided into two operable units (OU). The 100-NR-1 OU contains all the source waste sites located within the main industrial area around the 100-N Reactor and the Hanford Generating Plant, and includes the surface sediments and shallow subsurface soil associated with the LWDFs. Remedial activities that address the contamination in this unit are ongoing. The 100-NR-2 Groundwater OU contains the contaminated groundwater and aquifer. Figure 1-2 shows the 100-NR-2 Area, including waste sites and monitoring wells. Figure 1-3 is an inset of Figure 1-2 showing the current apatite permeable reactive barrier (PRB) location and wells.

1.2 Regulatory History

In November 1989, the U.S. Environmental Protection Agency (EPA) placed the Hanford Site, including the 100-N Area, on the National Priorities List (NPL) pursuant to the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act of 1986.*

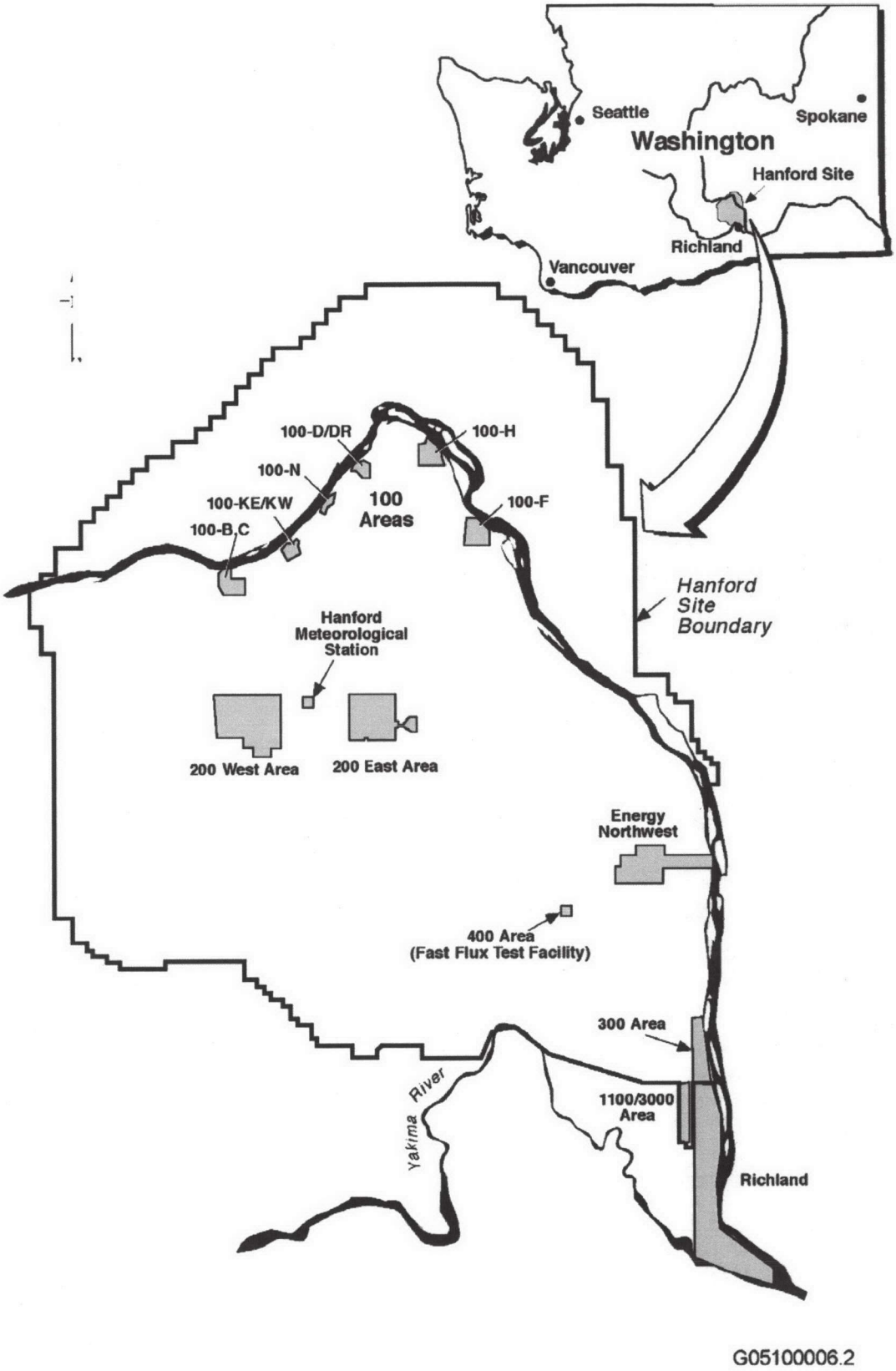

Figure 1-1. Hanford Site and Washington State

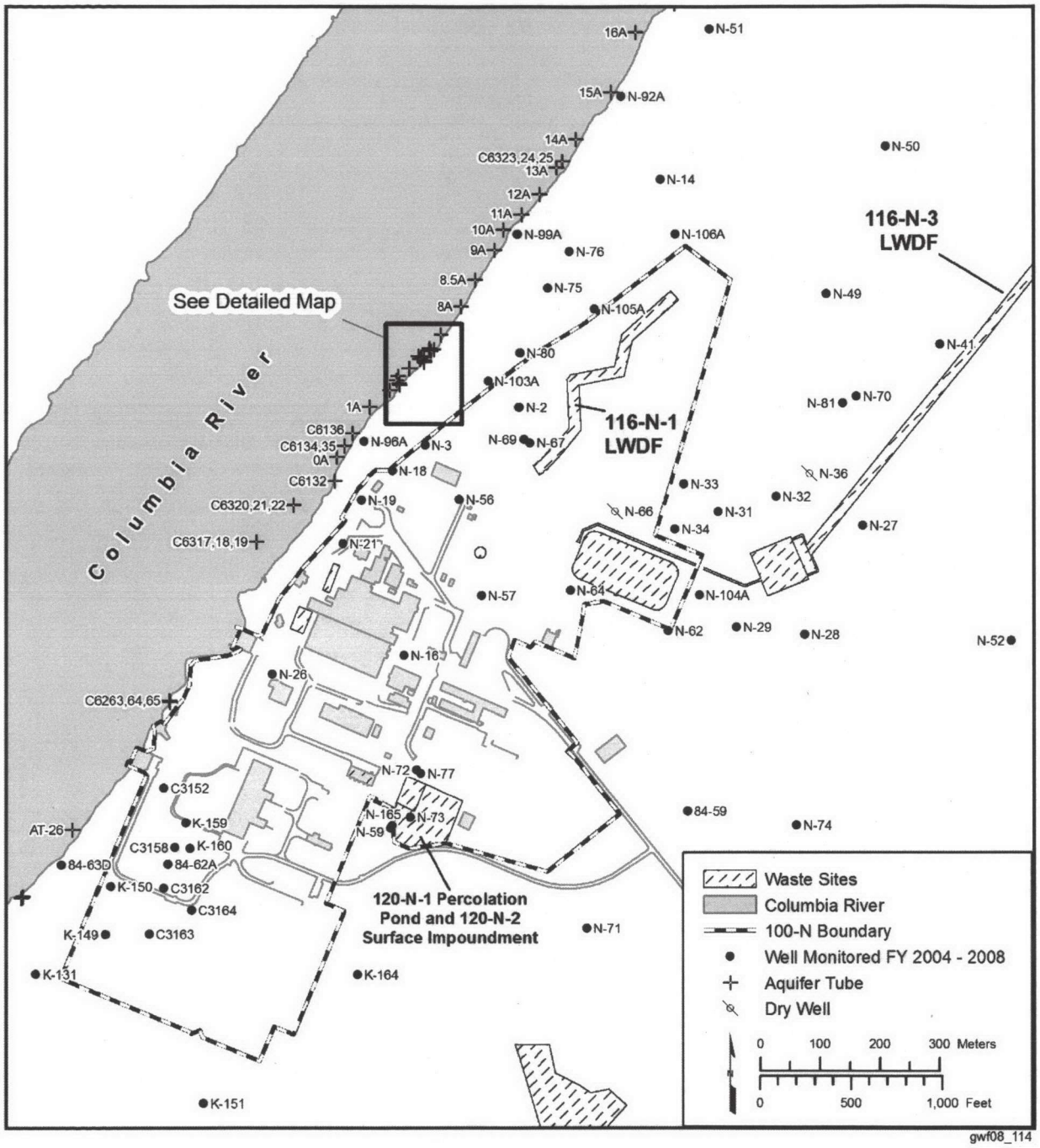

Figure 1-2. 100-NR-2 Groundwater Operable Unit

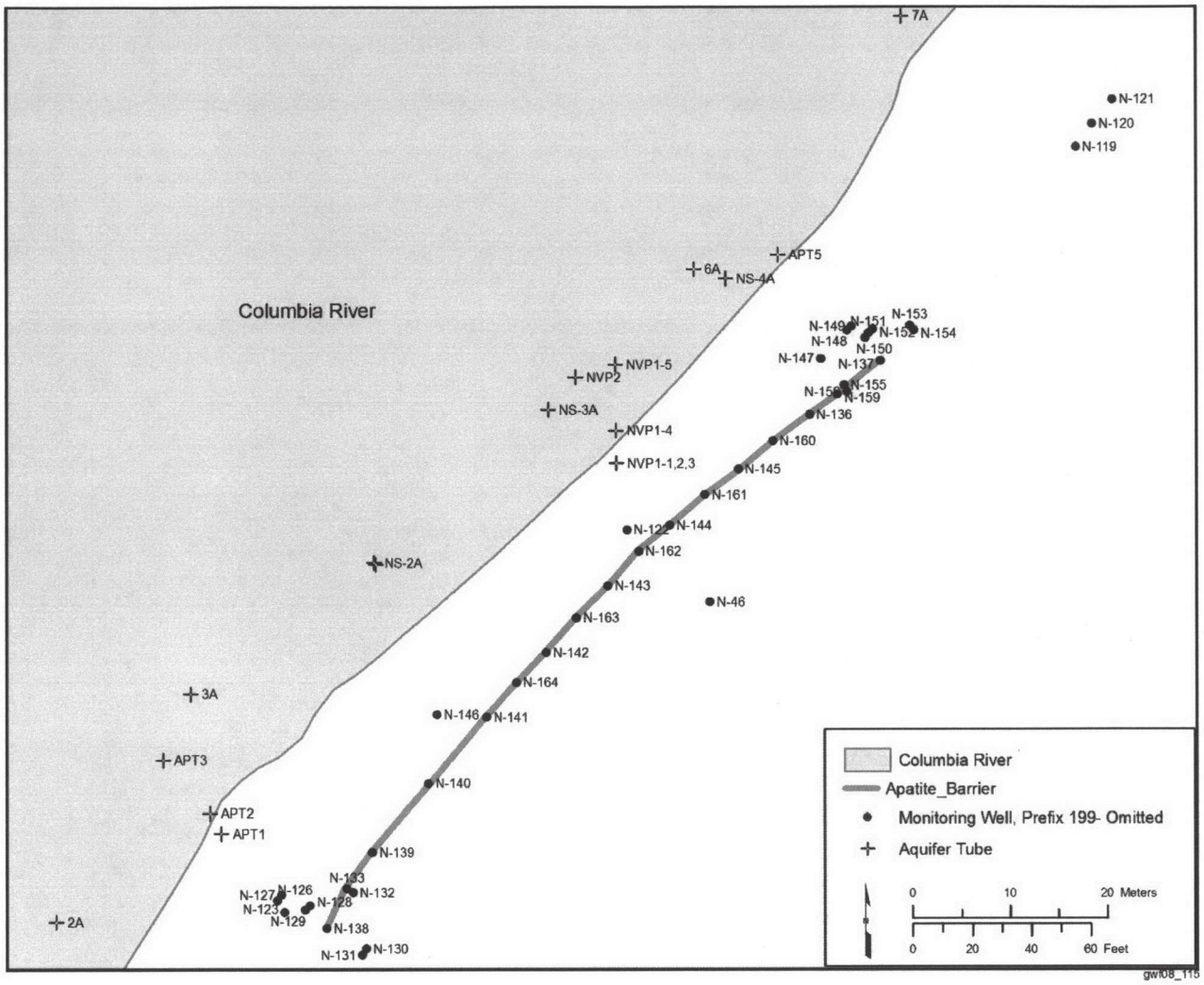

Figure 1-3. Inset of the Apatite PRB Location and Wells

Remedial investigations and feasibility studies (FSs) were conducted in the early 1990s. These efforts were specified by the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Washington State Department of Ecology [Ecology] et al. 2003), which was negotiated and approved by the Ecology, EPA, and DOE in May 1989. The Tri-Party Agreement governs all CERCLA efforts at the Hanford Site.

1.3 100-NR-2 Groundwater Operable Unit Strontium-90 Contamination

Strontium-90 was present in the liquid effluent discharged to the 116-N-1 Facility (1963 to 1985) and the 116-N-3 Facility (1983 to 1991). Both facilities were excavated to remove highly contaminated soil, and backfilled with clean soil. The vadose zone and aquifer beneath the facilities remain contaminated with Sr-90, which binds to sediment grains and is moderately mobile in groundwater.

A record of decision stipulates interim remedial action for Sr-90 in the 100-N Area (EPA/541/R-99/112). From 1995 to March 2006, a pump-and-treat system operated between the 116-N-1 Facility and the Columbia River to reduce the amount of contamination entering the river. Because Sr-90 binds to sediment, the pump-and-treat system was not effective in cleaning up the aquifer. The DOE began to implement an in situ remedial action, apatite sequestration, in 2006. Apatite-forming chemicals were injected into the aquifer during the summers of 2006, 2007, and 2008.

The size and shape of the Sr-90 plume change very little from year to year. The plume extends from beneath the 116-N-1 and 116-N-3 Facilities to the Columbia River at levels above the drinking water standard (8 pCi/L) (Figure 1-4). Concentrations exceeding 100 pCi/L are limited to the top ~3 m (10 ft) of the aquifer (PNNL-16346).

The area where the highest concentrations of Sr-90 reach the Columbia River is of special concern for remediation and monitoring. Figure 1-5 shows details of the Sr-90 plume in this region (Apatite PRB test site) in September 2008. The map shows Sr-90 concentrations were significantly affected by the recent apatite injections. Strontium-90 concentrations declined in the wells within the barrier and some downgradient wells (199-N-122 and 199-N-147).

Strontium-90 trends in monitoring well 199-N-67 near the former 116-N-1 Facility show no obvious, long-term decline in concentrations, but significant variability related to water levels (Figure 1-6). When the water table rises beneath the former waste facilities, Sr-90 from the vadose zone is mobilized and concentrations in groundwater increase. Water levels and Sr-90 concentrations in wells near the 116-N-1 Facility were high in the late 1980s, when liquid effluent was being discharged elsewhere in the 100-N Area, and declined after effluent discharges ceased in 1991. Concentrations rose again in the mid-1990s, which correlated with several years of relatively high river stage. Concentration peaks in each of the past 3 years were correlated with periods of high water table.

Figure 1-7 shows the Sr-90 trend in well 199-N-81, near the 116-N-3 Facility. Many of the variations are correlated to water level. However, the concentration increased in September 2008, while the water level dropped.

The Sr-90 contamination is limited to the upper portion of the unconfined aquifer. Wells 199-N-69 and 199-N-70, which are screened at the bottom of the unconfined aquifer, have no detectable Sr-90, while adjacent, shallow wells 199-N-67 and 199-N-81 have high concentrations (Figures 1-6 and 1-7).

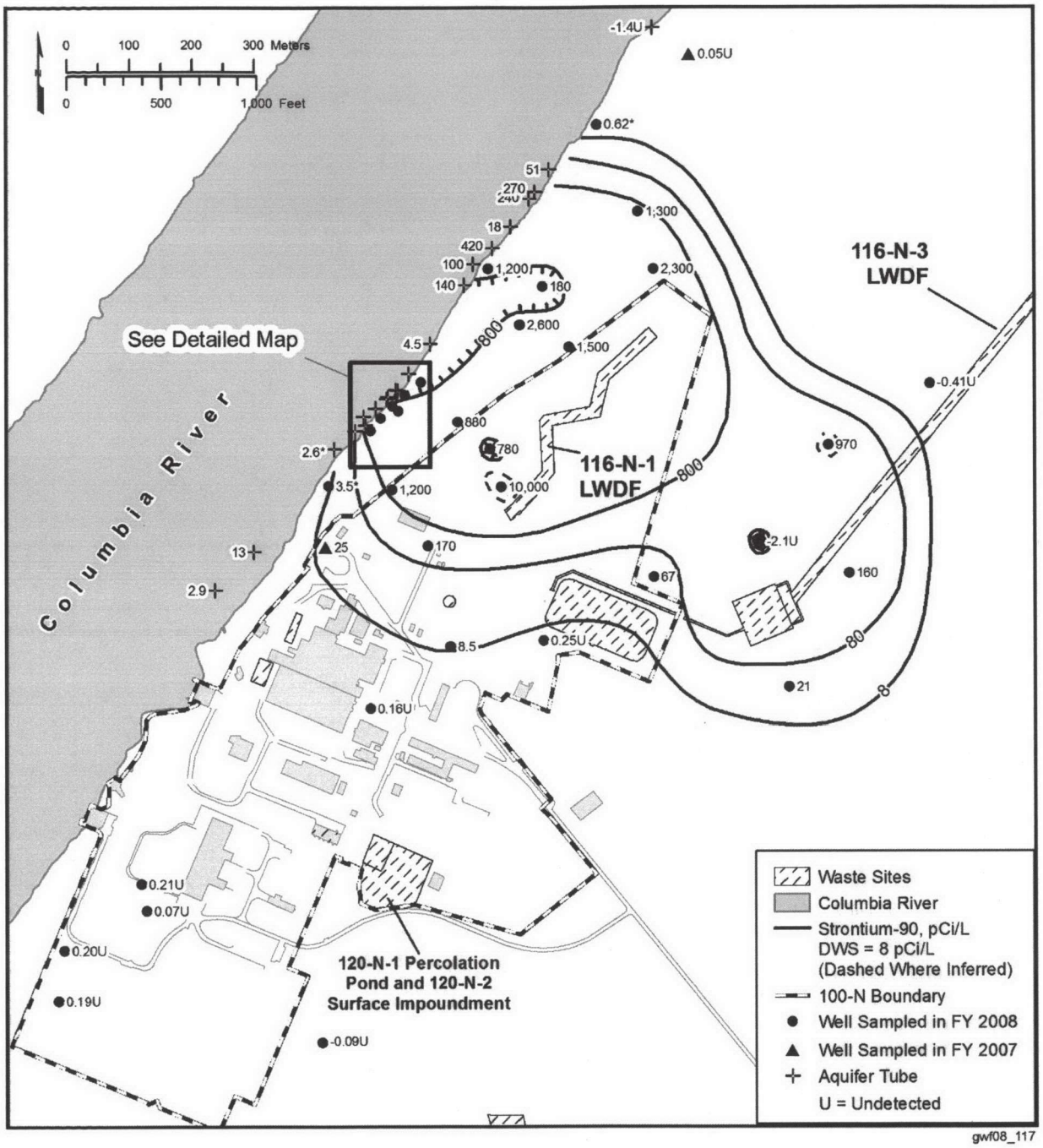

Figure 1-4. 100-NR-2 Strontium-90 Plume

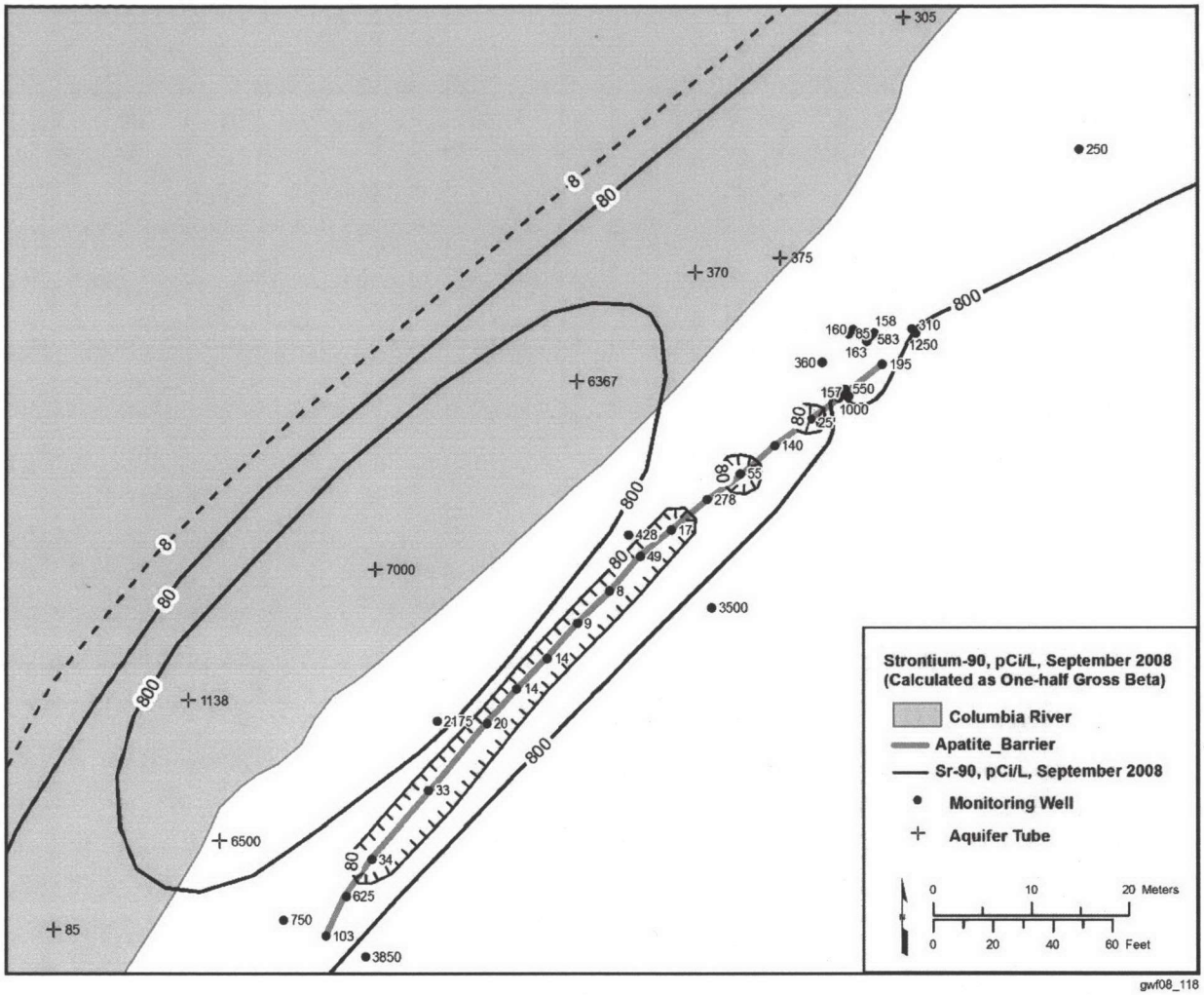

Figure 1-5. Inset of the 100-NR-2 Strontium-90 Plume, Apatite PRB Location

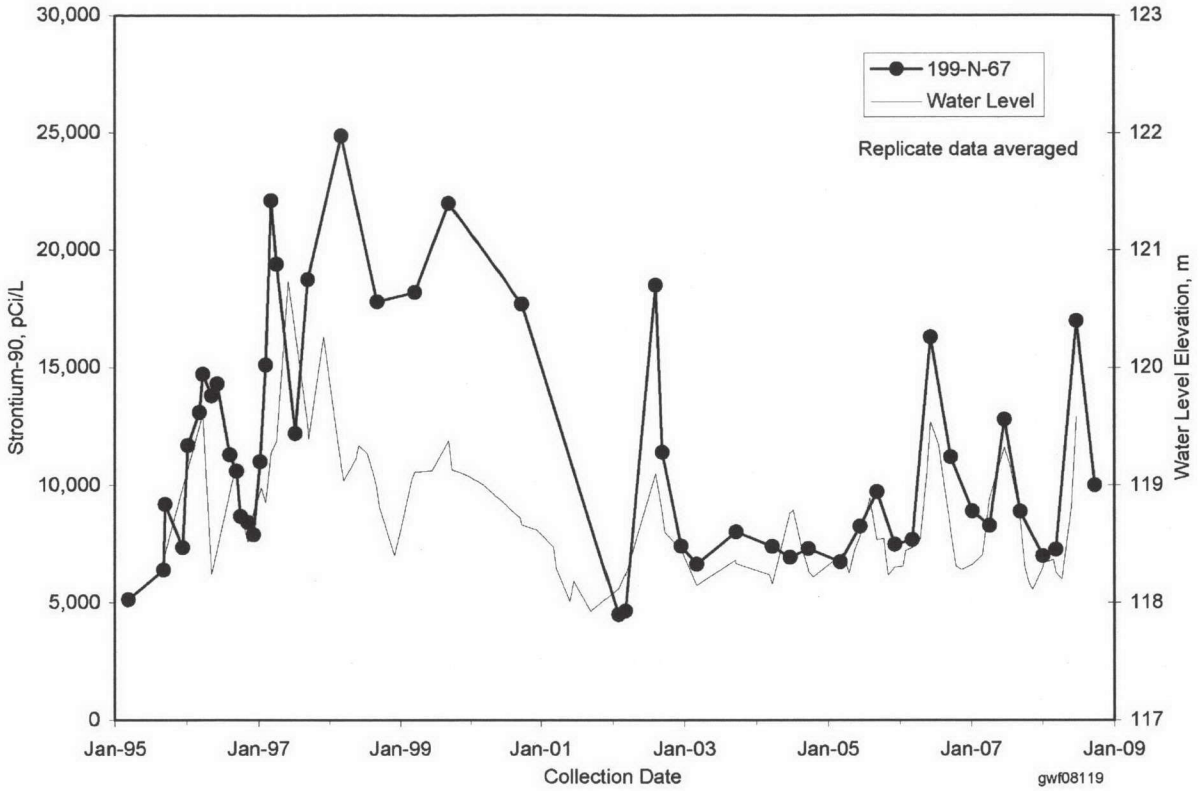

Figure 1-6. 100-NR-2 Strontium-90 Trends near 116-N-1 Facility (Well 199-N-67)

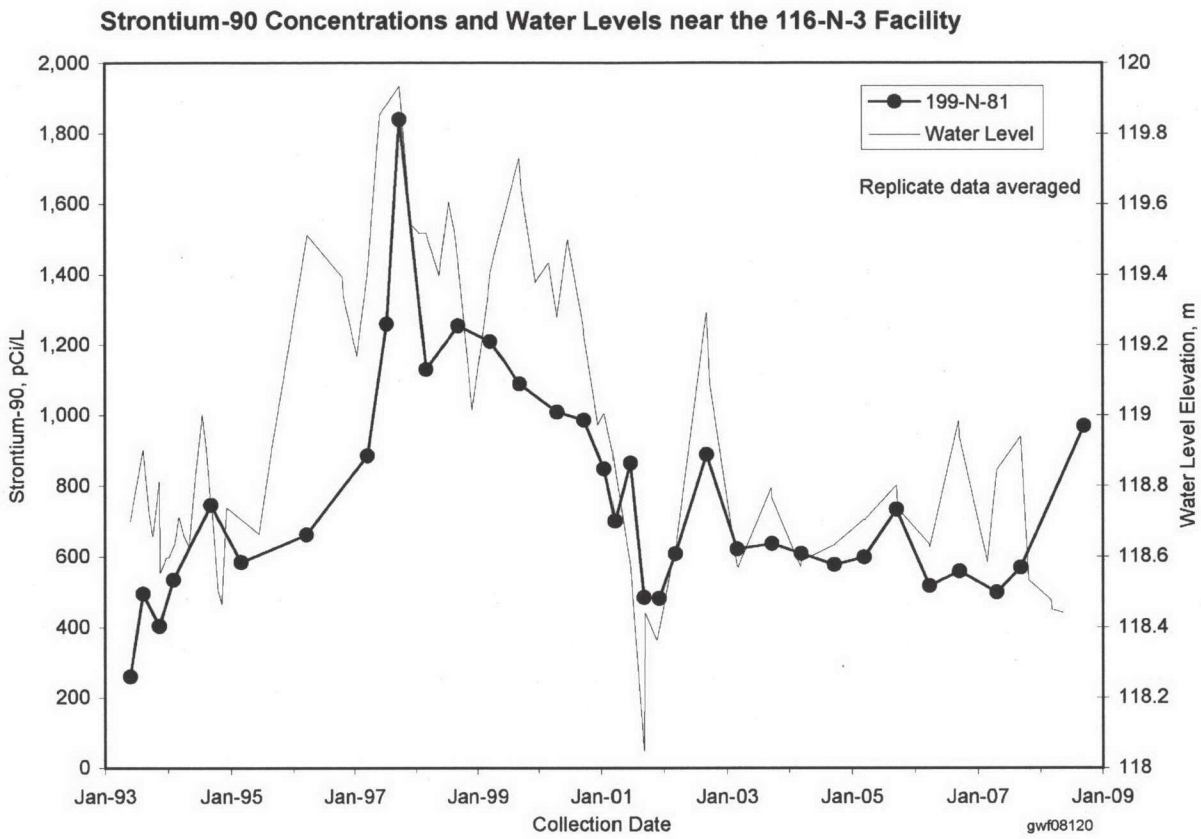

Figure 1-7. 100-NR-2 Strontium-90 Trends near 116-N-3 Facility (Well 199-N-81)

1.4 Purpose

This SAP supports the 100-NR-2 OU installation of multipurpose wells for characterization of the Sr-90 plume along the Columbia River shoreline. It describes a plan for collecting information that will support determining the extent and amount of Sr-90 contamination both upriver and downriver of the existing Apatite PRB (Figure 1-3), including geologic data (borehole logs and archive samples) and groundwater samples from completed wells. In addition, three of the multipurpose wells will collect core samples for laboratory testing to determine the extent and amount of apatite formation on the downriver end (pilot test 2 site) of the Apatite PRB.

1.5 Objectives

The objectives of this plan for this SAP include:

- Determine the extent of the 100-NR-2 Sr-90 plume along the Columbia River shoreline
- Determine the effectiveness of the 100-NR-2 Apatite Barrier for immobilizing Sr-90 in groundwater.

1.6 Scope

The scope of the 100-NR-2 Groundwater OU Sr-90 Plume Rivershore sampling involves the following work activities.

- Drilling 146 multipurpose shallow wells along the bank of the Columbia River for collection of groundwater and archive sediment samples
- Drilling 24 monitoring wells
- Drilling three of the monitoring wells for core collection within the pilot test 2 (downriver end) of the existing Apatite PRB. The core will be analyzed to determine long-term barrier performance and longevity
- Analysis of groundwater samples for Sr-90 contamination to characterize the Sr-90 plume and determine the effectiveness of the 100-NR-2 Apatite Barrier
- Collect archive sediment samples for possible lithology determination.

Figure 1-8 shows the approximate location of the new wells along the Columbia River shoreline at the 100-NR-2 Groundwater OU. The lines shown in the figure that extend beyond the existing barrier illustrate where the wells will be installed both upriver and downriver of the existing Apatite PRB. In addition, the location of the core wells is also indicated in the figure.

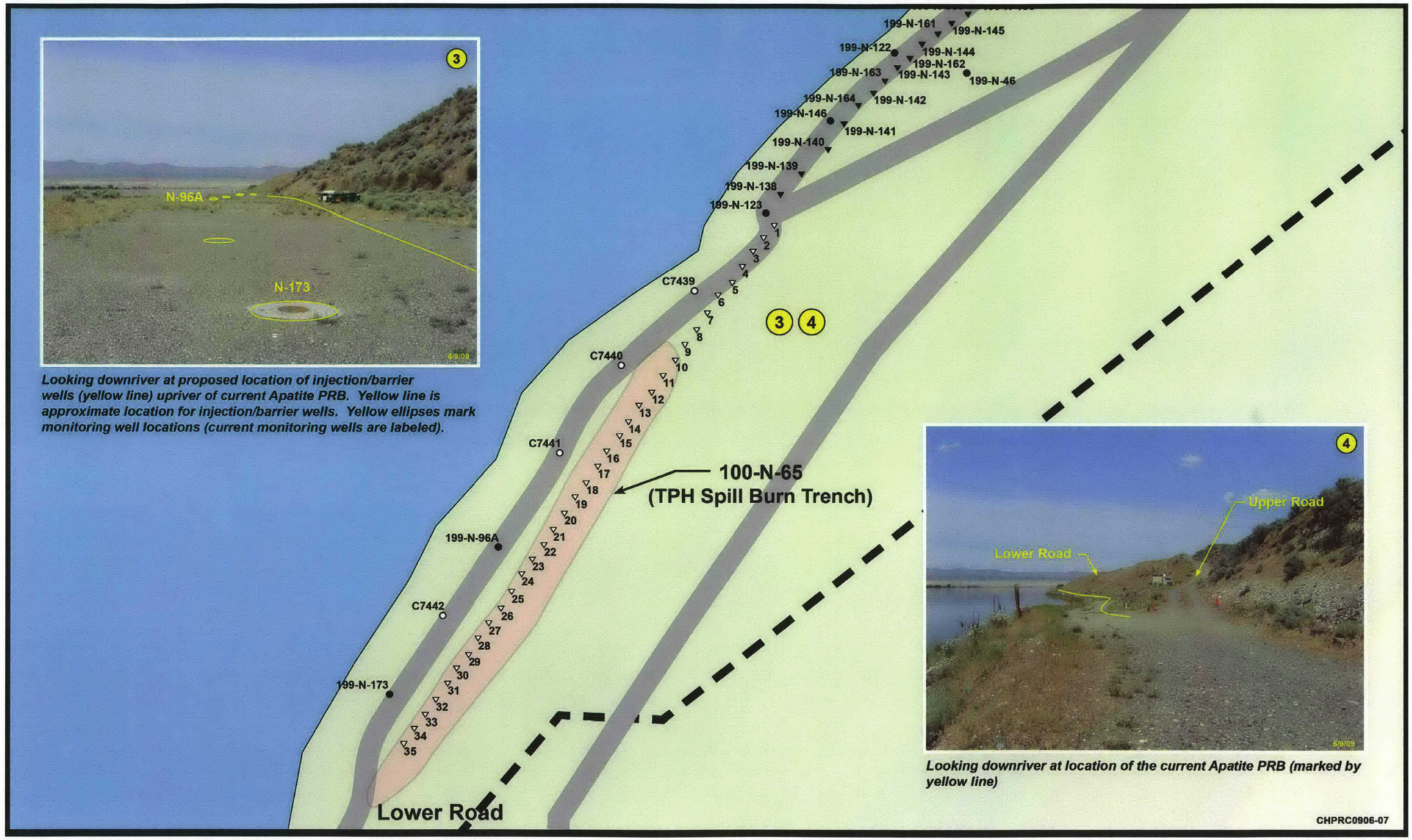

Figure 1-8. Proposed Locations of the Apatite PRB Multipurpose Wells and Core Wells (Page 1 of 4)

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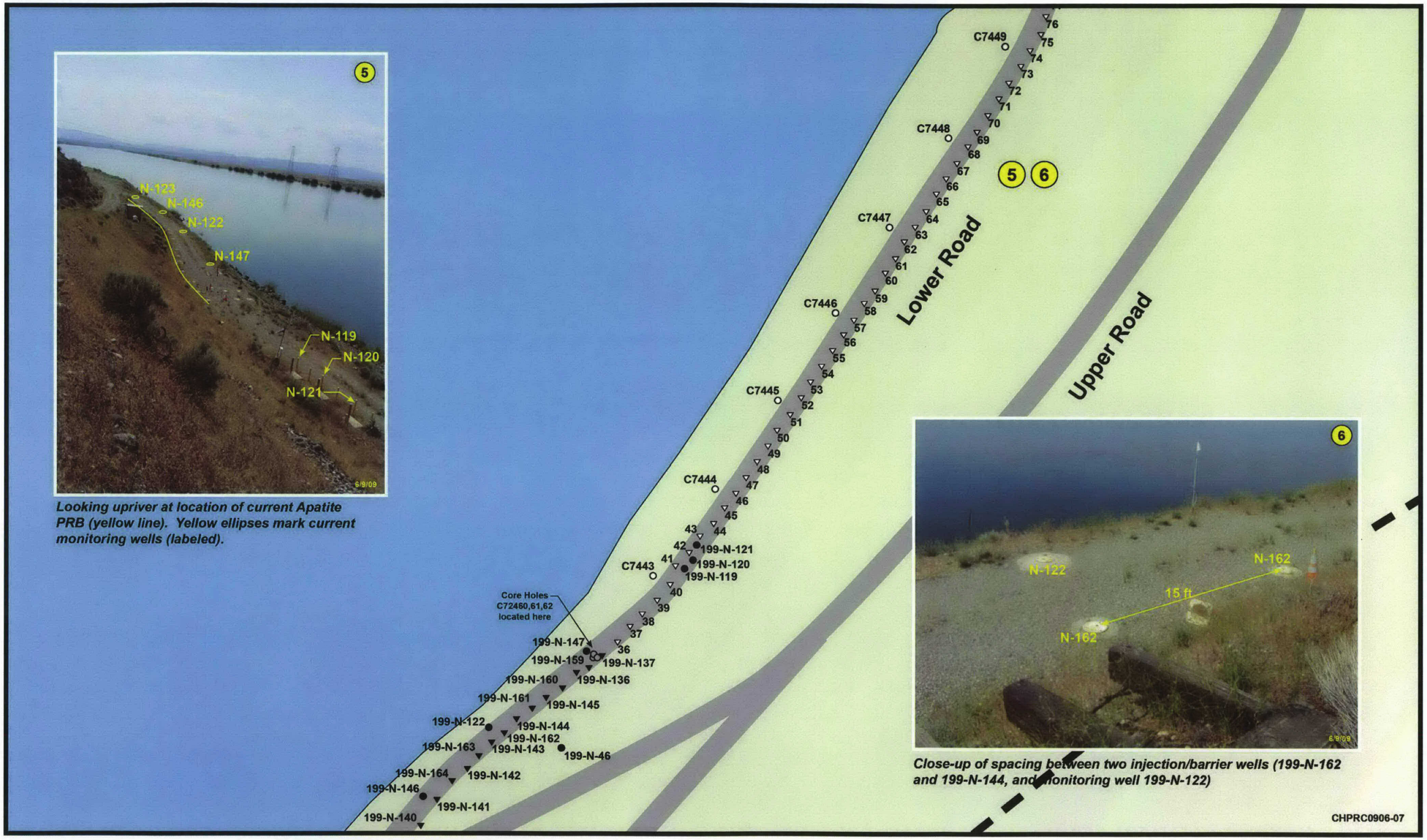

Figure 1-8. Proposed Locations of the Apatite PRB Multipurpose Wells and Core Wells (Page 2 of 4)

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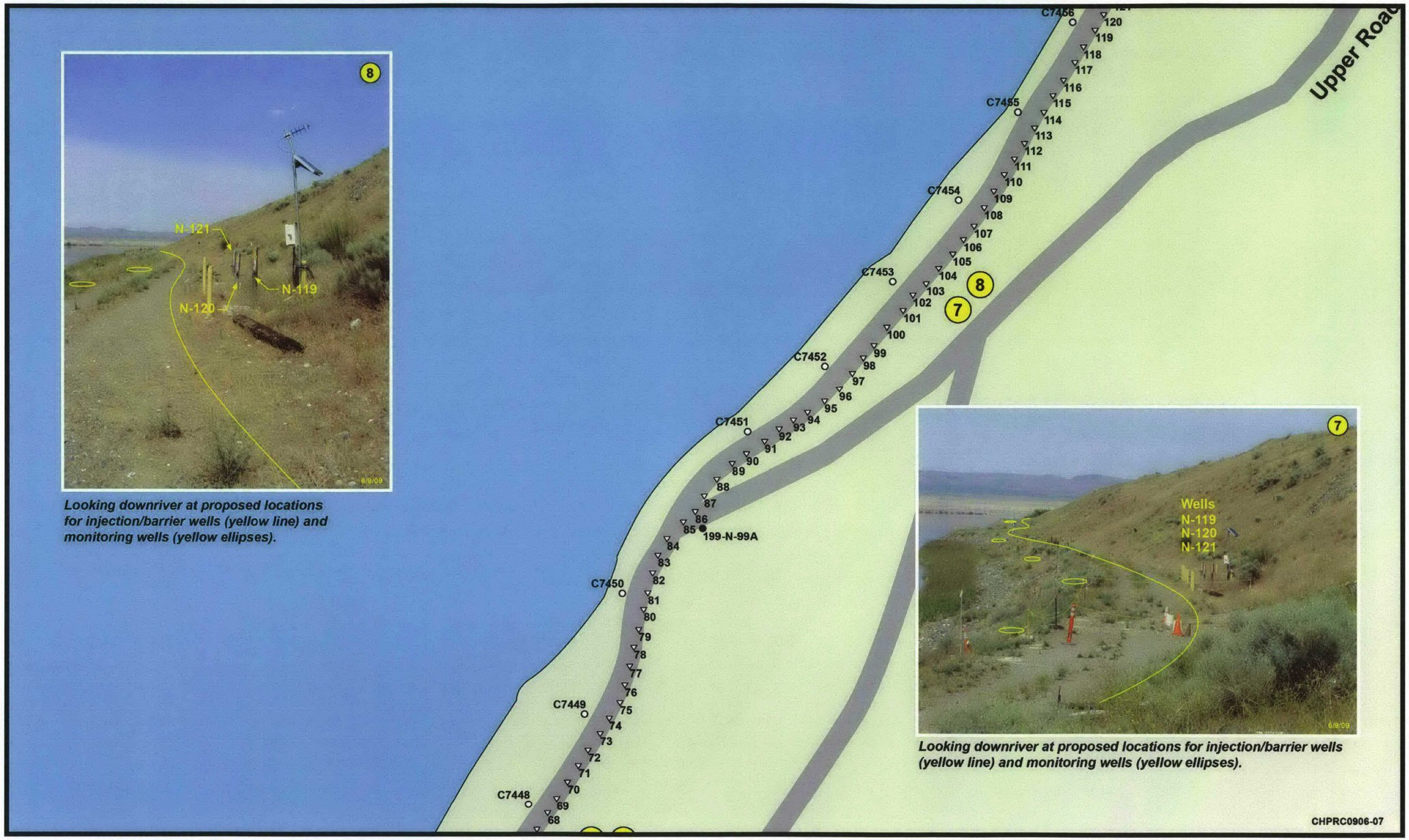

Figure 1-8. Proposed Locations of the Apatite PRB Multipurpose Wells and Core Wells (Page 3 of 4)

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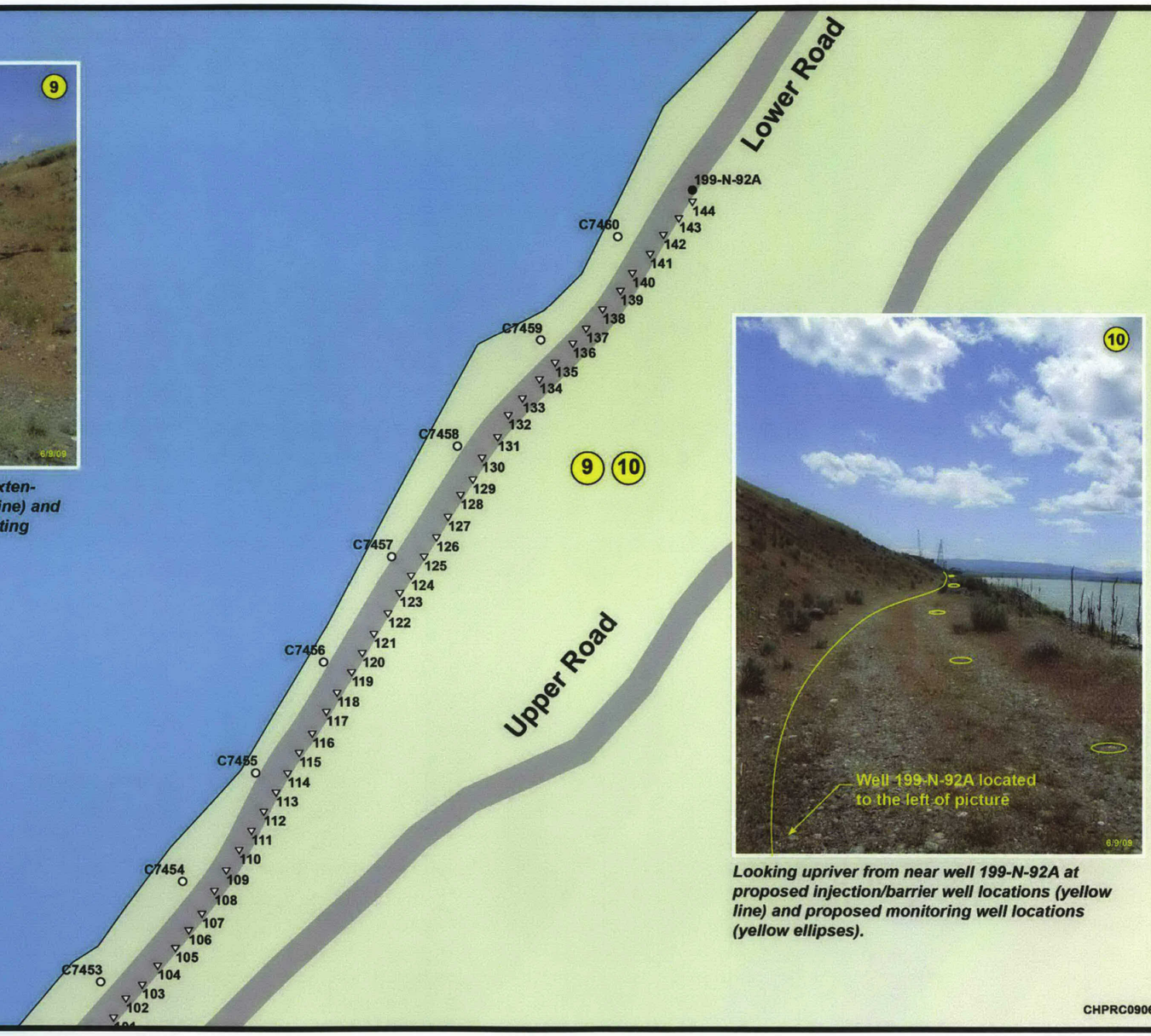
Looking downriver at lower end of proposed Apatite PRB extension. Proposed location for injection/barrier wells (yellow line) and monitoring well locations (yellow ellipses) are shown. Existing monitoring wells 199-N-99A and 199-N-92A are labeled.



Looking upriver from near well 199-N-92A at proposed injection/barrier well locations (yellow line) and proposed monitoring well locations (yellow ellipses).

Figure 1-8. Proposed Locations of the Apatite PRB Multipurpose Wells and Core Wells (Page 4 of 4)

The rivershore well identifiers are provided in Table 1-1.

Table 1-1. Well Identifiers

Hanford Well ID Numbers					
C7293	C7322	C7351	C7380	C7409	C7438
C7294	C7323	C7352	C7381	C7410	C7439
C7295	C7324	C7353	C7382	C7411	C7440
C7296	C7325	C7354	C7383	C7412	C7441
C7297	C7326	C7355	C7384	C7413	C7442
C7298	C7327	C7356	C7385	C7414	C7443
C7299	C7328	C7357	C7386	C7415	C7444
C7300	C7329	C7358	C7387	C7416	C7445
C7301	C7330	C7359	C7388	C7417	C7446
C7302	C7331	C7360	C7389	C7418	C7447
C7303	C7332	C7361	C7390	C7419	C7448
C7304	C7333	C7362	C7391	C7420	C7449
C7305	C7334	C7363	C7392	C7421	C7450
C7306	C7335	C7364	C7393	C7422	C7451
C7307	C7336	C7365	C7394	C7423	C7452
C7308	C7337	C7366	C7395	C7424	C7453
C7309	C7338	C7367	C7396	C7425	C7454
C7310	C7339	C7368	C7397	C7426	C7455
C7311	C7340	C7369	C7398	C7427	C7456
C7312	C7341	C7370	C7399	C7428	C7457
C7313	C7342	C7371	C7400	C7429	C7458
C7314	C7343	C7372	C7401	C7430	C7459
C7315	C7344	C7373	C7402	C7431	C7460
C7316	C7345	C7374	C7403	C7432	C7461
C7317	C7346	C7375	C7404	C7433	C7462
C7318	C7347	C7376	C7405	C7434	C7463
C7319	C7348	C7377	C7406	C7435	
C7320	C7349	C7378	C7407	C7436	
C7321	C7350	C7379	C7408	C7437	

ID = identification number

1.7 Site Geology/Hydrogeology

The Sr-90 Treatability Test Plan for the 100-NR-2 Groundwater Operable Unit (DOE/RL-2005-96) provides descriptions of the geology, hydrogeology, vadose zone, and groundwater contamination in the 100-NR-2 Groundwater OU.

1.8 Target Analytes

The contaminants of potential concern (COPCs) in the 100-NR-2 Groundwater OU and other target analytes will be used to characterize the groundwater in this SAP as shown in Table 1-2.

Table 1-2. Target Analytes

Target Constituent/ Analyte/Technique	Justification/ Rationale
Sr-90	100-NR-2 COPC
Chromium	100-NR-2 COPC
Manganese	100-NR-2 COPC
Strontium	100-NR-2 COPC
Nitrate	100-NR-2 COPC
Sulfate	100-NR-2 COPC
Benzene	100-NR-2 COPC[1]
Total petroleum hydrocarbon	100-NR-2 COPC[1]
Aluminum	Analyte of interest
Antimony	Analyte of interest
Arsenic	Analyte of interest
Barium	Analyte of interest
Cadmium	Analyte of interest
Calcium	Analyte of interest
Cobalt	Analyte of interest
Copper	Analyte of interest
Iron	Analyte of interest
Lead	Analyte of interest
Magnesium	Analyte of interest
Molybdenum	Analyte of interest
Nickel	Analyte of interest
Potassium	Analyte of interest

Table 1-2. Target Analytes

Target Constituent/ Analyte/Technique	Justification/ Rationale
Silver	Analyte of interest
Sodium	Analyte of interest
Vanadium	Analyte of interest
Zinc	Analyte of interest
Chloride	Analyte of interest
Fluoride	Analyte of interest
Nitrite	Analyte of interest
Phosphorus in phosphate	Analyte of interest
pH	Supporting information
Temperature (°C)	Supporting information
Specific conductance (µS/cm)	Supporting information
Dissolved oxygen (mg/L)	Supporting information
Oxidation-Reduction Potential (mV)	Supporting information
Apatite	Analyte of interest
Phosphate	Analyte of interest

[1] This analysis is performed only on upriver extension well installations.

1.9 Data Quality Features

A streamlined data quality objectives (DQO) process was used to develop the sampling requirements for this sampling plan because the test parameters for the Sr-90 Treatability Test are well understood and documented in project records. Through the graded approach, many of the featured elements of the DQO process were established. This section summarizes those key features.

1.9.1 Problem Definition

1.9.1.1 General Information

The drilling and sampling activities will be conducted outside of a waste site footprint, with the possible exception of the total petroleum hydrocarbons (TPH) waste site plume (100-N-65, UPR 100-N-17 Diesel Oil Interceptor Trench). The surface sediments are not radiologically or chemically contaminated; however, the sediment in the saturated zone beneath the test area contains elevated levels of Sr-90. Access to the test area is not restricted, however controls are anticipated during drilling and sampling activities.

The media to be sampled include groundwater for laboratory analysis and sediments for archiving. The groundwater samples will be collected by pumping and collection in glass and/or poly bottles. Sediments will be collected from grab samples in chip trays for visual lithology records and glass mason jars for archive samples during the installation of the shallow wells. The approximate locations for the wells are depicted in Figure 1-8.

1.9.1.2 Problem Statement

In order to comprehensively characterize the highest concentration portion of the Sr-90 groundwater plume along the Columbia River shoreline in the 100-NR-2 Groundwater OU, data regarding groundwater concentrations of Sr-90 between seep wells NS-1 and NS-4 are required.

1.9.1.3 Conceptual Site Model

The sediment strata in the existing barrier study area includes 0 to 3 m (0 to 10 ft) of backfill material underlain by coarse-grained sediments of the Hanford formation, which extends beyond the total depth of the boreholes (proposed to be 2.4 to 3.7 m [8 to 12 ft] below ground surface [bgs]). The contact with the underlying Ringold Formation is at a depth of approximately 3 to 4.6 m (10 to 15 ft) bgs. A variably saturated zone is defined by water conditions for the site that range from approximately 4.6 to 6.1 m (15 to 20 ft) bgs during spring/summer high river-stage conditions to approximately 7.6 m (25 ft) bgs during low river-stage conditions. The proposed well design provides for collection of groundwater samples within the variably saturated zone while retaining the ability to collect aqueous samples at the water table under all but the most extreme low-water conditions in the Ringold Unit.

Figures 1-9 and 1-10 present the generalized stratigraphy and well construction details for the Hanford and Ringold Formation wells, respectively, and illustrates the construction details for the 170 new 100-NR-2 OU apatite PRB multipurpose wells.

Sampling Media and Locations. Continuous sediment cores will be collected with split-spoon samplers from three of the boreholes (Hanford Well ID Numbers C7460, C7461, and C7462) (see Figure 1-8 for approximate location).

1.9.1.4 Decision Rules

There are no decision rules. The data collected during this sampling activity will be used to fill characterization data gaps and possibly determine apatite barrier treatability test performance.

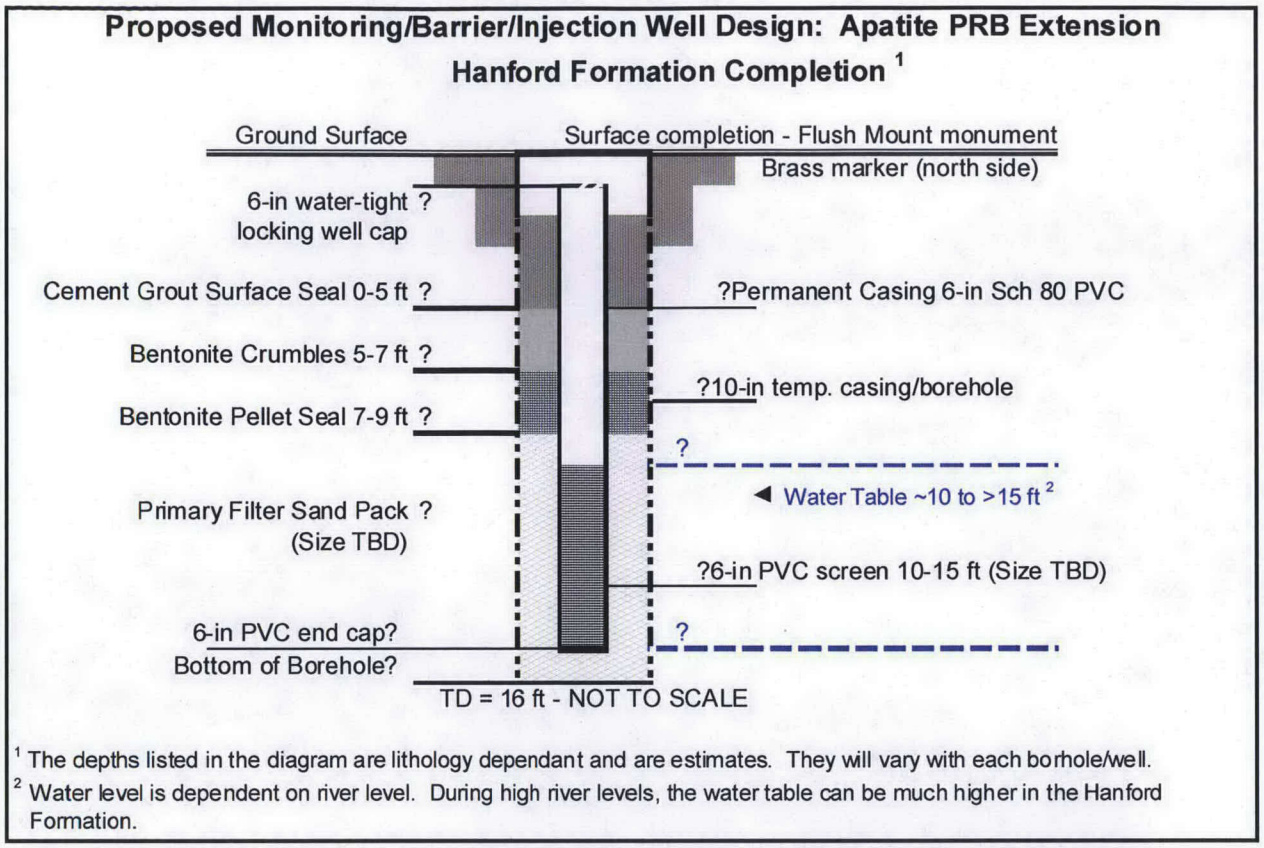
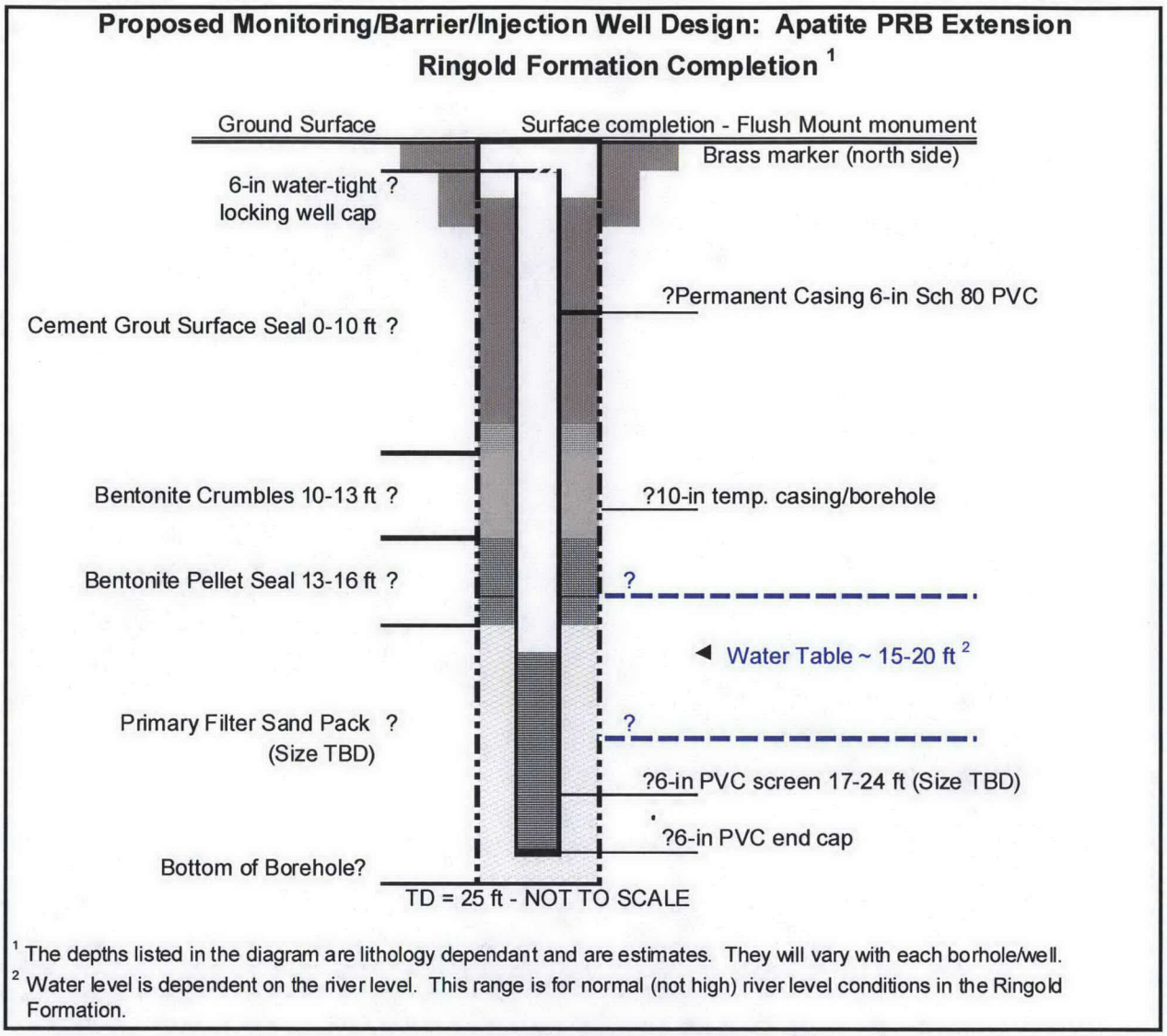


Figure 1-9. Generalized Well Construction for Well Completed in the Hanford Formation



[1] The depths listed in the diagram are lithology dependant and are estimates. They will vary with each borhole/well.
[2] Water level is dependent on the river level. This range is for normal (not high) river level conditions in the Ringold Formation.

Figure 1-10. Generalized Well Construction for Completed Wells in the Ringold Formation

2 Quality Assurance Project Plan

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including planning, implementation, and assessment of sampling, field measurements, and laboratory analysis.

This QAPjP complies with the requirements of the following:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830, Subpart A, "Quality Assurance Requirements"
- *EPA Requirements for Quality Assurance Project Plans, QA/R-5* (EPA/240/B-01/003).

Sections 6.5 and 7.8 of the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 2003), Attachment 2: Action Plan require that the QA/QC and sampling and analysis activities specify the QA Requirements for Treatment, Storage, and Disposal Units as well as for Past Practice Processes. Therefore, the organization of this QAPjP is patterned after the QA elements of EPA "Requirements for Quality Assurance Project Plans" (EPA/240/B-01/003)(QA/R-5). The QA Project Plan demonstrates conformance to Part B requirements of ANSI/ASQC E4-1994. The QAPjP is divided into the following four sections (designated in EPA QA/R-5 by A, B, C, and D), which describe the quality requirements and controls applicable to this investigation.

In addition to the requirements cited above, the following reference was also used as a resource for identification of QAPjP elements: *Intergovernmental Data Quality Task Force, Uniform Federal Policy for Quality Assurance Project Plans – Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual* (EPA-505-B-04-900A). The UFP-QAPP Manual is a valuable resource and provides a comprehensive treatment of quality elements that should be addressed in any SAP. The UFP-QAPP Manual includes format requirements that were not followed.

The QAPjP is divided into the following four sections, which describe the quality requirements and controls applicable to this investigation:

- Project Management (Section 2.1): This section addresses project management, including the project history and objectives, as well as the roles and responsibilities of the project team. These elements ensure the project has a defined goal, the project team understands the goal and the approach to be used, and the planning outputs are clearly documented.

- Data Generation and Acquisition (Section 2.2): The elements discussed in this section address all aspects of the project design and implementation. Implementation of these elements ensures appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and are properly documented.

- Assessment and Oversight (Section 2.3): This section addresses the activities for assessing the effectiveness of the project's implementation and the associated QA/QC activities. The purpose of assessment is to ensure the QAPjP is implemented as prescribed.

- Data Validation and Usability (Section 2.4): This section discusses the QA activities that occur after the data collection or generation phase of the project is completed. Implementation of these elements ensures the data conform to the specified criteria, thus achieving project objectives.

2.1 Project Management

The following subsections address the basic aspects of project management and ensure the project has defined goals, the project team understand the goals and the approaches used, and the planned outputs are appropriately documented. Project management roles and responsibilities discussed in this section apply to the major activities covered under the SAP.

2.1.1 Project/Task Organization

The primary contractor (or approved subcontractor) is responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory.

The project organization depicted in Figure 2-1 (in regard to sampling and characterization) is described in the subsections that follow. The project manager maintains a list of individuals or organizations that are the points-of-contact (POCs) for each functional element shown in this figure. For each functional primary contractor role, there is a corresponding oversight role within DOE.

2.1.1.1 Regulatory Project Manager

The Washington State Department of Ecology (Ecology) has assigned project managers that are responsible for overseeing this cleanup project and activities. The Ecology has approval authority as the lead regulatory agency for the work performed under this SAP and is responsible for working with RL to resolve issues and approve the documents in accordance with the Tri-Party Agreement.

2.1.1.2 RL Project Manager

RL is responsible for Hanford Site cleanup. The RL project manager is responsible for authorizing the contractor to perform activities under CERCLA, the *Resource Conservation and Recovery Act of 1976* (RCRA), the *Atomic Energy Act of 1954*, and the Tri-Party Agreement. RL is also responsible for obtaining lead regulatory agency (Ecology) approval of this SAP to authorize the specific activities.

2.1.1.3 RL Technical Lead

The RL technical lead is responsible for performing the day-to-day oversight of the contractor in performing the work scope, working with the contractor and the regulatory agencies to identify and work through issues, and providing technical input to the RL project manager.

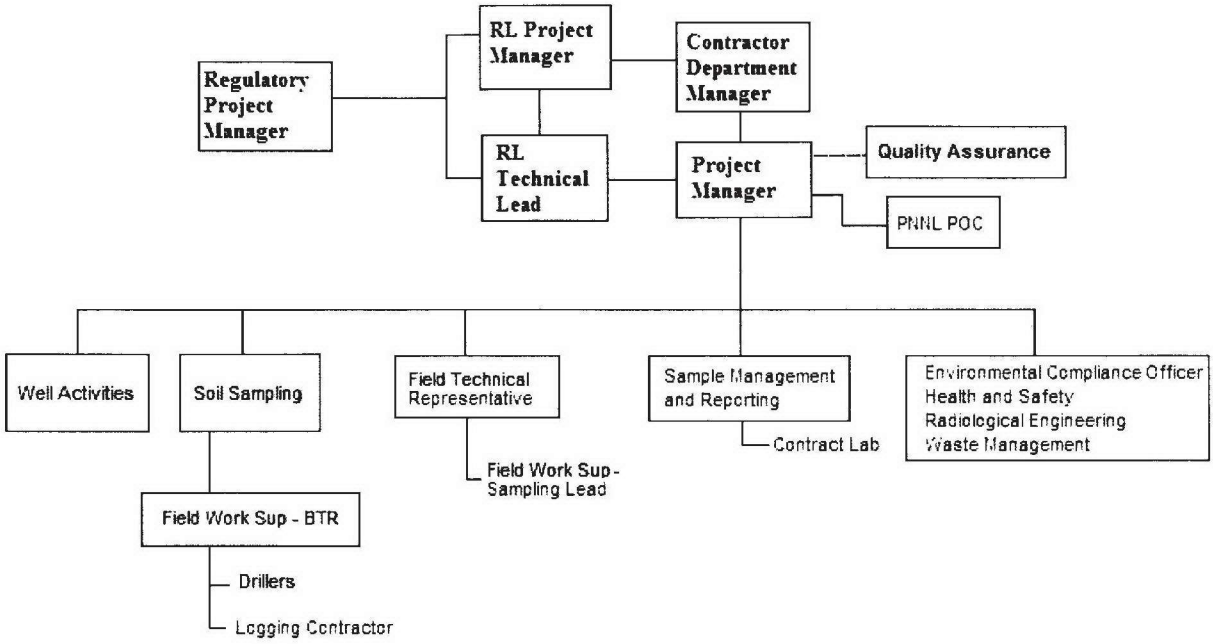
2.1.1.4 Contractor Department Manager

The contractor department manager provides oversight for all activities and coordinates with RL, the regulators, and primary contractor management in support of sampling activities. In addition, support is provided to the project manager to ensure work is performed safely and cost effectively.

2.1.1.5 Project Manager

The project manager is responsible for: directly managing sampling documents and requirements, field activities, and subcontracted tasks and for ensuring that the project file is properly maintained; ensures that the sampling design requirements are converted into field instructions (e.g., work packages) that provide specific direction for field activities; works closely with the QA and the Health and Safety organizations, as well as the field work supervisor, to integrate these and the other lead disciplines in planning and implementing the workscope; and maintains a list of individuals or organizations filling each of the functional elements of the project's organization (Figure 2-1). In addition, the project manager is responsible for version control of the SAP to ensure that personnel are working to the most current job

requirements; also coordinates with and reports to RL and primary contractor management on all sampling activities; and supports RL in coordinating sampling activities with the regulators.



BTR = buyer's technical representative
PNNL = Pacific Northwest National Laboratory
POC = point of contact
RL = U.S. Department of Energy, Richland Operations Office
Sup = supervisor

Figure 2-1. Project Organization

2.1.1.6 Quality Assurance

The QA POC is matrixed to the project manager and is responsible for QA issues on the project. Responsibilities include overseeing the implementation of project QA requirements; reviewing project documents, including DQO summary reports, SAPs, and the QAPjP; and participating in QA assessments on sample collection and analysis activities, as appropriate.

2.1.1.7 Pacific Northwest National Laboratory Point-of-Contract

The PNNL POC is the lead scientist associated with developing the Apatite permeable barrier, and provides consultation and technical information to the project manager.

2.1.1.8 Environmental Compliance Officer

The environmental compliance officer (ECO) provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and develops appropriate mitigation measures, with the goal of minimizing adverse environmental impacts. The ECO also reviews plans, procedures, and technical documents to ensure all environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost-effective solutions; and responds to environmental/regulatory issues or concerns raised by RL and/or the regulatory agencies. The ECO

may also oversee project implementation for compliance with applicable internal and external environmental requirements.

2.1.1.9 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by Federal regulation or by internal primary contractor work requirements. In addition, the Health and Safety organization assists project personnel in complying with applicable health and safety standards and requirements. The Health and Safety organization coordinates with Radiological Controls to determine personnel protective equipment requirements.

2.1.1.10 Radiological Engineering

The Radiological Engineering lead is responsible for radiological/health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, the radiological engineer lead identifies radiological hazards and implements appropriate controls to maintain worker exposures ALARA (e.g., requiring personal protective equipment). In addition, the radiological engineering lead interfaces with the project Health and Safety contact, and plans and directs radiological control technician (RCT) support for all activities.

2.1.1.11 Waste Management

The Waste Management lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. In addition, the Waste Management lead is responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpreting the characterization data to generate waste designations, profiles, and preparing and maintaining other documents that confirm compliance with waste acceptance criteria.

2.1.1.12 Well Activities

The Well Activities lead has overall responsibility for planning, coordinating, and executing construction activities. The Well Activities lead coordinates with the project manager to identify field constraints that could affect sampling design and provides direction to the geological buyer's technical representative (BTR), who oversees the field geologist.

The drilling BTR oversees field construction activities. The BTR is responsible for daily interface with drilling and remediation subcontractors. The BTR verifies all pre-field activities are complete prior to initiating work, reviews and approves subcontractor drilling submittals, and ensures work is completed in accordance with specifications. The BTR submits field records as required.

2.1.1.13 Soil Sampling

Sediment sampling includes activities of the field work supervisor/sampling lead and the field technical representative (FTR).

2.1.1.14 Field Work Supervisor

The field work supervisor is responsible for planning and coordinating field sampling resources; ensuring the availability of trained samplers; and is responsible for directing training, mock-ups, and practice

sessions with field personnel to ensure the sampling design is understood and can be performed as specified.

The field work supervisor directs the samplers who collect groundwater, sediment, vapor, and multimedia samples (including replicates/duplicates) and prepare all sample blanks according to the SAP, corresponding standard procedures, and work packages. The samplers also complete the field logbook and chain-of-custody forms, as well as any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

2.1.1.15 Field Technical Representative

An FTR acts as a technical interface between the project manager and the field crew supervisors (i.e., the field work supervisor lead and the field work supervisor BTR) and ensures the technical aspects of the field work will be met. The field work supervisor BTR oversees drillers, contract loggers, and daily operations at the job site. The FTR reviews the SAP for field collective concerns, analytical requirements, and special sampling requirements, and generates appropriate field sampling paperwork. The FTR, in consultation with the project manager, resolves issues arising from translation of technical requirements to field operations and coordinates resolution of off-normal sampling situations.

2.1.1.16 Sample Management and Reporting Organization

The Sample Management and Reporting Organization coordinates laboratory analytical work ensuring the laboratories conform to Hanford Site internal laboratory quality assurance requirements, or their equivalent, as approved by DOE, the EPA, and Ecology. The Sample Management and Reporting Organization receives the analytical data from the laboratories, performs the data entry into the *Hanford Environmental Information System* (HEIS), and arranges for data validation. The Sample Management and Reporting Organization is responsible for informing the project manager of any issues reported by the analytical laboratory; developing and overseeing the implementation of the letter of instruction to the analytical laboratories; overseeing data validation; and working with the project manager to prepare a characterization report on the sampling and analysis results.

The Sample Management and Reporting Organization is also responsible for the performance of EPA's DQO process, or equivalent, that results in the development of the SAP. Responsibilities include documentation as well as development of the DQOs and the SAP, including sampling design, associated presentations, resolution of technical issues, and any revisions to the SAP.

2.1.1.17 Contract Laboratories

The contract laboratories analyze samples in accordance with established procedures and provide the necessary sample reports and explanation of results in support of data validation. The laboratories must meet site-specified QA requirements and must have an approved QA plan in-place.

2.1.2 Problem Definition/Background

Discussions of the background, objectives, purpose, and objectives are provided in Sections 1.1 and 1.3 through 1.5.

2.1.3 Task Description

Discussion of the task description is provided in Section 3.

2.1.4 Quality Objectives and Criteria

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by data quality indicators (DQI), evaluation against identified DQOs, and evaluation against the work activities identified in this SAP. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. The principal DQI are precision, bias, or accuracy; representativeness; comparability; completeness; and sensitivity. For the purposes of this document, these DQIs are defined in Table 2-1. The DQIs will be evaluated during the Data Quality Assessment (DQA) process (Section 2.4.3).

Quality objectives and project-specific measurements requirements are presented in Table 2-2. In consultation with the laboratory, the project manager, and/or others as appropriate, the Sample Management and Reporting Organization identifies appropriate analytical methods.

2.1.5 Special Training/Certification

A graded approach is used to ensure workers receive a level of training commensurate with their responsibilities and in compliance with applicable DOE orders and government regulations. The field work supervisor, in coordination with line management, ensures field personnel meet all special training requirements.

Typical training requirements or qualifications have been instituted by the primary contractor management team to meet training requirements imposed by the CH2M HILL Plateau Remediation Company (CHPRC), regulations, DOE orders, DOE contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers, the *Washington Administrative Code* (WAC), etc. For example, the environmental safety and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training and supervised 24-hour hazardous waste site experience
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- Hanford General Employee Radiation Training
- Hanford General Employee Training
- Radiological Worker Training.

Project-specific safety training, geared specifically to the project and the day's activity, will be provided. Project-specific training includes the following:

- Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements.
- Samplers are required to have certification for the type of sampling being performed in the field.
- Qualification requirements for RCTs are established by the Radiation Protection Program. The RCTs assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

Table 2-1. Data Quality Indicators

Data Quality Indicator	Definition	Example Determination Methodologies	Project-Specific Information[a]	Corrective Actions Examples
Precision	The measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions; calculated as either the range or as the standard deviation. May also be expressed as a percentage of the mean of the measurements, such as relative range, relative percent difference, or relative standard deviation (coefficient of variation).	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 or have two or more laboratories analyze identical samples with the same method. Split a sample in the field and submit both samples for sample handling, preservation and storage, and analytical measurements. Collect, process, and analyze colocated samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	Precision criteria shall apply: • Laboratory analysis: Adherence to QAPjP Table 2-2 and laboratory SOPs provides the level of precision adequate for data use • One duplicate collected for one in 20 water samples. • Field measures: Achieved by adherence to SOPs • Apatite Formation Testing: Achieved by adherence to PNNL laboratory SOPs and PNNL QA plan, yielding the needed precision.	Data interpretation or data assessment may be performed.
Accuracy	A measure of the overall agreement of a measurement to a known value; includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.	Analyze a reference material or re-analyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample); usually expressed either as percent recovery or as percent bias.	Accuracy criteria shall apply: • Laboratory analysis: Adherence to QAPjP Table 2-2 and laboratory SOPs provides the level of accuracy for data use • Lab QC • Field measures: Achieved by adherence to SOPs • Apatite Formation Testing: Adherence to PNNL laboratory SOPs and PNNL QA plan, yielding the needed accuracy.	Data interpretation or data assessment may be performed.

Table 2-1. Data Quality Indicators

Data Quality Indicator	Definition	Example Determination Methodologies	Project-Specific Information[a]	Corrective Actions Examples
Representative -ness	A qualitative term that 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 (ANSI/ASQC E4-1994).	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.	Laboratory Analysis: Groundwater samples will be collected from each of the wells along the river shore. The results will represent linear variability across the study area and track trends over time. It provides a practical method for designating sample locations and ensures uniform coverage of the test site area. Apatite Formation Testing: Soil samples will be collected in a focused design within a representative central portion of the barrier in accordance with the Treatability Test Plan.	Data interpretation or data assessment may be performed.
Comparability	A qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined for the decision(s) to be made.	Compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols.	Laboratory Analysis: The sample results need only be internally comparable. All sampling personnel will use the same sampling protocols. All samples will be submitted to the laboratory for analysis by the same methods; thus, data results will be comparable. Field splits will provide some measure of inter-lab comparability. Apatite Formation Testing: The internal data set is not expected to be comparable to any other data set. Lateral comparability will be ensured through standard methods.	If data are not comparable to other data sets: • Assess potential impacts in data quality assessment if performed.

Table 2-1. Data Quality Indicators

Data Quality Indicator	Definition	Example Determination Methodologies	Project-Specific Information[a]	Corrective Actions Examples
Completeness	A measure of the amount of valid data needed to be obtained from a measurement system.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (DQOs or performance/acceptance criteria).	Laboratory and Field Analyses: The water samples collected from 170 wells shall be collected in order to meet the completeness criteria. Apatite Formation Testing: The soil samples collected from three boreholes shall be collected in order to meet the completeness criteria.	Evaluate the impact to the resulting data set and ability to define treatability test design criteria.
Sensitivity	The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.	Determine the minimum concentration or attribute that can be measured by a method (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit). The practical quantitation limit is the lowest level that can be routinely quantified and reported by a laboratory.	Sensitivity criteria shall apply: • Laboratory Analysis: Adherence to this QAPjP and laboratory SOPs provides the level of sensitivity for data use. • Apatite Formation Testing: Achieved by adherence to PNNL laboratory SOPs and PNNL QA plan, yielding the needed sensitivity.	Data interpretation or data assessment may be performed.

Note: ANSI/ASQC E4-1994, Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs.

a. Field sampling requirements are noted. Laboratories will follow contract requirements for use and interpretation of laboratory control samples. Precision, accuracy, and sensitivity requirements are satisfied by following method procedures because analyses are being performed to support treatability test design (not for regulatory decision making).

PNNL = Pacific Northwest National Laboratory

QA = quality assurance

Table 2-2. Analytical Performance Requirements

CAS Number	Analyte	Matrix	Analytical Method	Action Level[a]	RDL	Accuracy Req't (% Recovery)[b]	Precision Req't (RPD)[b]
Radiological Constituents							
Rad-Sr	Sr-90	Water	Strontium 89/90 – Total Rad. Sr	N/A	2 pCi/L	80-120%	±20%
12587-47-2	Gross Beta	Water	Gross beta	N/A	4 pCi/L	80-120%	±20%
Nonradiological Constituents							
7440-90-5	Aluminum	Water	ICP Metals – 6010	N/A	50 µg/L	80-120%	±20%
7440-36-0	Antimony	Water	ICP Metals – 6010	N/A	60 µg/L	80-120%	±20%
7440-38-2	Arsenic	Water	ICP Metals – 6010	N/A	100 µg/L	80-120%	±20%
7440-39-3	Barium	Water	ICP Metals – 6010	N/A	20 µg/L	80-120%	±20%
7440-43-9	Cadmium	Water	ICP Metals – 6010	N/A	5 µg/L	80-120%	±20%
7440-70-2	Calcium	Water	ICP Metals – 6010	N/A	1000 µg/L	80-120%	±20%
7440-47-3	Chromium	Water	ICP Metals – 6010	N/A	10 µg/L	80-120%	±20%
7440-48-4	Cobalt	Water	ICP Metals – 6010	N/A	20 µg/L	80-120%	±20%
7440-50-8	Copper	Water	ICP Metals – 6010	N/A	10 µg/L	80-120%	±20%
7439-89-6	Iron	Water	ICP Metals – 6010	N/A	50 µg/L	80-120%	±20%
7439-92-1	Lead	Water	ICP Metals – 6010	N/A	50 µg/L	80-120%	±20%
7439-95-4	Magnesium	Water	ICP Metals – 6010	N/A	750 µg/L	80-120%	±20%
7439-96-5	Manganese	Water	ICP Metals – 6010	N/A	5 µg/L	80-120%	±20%
7439-98-7	Molybdenum	Water	ICP Metals – 6010	N/A	20 µg/L	80-120%	±20%
7440-02-0	Nickel	Water	ICP Metals – 6010	N/A	40 µg/L	80-120%	±20%

Table 2-2. Analytical Performance Requirements

CAS Number	Analyte	Matrix	Analytical Method	Action Level[a]	RDL	Accuracy Req't (% Recovery)[b]	Precision Req't (RPD)[b]
7440-09-7	Potassium	Water	ICP Metals – 6010	N/A	4000 µg/L	80-120%	±20%
7440-22-4	Silver	Water	ICP Metals – 6010	N/A	10 µg/L	80-120%	±20%
7440-23-5	Sodium	Water	ICP Metals – 6010	N/A	500 µg/L	80-120%	±20%
7440-24-6	Strontium	Water	ICP Metals – 6010	N/A	10 µg/L	80-120%	±20%
7440-62-2	Vanadium	Water	ICP Metals – 6010	N/A	25 µg/L	80-120%	±20%
7440-66-6	Zinc	Water	ICP Metals – 6010	N/A	10 µg/L	80-120%	±20%
16887-00-6	Chloride	Water	Anions by IC – 300.0	N/A	200 µg/L	80-120%	±20%
16984-48-8	Fluoride	Water	Anions by IC – 300.0	N/A	500 µg/L	80-120%	±20%
NO2-N	Nitrogen in nitrate	Water	Anions by IC – 300.0	N/A	75 µg/L	80-120%	±20%
NO3-N	Nitrogen in nitrite	Water	Anions by IC – 300.0	N/A	75 µg/L	80-120%	±20%
PO4-P	Phosphorus in phosphate	Water	Anions by IC – 300.0	N/A	500 µg/L	80-120%	±20%
14808-79-8	Sulfate	Water	Anions by IC – 300.0	N/A	100 µg/L	80-120%	±20%
71-43-2	Benzene	Water	Volatile Organics 8260	N/A	5 µg/L	80-120%	±20%
TPH	TPH	Water	Total Petroleum Hydrocarbons – 418.1	N/A	500 µg/L	80-120%	±20%
Field Measurements							
pH – 150.1	pH	Water	150.1 – pH-Field	N/A	0.1 pH unit	c	c
Temp – 170.1	Temperature (°C)	Water	170.1 – Temperature-Field	N/A	0.1 °C	c	c

Table 2-2. Analytical Performance Requirements

CAS Number	Analyte	Matrix	Analytical Method	Action Level[a]	RDL	Accuracy Req't (% Recovery)[b]	Precision Req't (RPD)[b]
Cond – 120.1	Specific conductance (µS/cm)	Water	120.1 – Conductivity-Field	N/A	0.1 µS/cm	c	c
Oxygen – 360.1	Dissolved oxygen (mg/L)	Water	360.1 – Oxygen-Field	N/A	0.1 mg/L	c	c
REDOX_FLD	Oxidation-Reduction Potential (mV)	Water	Redox_Probe_Field	N/A	±1 mV	c	c
PNNL Apatite Formation Testing							
14265-44-2	Phosphate, Apatite	Sediment	XRD	N/A	N/A	d	d
14265-44-2	Phosphate, Apatite	Sediment	SEM/EDS	N/A	N/A	d	d
14265-44-2 Rad-Sr	Phosphate, Sr-90	Sediment	Acid dissolution of sediment and phosphate measurement	N/A	N/A	d	d
N/A	Apatite	Sediment	Fluorescence of substituted apatites	N/A	N/A	d	d

Table 2-2. Analytical Performance Requirements

CAS Number	Analyte	Matrix	Analytical Method	Action Level[a]	RDL	Accuracy Req't (% Recovery)[b]	Precision Req't (RPD)[b]

a. Action levels are not applicable for this sampling activity; this is a characterization effort for information gathering purposes. The results will be used for characterization and to determine effectiveness of the Apatite Barrier, which are not contingent on action levels.

b. Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples is also performed. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analyses.

c. This method has no quantitative requirements beyond adherence to the field measurement methodology.

d. PNNL laboratory procedures and QA plan will apply to all analyses performed by PNNL.

Apatite = chemical formula – $Ca_5(PO_4)_3(F,Cl,OH)$

CAS = chemical abstract services

ICP = inductively coupled plasma emission spectroscopy

EDS = energy dispersive X-ray spectroscopy

N/A = not applicable

RDL = required detection limit

RPD = relative percent difference

SEM = scanning electron microscope

XRD = X-ray Diffraction

In addition, pre-job briefings will be performed to evaluate an activity and its hazards by considering many factors, 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
- Safety procedures applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts.

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

2.1.6 Documents and Records

The project manager is responsible for ensuring the current version of this SAP is being used and providing any updates to field personnel. Version control is maintained by the administrative document control process. Significant changes to the sampling plan will be reviewed and approved by RL and the regulatory agency prior to implementation. Table 2-3 defines the types of changes that may be made to the sampling design and the documentation requirements.

The field work supervisor-BTR is responsible for ensuring field instructions are maintained up-to-date and are aligned with any revisions to this SAP. The field work supervisor-BTR will ensure all deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action procedures.

The project manager and field work supervisor (or designee) will be responsible for communicating field corrective action requirements and ensuring immediate corrective actions are applied to field activities.

Logbooks are required for field sampling activities. The logbook must be identified with a unique project name and number. Individuals responsible for logbooks will be listed and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Entries will be made in indelible ink and pages will not be removed from logbooks for any reason. Logbook corrections will made by marking the erroneous data through with a single line, entering the correct data, and initialing and dating the changes.

The project manager is responsible for ensuring a project file is properly maintained. The project file will include the following, as appropriate:

- Field logbooks or operational records
- Data forms

- Global Positioning System data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective-action reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract
- Laboratory data packages
- Remedial investigation report
- Verification and validation report.

Examples of documentation and configuration controls to detail the actions and associated documentation for specific types of changes are shown in Table 2-3.

Table 2-3. Change Controls for Sampling Projects

Type of Change	Action	Documentation
By drilling lead or sampling lead: • Increasing sampling frequency based on field screening results or visual observations • Addition of constituents • Limited borehole location movement to avoid physical interferences	Field Technical Representative approval No sampling and analysis plan revision necessary	• Logbook entry • Field sample report entry • Traveler report entry
By project management: • Change in target analytes or contaminants of potential concern • Adding wells • Significant borehole location changes • Significant increases in sampling frequency	RL and regulatory agency approval	• Letter report documenting changes • SAP revision or Tri-Party Agreement change notice

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

SAP = sampling and analysis plan

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 hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure the accuracy and retrievability of stored records. Records required by the Tri-Party Agreement will be managed in accordance with the requirements of the agreement.

2.2 Data Generation and Acquisition

This section addresses the basic elements of project design and implementation. Implementation ensures appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and properly documented.

2.2.1 Sampling Process Design

The sampling design used for this project is systematic and grid sampling. In systematic and grid sampling, samples are taken at regularly spaced intervals over space or time. The sampling locations are defined so all locations are at regular intervals over an area (grid) or time (systematic). Systematic and grid sampling is useful for estimating spatial patterns or trends over time. This design provides a practical and easy method for designating sample locations and ensures uniform coverage of a site, unit, or process. In this case, the spatial coverage will be provided by a closely spaced line of wells that will characterize the Sr-90 plume along a portion of the Columbia River. The key features of the sampling design are provided in Section 3.5 of this SAP.

2.2.2 Sampling Methods

Specific sampling information (described in Section 3.5) will include the following:

- Field sampling methods
- Corrective actions for sampling activities
- Decontamination of sampling equipment
- Sample preservation, containers, and holding times (Section 3.6).

Special care will be taken to prevent cross-contamination of samples to avoid the following common ways in which cross-contamination or background contamination may compromise 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.

2.2.3 Sample Handling and Custody

Field sample handling, shipping, and custody requirements will be consistent with established procedures. Specific sample handling information (described in Section 3.7) includes the following:

- Container requirements
- Container labeling and tracking process
- Sample custody requirements
- Shipping and transportation.

2.2.4 Analytical Methods

Information on analytical and geophysical performance requirements is provided in Table 2-2. These analytical methods are controlled in accordance with the laboratory's QA Plan and the requirements of this QAPjP. The primary contractor participates in oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work.

If the laboratory uses a nonstandard or unapproved method, the laboratory must provide method validation data to confirm the method is adequate for the intended use of the data. This includes information such as determination of detection limits, quantitation limits, typical recoveries, and analytical precision and bias. Deviations from the analytical methods noted in Table 2-2 must be approved by the Sample and Data Management Organization in consultation with project manager.

Laboratories providing analytical services in support of this SAP will have in place a corrective action program that addresses analytical system failures and documents on the effectiveness of any corrective actions. Issues that may affect analytical results are to be resolved by the Sample and Data Management Organization in coordination with the project manager.

2.2.4.1 Non-Routine Analytical Methods

Non-routine analytical methods will not be employed by the Waste Sampling and Characterization Facility (WSCF) laboratory for the samples collected for this SAP.

2.2.5 Quality Control

QC procedures must be followed in the field and laboratory to ensure reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field variability. Field QC for sampling will require the collection of field duplicates and splits. Laboratory QC samples estimate the precision and bias of the analytical data. The requirements for QC are discussed in Section 3.5.2.

2.2.5.1 Field Quality Control Samples

Field transfer blanks, duplicates and split samples will be collected from the well samples.

Field transfer blanks are preserved volatile organic analysis sample containers filled at the sample collection site with reagent water transported to the field. The samples are prepared during the sampling to evaluate potential contamination caused by conditions in the field. After collection, field transfer blank bottles are sealed and placed in the same storage container with the samples from the associated sampling event. Field transfer blank samples are analyzed for volatile organic compounds only.

A minimum of one field transfer blank will be collected at each borehole where the samples will undergo volatile organic analysis. The field transfer blank will consist of reagent water added to clean sample containers at the location where the volatile organic compound sample was collected.

Field duplicate samples are used to evaluate sample consistency and the precision of field sampling methods. Field duplicates are independent samples that are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently.

A **field split** is a representative sample(s) from a sampling event(s) sent to a third-party laboratory (reference laboratory). Evaluation of the results can provide an indication of inter-laboratory variability. Large relative percent differences can be an indication of laboratory performance problems and should be

investigated. Only those results greater than five times the method detection limit or minimum detectable activity at both laboratories are evaluated.

2.2.5.2 Laboratory Quality Control Samples

The laboratory QC samples (e.g.. method blanks, laboratory control sample/blank spike, and matrix spike) are defined in Chapter 1 of SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III A, as amended, and will be run at the frequency specified in that reference unless superseded by agreement.

QC checks outside control limits will be identified in the data validation process and during the DQA, if performed, described in Section 2.4.

2.2.5.3 Quality Control Requirements

Only disposable equipment will be used for well sampling, and equipment rinsate blanks are not required. Because benzene and TPH samples are collected, a field transfer blank is required for each sample.

Field duplicates must agree within 20 percent, as measured by the relative percent difference, to be acceptable. Only those field duplicates with at least one result greater than five times the appropriate detection limit are evaluated. Unacceptable field duplicate results are also flagged with a "Q" in the database.

For chemical analyses, the acceptance criteria for laboratory duplicates, matrix spikes, matrix spike duplicates, surrogates, and laboratory control samples are generally derived from historical data at the laboratories in accordance with SW-846. Typical acceptance limits are within 25 percent of the expected values, although the limits may vary considerably with the method and analyte. For radiological analyses, the acceptance limits for laboratory QC samples are specified in the laboratory contract.

Holding time is the elapsed time period between sample collection and analysis. Exceeding recommended holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Recommended holding times depend on the analytical method, as specified in SW-846 or EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes*. Holding times are specified in laboratory contracts. Data associated with exceeded holding times are flagged with an "H" in HEIS.

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies. The groundwater project periodically audits the analytical laboratories to identify and solve quality problems or to prevent such problems. Audit results are used to improve performance. Summaries of audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

Failure of QC will be determined and evaluated during data validation and DQA process. Data will be qualified as appropriate.

2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Equipment used for collection, measurement, and testing should meet applicable standards (e.g., American Society for Testing and Materials [ASTM]) or will have been evaluated as acceptable and valid in accordance with procedures, requirements, and specifications. The field work supervisor, FTR, or equivalent will ensure the data generated from instructions using a software system are backed up

and/or downloaded on a regular basis. Any software configuration will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field that directly affects the quality of analytical data will be subject to preventive maintenance measures to minimization measurement system downtime. Onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and the onsite organization's QA plan or operating procedures (as appropriate). Maintenance of laboratory instruments will be performed in a manner consistent with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (as amended), or with auditable DOE Hanford Site and contractual requirements. Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use.

2.2.7 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in Section 3.4 of this SAP. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan.

2.2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling activities are procured in accordance with internal work requirements and processes that describe the contractor acquisition system and the responsibilities and interfaces necessary to ensure items procured/acquired for the contractor meet the specific technical and quality requirements. The procurement system ensures purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with the laboratory's QA plan.

2.2.9 Non-direct Measurements

Non-direct measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Non-direct measurements will not be evaluated as part of this activity.

2.2.10 Data Management

The Sample Management and Reporting Organization, in coordination with the Project Manager, is responsible for ensuring analytical data are appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management procedures. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). 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., 2003).

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed laboratory sample collection activities, as discussed in the sample team's procedures. In the event specific procedures do not exist for a particular work evolution, or it is determined additional guidance to complete certain tasks is needed, a work package will be developed to adequately control the activities, as appropriate. Examples of the sample team's requirements include activities associated with the following:

- COC/sample analysis requests

- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks
- Checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document field activities, including radiological measurements when this SAP is implemented. All field activities will be recorded in the field logbook. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information as per 10 CFR 835, "Occupational Radiation Protection."
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of primary contractor radiological records.
- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related records.
- The indoctrination of personnel on the development and implementation of sample plans.
- The requirements associated with preparing and transporting regulated material.
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities. Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.
- 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.

Laboratory errors are reported to the Sample Management and Reporting Organization on a routine basis. For reported laboratory errors, the sample issue resolution process will be initiated in accordance with Contractor procedures. This process is used to document analytical errors and to establish their resolution with the Project Manager.

2.3 Assessment and Oversight

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

2.3.1 Assessments and Response Actions

Contractor management, regulatory compliance, quality, and/or health and safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. The project manager will determine if a DQA will be performed for the activities identified in this SAP; the DQA process, if performed, is discussed in Section 2.4). The results of the DQA will be provided to the project manager. No other planned assessments have been identified.

If circumstances arise in the field that dictate the need for additional assessment activities, the activities will be performed and recorded. 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 in accordance with the contractor QA program, the corrective action management program, and associated procedures that implant these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. The primary contractor conducts oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratory will be dispositioned in accordance with the laboratory's QA plan.

2.4 Data Validation and Usability

The elements in this group address the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether data conform to the specified criteria, thus satisfying project objectives.

2.4.1 Data Review, Verification, and Validation

The criteria for verification may include review for completeness (all samples were analyzed as requested), use of the correct analytical method/procedure, review for transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

Data validation will be performed to ensure that the data quality goals established during the planning phase have been achieved. Data validation will be in accordance with internal procedures. The criteria for data validation are based on a graded approach. The primary contractor has defined five levels of validation, A through E. Level A is the lowest level and is the same as verification. Level E is a 100 percent review of data (e.g., calibration data; calculations of representative samples from the dataset). Validation will be performed to contractor Level C, which is a review of the QC data. Level C validation specifically requires verification of deliverables and requested versus reported analyses and qualification of the results based on analytical holding times, method blank results, matrix spike/matrix spike duplicate, surrogate recoveries, duplicates, and analytical method blanks. Level C validation will be performed on at least 5 percent of the data by matrix and analyte group. Analyte group refers to categories, such as radionuclides, volatile chemicals, semivolatiles, metals, and anions. The goal is to cover the various analyte groups and matrices during the validation.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences of risk. Data validation will not be performed for physical property data and/or field screening results.

2.4.2 Verification and Validation Methods

Validation activities will be based on EPA functional guidelines. Data validation may be performed by the analytical laboratory, Sample Management and Reporting, and/or by a party independent of both the data collector and the data user.

Qualifications for data validators compatible with HEIS will be used.

When outliers or questionable results are identified, additional data validation will be performed. The additional validation will be performed for up to 5 percent of the statistical outliers and/or questionable data. The additional validation will begin with Level C and may increase to Levels D and E as needed to ensure that data are usable. Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the dataset. Data validation will be documented in data validation reports. An example of questionable data is the positive detections are greater than the practical quantitation limit or reporting limit in soil/aquifer sediment from a site that should not have exhibited contamination. Similarly, results below background would not be expected and could trigger a validation inquiry.

Data validation will be documented in data validation reports, which will be included in the project file.

2.4.3 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 data evaluation is to determine whether quantitative data are of the correct type and of adequate quality and quantity to meet the project DQOs. The project manager is responsible for determining whether a DQA is necessary and ensuring that it is performed, if required. The results of the DQA will be used in interpreting the data and determining if the objectives of this activity have been met.

The DQA (if performed) with be in accordance with the EPA's DQA process, *Data Quality Assessment: A Reviewer's Guide*, QA/G-9R (EPA/240/B-06/002) and *Data Quality Assessment: Statistical Tools for Practitioners*, EPA QA/G-9S (EPA/240/B-06/003).

2.4.4 Corrective Actions

The responses to data quality defects identified through the DQA process will vary and may be data-specific or measurement-specific. Some pre-identified corrective actions are identified in Table 2-1.

3 Field Sampling Plan

3.1 Sampling Objectives

This field sampling plan identifies and describes the sampling and analysis activities being conducted to support characterization of the 100-NR-2 Groundwater OU Sr-90 plume along the Columbia River shoreline. The key features of the sampling design are summarized in Table 3-1.

Table 3-1. Key Features of Sampling Design

Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Sample Frequency	Depth Interval (ft)	Field QC	Analytes
Field Measurements Sampling						
Well Water Sampling	Field measurement samples collected at the end of well development and before analytical samples. Use unfiltered water, measure as soon as possible after collection at the well head.	Data establishes baseline of field measurements prior to collection of analytical samples	One sample from each well	Varies with well	N/A	Field Measurements in Table 2-2.
Analytical Laboratory Sampling						
Well water sampling	Collected after field measurements sampling.	Characterize 100-NR-2 plume along the river	One sample from each well	Varies with well	One Duplicate for every 20 wells One Split for every Sr-90 sample collected	Gross Beta and Nonradiological analytes in Table 2-2[a]
		Determine effect of upstream TPH spill	One sample from each well upstream of existing PRB	Varies with well	One Field Transfer Blank for each Benzene sample	Add Benzene and TPH analysis to water samples from these wells

Table 3-1. Key Features of Sampling Design

Sampling Collection Methodology	Key Features of Design	Basis for Sampling Design	Sample Frequency	Depth Interval (ft)	Field QC	Analytes
Apatite Formation Testing						
Continuous core sampling	Collect continuous core samples during drilling of wells C7460, C7461, and C7462.	Analyze soil core to determine apatite presence, presence of phosphate, Sr-90 concentrations, and Sr-90 absorption into apatite	Continuous core sample from designated wells	From surface to ground-water	--	Sr-90, apatite, Ca, Sr, PO4

[a] Sr-90 analysis will be added to split samples as directed by Project Manager

QC = quality control

3.2 Documentation of Field Activities

Logbooks or data forms are required for field activities. Requirements for the logbook are provided in Section 2.1.4. Data forms may be used to collect field information; however, the forms must follow the same requirements as the logbooks and must be referenced in the logbooks.

3.3 Sampling Design

3.3.1 Borehole Installation

To collect groundwater and sediment samples, 146 multi-purpose shallow boreholes/wells will be installed along the bank of the Columbia River for collection of groundwater and sediment samples. In addition, 24 monitoring wells will be drilled in the same vicinity; three of the 24 monitoring wells will be drilled through the Apatite Barrier and will be continuously cored for analysis to determine long-term barrier performance.

The drill rig and all downhole equipment will be decontaminated by high-temperature and pressure washing prior to use and before starting each new well. Approximately one-half of the boreholes will be drilled to ~ 4.6 m (15 ft) bgs within the Hanford formation and the other half will be drilled to 7.6 m (25 ft) bgs in the Ringold Formation. The final total depth of the wells will be confirmed by the BTR and field geologist/hydrogeologist and may change depending on the hydrogeologic conditions encountered.

Drilling activities are considered low radiological risk and low chemical risk based on the drilling and sampling data from nearby wells. Radiological contamination in the historical saturated zone is not expected to be a significant concern, although Sr-90 has been detected in the groundwater at nearby wells.

3.3.2 Well Construction

Figures 1-9 and 1-10 present the proposed well design for the Hanford formation and Ringold Formation wells, respectively, and illustrates the construction details for the 170 new 100-NR-2 OU apatite PRB multipurpose wells. All drilled boreholes shall be 25.4-cm (10-in.), nominal-diameter and completed using 15.24-cm (6-in.), Schedule 80, polyvinyl chloride (PVC) casing with an end cap of the same

material. The well screen will be 15.24-cm (6-in.), PVC screen (with slot size and configuration to be determined) and will be 1.52- to 2.13-m (5- to 7-ft) long (length varies between Hanford formation and Ringold Formation wells). All wells will have a flush-mount surface completion and an interior locking water-tight cap for the 6-inch PVC pipe.

Annular fill material will consist of a primary filter pack (size of the mesh silica sand to be determined), bentonite intermediate seals, and a cement grout surface seal. An environmentally compatible, non-petroleum lubricant (e.g., Jet-Lube Well Guard® thread compound, or equivalent) may be used for lubricating the threads of the temporary drill casing while installing the wells. A general summary of proposed well construction parameters for these wells, including the estimated water level, well depth, screen interval, primary sand pack intervals, bentonite intermediate intervals, and cement grout surface seal interval is provided in Table 3-2.

Table 3-2. Proposed Well Construction for 100-NR-2 Groundwater Operable Unit Apatite PRB Multipurpose Wells

Estimated Depth to Water (ft)[a]	Planned Total Depth (ft)[b]	Screen and Casing Inner Diameter (in.)	Screen Slot Size	Screen Length[b] (ft)/ Interval (ft bgs)	Primary Filter Pack Mesh/ Interval (ft bgs)	Bentonite Intermediate Seals (ft bgs)	Cement/Grout Surface Seal (ft bgs)
Approx. 10 ->15	15	6	TBD	5/ 10 to 15	TBD/ 9-16	5 to 7 / 7 to 9	0 to 5
Approx. 15 - 20	25	6	TBD	7/ 17 to 24	TBD/ 16 to 25	10 to 13 / 13 to 16	0 to 10

a. Depth to water can range from 3 to >6 m (10 to >20 ft) bgs, depending on Columbia River stage.

b. Information presented in the table are estimates. Final position of well screen, filter pack interval, bentonite intervals, and cement seal interval will be determined based on actual borehole conditions.

bgs = below ground surface

TBD = to be determined

Final well construction details will be confirmed by the BTR and/or CHPRC field geologist/ hydrogeologist prior to construction.

Final placement of the well screen will be at the direction of the BTR and/or CHPRC field geologist/hydrogeologist. The well casing/screen pipe string must be maintained in tension (i.e., the weight of the string is suspended from the top and not allowed to rest on the bottom of the borehole) to maintain straightness of the completed well. The primary filter pack will consist of sand (mesh size TBD), placed from 0.3 m (1 ft) below the screen to 0.3 m (1 ft) above the screen, and will be settled by the dual-surge block method and bailing technique if field conditions permit.

3.4 Calibration of Field Equipment

The Field Work Supervisor is responsible for ensuring all field equipment is calibrated appropriately. All onsite environmental instruments are calibrated in accordance with the manufacturer's operating

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instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. The results from all instrument calibration activities are recorded in logbooks and/or work packages; either hard copy or electronic are acceptable.

Calibrations must be performed as follows:

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

Field instrumentation, calibration, and QA checks will be performed in accordance with the following:

- Calibration of radiological field instruments on the Hanford Site is performed under contract by PNNL, as specified in their program documentation.
- Daily calibration checks will be performed and documented for each instrument used to characterize areas that are under investigation. These checks will be made on standard materials, sufficiently similar to the matrix under consideration, that direct comparison of data can be made. 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.

3.5 Sampling Locations and Frequency

The key features of the sampling design for the new shallow multipurpose wells are identified in Table 3-1. Table 1-1 provides the Well ID numbers. The well locations shown in Figure 1-2 show the approximate well locations. The coordinates for the wells will be provided in the well drilling statement of work.

3.5.1 Media Sampling

During the installation of three of the 24 monitoring wells, continuous core samples will be collected from the ground surface to total depth (see Figure 1-8). The continuous core locations were selected to obtain information within the footprint of the Apatite Barrier. The resulting data will be used to assess spatial variability in sediment physical properties, areal and vertical extent of apatite formation, and barrier performance via Sr-90 activity.

A 10.2-cm (4-in.) inner-diameter core will be collected in 0.762-m (2.5-ft)-long runs; the split-spoon 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 taped to prevent the caps from coming off during transport or storage. The soil core in the Lexan® liners will be analyzed as described in Table 3-1.

Archive grab samples will be collected in chip trays and mason jars by the well site geologist. All material should be cataloged and the containers labeled according to depth and well number.

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Water levels will be monitored during well construction and development activities. No water samples will be collected during drilling. Final development water samples will be collected when the well is completed and ready for use.

3.5.2 Quality Control Sampling

Field and laboratory QC sampling requirements are summarized in Table 3-3.

Table 3-3. Project Quality Control Sampling Summary

QC Sample Type	Purpose	Frequency
Field QC		
Field transfer blanks	Evaluate potential contamination caused by field conditions	1 /Benzene sample
Field duplicates	Precision of all steps after acquisition	1/20
Field splits	Indicates inter-laboratory variability	a
Laboratory QC		
Method blank	Laboratory contamination	1 per batch
Matrix duplicates	Laboratory reproducibility	b
Matrix spikes	Matrix effect and Laboratory accuracy	b
Matrix spike duplicates	Laboratory Reproducibility/Accuracy	b
Laboratory control samples	Method accuracy	1 per batch
Surrogates	Recovery/yield	b

QC = quality control

a. As directed by the Project Manager.

b. As defined in the laboratory contract or QA plan and/or analysis procedures.

3.5.3 Corrective Actions and Deviations for Sampling Activities

The project manager or FTR (or designee) must document all deviations from procedures or other problems pertaining to sample collection, COC, target analytes, sample transport, or noncompliant monitoring. Examples of deviations include samples that cannot be 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 in the field logbook or on nonconformance report forms in accordance with internal corrective action procedures. The project manager or FTR (or designee) will be responsible for communicating field corrective action requirements and ensuring immediate corrective actions are applied to field activities.

More significant changes in sample locations that do not affect DQOs will require notification and approval of the project manager. Changes to sample locations that could result in impacts to meeting the DQOs will require concurrence with RL and regulatory project managers. Changes to the SAP will be documented as described in Section 2.1.4.

3.5.4 Decontamination of Sampling Equipment

To prevent contamination of the samples, care should be taken to use clean equipment for each sampling activity.

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.

3.6 Sampling Procedures

Samples will be collected in accordance with standard procedures. Sample preservation, containers, and holding times are presented in Table 3-4.

Table 3-4. Sample Preservation, Container, and Holding Time Guidelines

Analytes	Analytical Priority	Matrix	Container	Volume[a]	Preservation	Packing Requirement	Holding Time
Strontium 89/90—Total Rad. Sr	1	Water	G/P	1-L	HNO_3 to pH <2	None	6 months
Gross beta	1	Water	G/P	1-L	HNO_3 to pH <2	None	6 months
ICP Metals—6010	1	Water	G/P	250-mL	HNO_3 to pH <2	None	6 months
Anions by IC—300.0	2	Water	G/P	120-mL	Cool, 4°C	None	48 hours
Benzene by 8260	3	Water	aGs	3-40-mL	HCl pH<2, Cool, 4°C	None	14 days
TPH by 418.1	3	Water	aG	3-1000-mL	HCl pH<2, Cool, 4°C	None	14 days
Field Measurements							
pH	1	Water	Poly beaker	50-mL	None	None	N/A
Temperature (°C)	1	Water	Poly beaker	50-mL	None	None	N/A
Specific conductance (µS/cm)	1	Water	Poly beaker	50-mL	None	None	N/A
Dissolved oxygen (mg/L)	1	Water	Poly beaker	50-mL	None	None	N/A
Oxidation-Reduction Potential (mV)	1	Water	Poly beaker	50-mL	None	None	N/A

Table 3-4. Sample Preservation, Container, and Holding Time Guidelines

Analytes	Analytical Priority	Matrix	Container	Volume[a]	Preservation	Packing Requirement	Holding Time
PNNL Apatite Formation Testing							
Apatite, phosphate, Sr-90	1	Soil	6-in Lexan split spoon liners	~ 1-L/ liner	Cool	None	N/A

ICP = inductively coupled plasma emission spectroscopy

3.7 Sample Handling

3.7.1 Packaging

All field sample handling, shipping, and custody requirements will be consistent with established procedures. Level I EPA pre-cleaned sample containers will be used for water samples collected for chemical and radiological analysis. Sediment containers used in this SAP include Lexan liners, which are cleaned to EPA specifications before use in sample collection. Geological archive samples are not used for chemical analysis and do not need to meet any specific cleaning requirements. Chip trays and mason jars come "clean" from the manufacturers and can be used without additional cleaning. The radiological engineering organization will screen samples for radiological levels. This information and other data will be used to select proper packaging, marking, labeling, and shipping paperwork and verify the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. If the sample dose rate exceeds laboratory acceptance criteria, options will be evaluated with the field work supervisor. Container types and volumes are identified in Table 3-4. The final types and volumes will be indicated on the field task instruction prepared by the sampling coordinator.

3.7.2 Container Labeling and Sample Documentation

A sampling and data tracking (SDT) database is used to track the samples from the point of collection through the laboratory analysis process. When a project plans sampling and generates a SAP, the Sample and Data Management team generates a Sample Authorization Form (SAF) to allow for samples to be collected and analyzed. Each SAF has a unique number and is associated with a project's SAP. The SDT database generates several forms for tracking sampling documentation. These include a Field Sampling Report (FSR) for each set of samples and accompanying COC forms. The sample location, depth, and corresponding sample numbers are also documented in the sampler's controlled field logbook. A custody seal (e.g., evidence tape) is affixed to each sample container and/or the sample collection package in such a way as to indicate potential tampering as required by procedure.

Each sample container will be labeled with the following information on firmly affixed, water-resistant labels (generated by SDT for most samples):

- Sample authorization form number (SAF number)
- Sample collection date/time, well identification, and interval sampled
- Analysis required
- Preservation method (if applicable).

In addition to the information requirements stated above, sample records must also include the following information:

- COC (each COC has a unique number associated with the SAF it was generated under)
  - Analysis(ses) required
  - Number and size of bottles for each analysis
  - Preservation methods for each analysis
  - Source of sample (well number, sample collection depth (ft bgs), etc.)
  - Matrix (sediment or water)
  - Any special instructions or hazards related to the samples.
- FSR (each FSR has a unique number associated with the SAF under which it was generated)
  - Field data table (for pH, temperature, conductivity, dissolved oxygen, oxidation-reduction potential, and other field measurements)
  - Radiological readings
  - Industrial hygiene readings
  - Sampling conditions (weather, etc.)
  - Any other relevant comments pertaining to sample collection activities.

3.7.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure sample integrity throughout the analytical process. The custody of samples will be maintained from the time the samples are collected until the ultimate disposal of the samples, as appropriate. A custody seal (e.g., evidence tape) is affixed to each sample container and/or the sample collection package in such a way as to indicate potential tampering. A COC 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 containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying COC form. COC procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure sample integrity is maintained. Each time the responsibility changes for the sample custody, 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 Sample and Data Management Organization within 48 hours of shipping.

The following information is required on a completed COC form:

- Project name
- Signature of sampler
- Unique sample number
- Well identification and sample depth
- Date and time of collection
- Matrix
- Preservatives
- Signatures of individual involved in sample transfer
- Requested analyses (or references thereto).

3.7.4 Sample Transportation

Sample transportation will be in compliance with applicable regulations for packaging, marking, labeling, and shipping hazardous materials, hazardous substances, and hazardous waste as mandated by the U.S. Department of Transportation (49 CFR, "Transportation"), in association with the International Air Transportation Authority, DOE requirements, and applicable program-specific implementing procedures.

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4 Health and Safety

All field operations will be performed in accordance with CHPRC health and safety requirements, outlined in an approved project-specific health and safety plan. In addition, a work control package will be prepared to further control site operations. This work package will include an activity hazard analysis and reference applicable radiological control requirements, if required. Radiological contamination is expected to be encountered during performance of the well drilling and sampling activities.

The sampling processes and associated activities will take into consideration exposure reduction and contamination control techniques (e.g., ALARA 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 this SAP as input to determine exposure levels to workers, and to conduct health and safety assessments during all field activities, in accordance with the health and safety plan.

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5 Management of Waste

All waste generated by well drilling, well construction, sampling activities, and well development will be managed in accordance with the waste management portion of an approved waste control plan. Disposition of drill cutting, purgewater, and miscellaneous solid waste will be conducted in accordance with the project-specific waste DQOs.

Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the laboratory contract and agreements for return to the project site. Pursuant to 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).

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6 References

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