DOE/RL-2000-59
Revision 1

Sampling and Analysis Plan for Aquifer Sampling Tubes

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

Approved for Public Release;
Further Dissemination Unlimited

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Freestone Environmental

Date Published
February 2009

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Release Approval Date 02/24/2009

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CONCURRENCE PAGE

Title: Sampling and Analysis Plan for Aquifer Sampling Tubes

Concurrence: U.S. Department of Energy, Richland Operations Office

Signature 2-27-09 Date

Washington State Department of Ecology

Signature 3/10/09 Date

Environmental Protection Agency

Signature March 12, 2009 Date

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LIST OF TERMS

ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FY	fiscal year
GC	gas chromatography
ICP/MS	ion chromatography/mass spectrometry
HEIS	Hanford Environmental Information System
LCS	laboratory control sample
MCL	maximum contaminant level
MDA	minimum detectable activity
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
OU	operable unit
PCB	polychlorinated biphenyl
PNNL	Pacific Northwest National Laboratory
QA	quality assurance
QC	quality control
RCT	radiological control technician
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
RPD	relative percent difference
RSD	relative standard deviation
S&GRP	Soil and Groundwater Remediation Project
SVOA	semi-volatile organic analysis
TPH	total petroleum hydrocarbon
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VOA	volatile organic analysis
VOC	volatile organic compound

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METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerels	millibecquerels	0.027	picocuries

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1.0 INTRODUCTION

Groundwater contamination is known or suspected along the Hanford Site shoreline of the Columbia River, adjacent to the retired reactor areas and the fuel fabrication area. Aquifer sampling tubes were installed along the 100 Areas, 300 Area, and the intervening 600 Area shoreline to monitor the extent and concentration of contaminated groundwater discharging into the river. Aquifer sampling tubes are emplaced in the aquifer at the shoreline to obtain groundwater samples from near or within the groundwater/river water interface. Because of the ease of installation, the tubes provide more continuous coverage of the Hanford Site shoreline than groundwater monitoring wells. Figures 1-1 through 1-10 show the locations of Hanford Site aquifer tubes.

This sampling and analysis plan (SAP) presents the overall rationale and strategy for the sampling and analysis of aquifer sampling tubes adjacent to and within the Columbia River. Project background information and the quality assurance project plan (QAPjP) are also provided. The fiscal year (FY)-specific sampling locations and analyses for aquifer sampling tubes are presented in Appendix A. Appendix A will be reviewed each FY and revised as needed to satisfy changing operable unit (OU) data needs. The appendix will be subject to review and approval by the U.S. Department of Energy (DOE) and the regulatory agencies.

1.1 BACKGROUND

1.1.1 Project History

The Hanford Site became a Federal facility in 1943 when the U.S. Government took possession of the land to produce nuclear materials for defense purposes. Production at Hanford continued until the late 1980s, when the mission changed from producing nuclear materials to cleaning up the radioactive and hazardous wastes generated over the previous years.

The 100 Areas, the locations of the former plutonium-production reactors and associated support facilities, were constructed along the shoreline of the Hanford Site to use Columbia River water to cool the reactor cores. Uranium fuel assemblies for the reactors were fabricated at the 300 Area, located along the river just north of city of Richland, Washington. Due to operational waste disposal practices, groundwater contamination was known or suspected along the Hanford Site shoreline of the Columbia River adjacent to these areas.

Initial characterization of contamination near the river relied on data from a limited number of near-river wells, contaminant plume migration predictions, and riverbank seepage sampling to anticipate shoreline conditions. Methods were later developed to obtain groundwater samples from the aquifer near the groundwater/river water interface. These methods include using (1) divers to obtain samples of porewater from riverbed sediment and to later install horizontal monitoring points, and (2) sampling tubes that are driven into the aquifer at the shoreline. The latter method provided easy access to the aquifer and permitted sampling the aquifer at multiple depths to determine the thickness of the potentially contaminated groundwater layer that discharges into the river (*Aquifer Sampling Tube Installation Completion Report: 100 Area and Hanford Townsite Shorelines* [BHI-01153]).

Porewater samples collected in the Columbia River offshore of the 100-H Area in March through April 1995 identified three sites with elevated hexavalent chromium concentrations (greater than the 22 µg/L maximum contaminant level [MCL]). Sampling offshore in the 100-D/DR Area in October and November 1995 resulted in locating hexavalent chromium concentrations up to 632 µg/L. This contaminated groundwater was seeping into the Columbia River in the vicinity of the fall Chinook salmon (*Onchorynchus t.shawytscha*) spawning habitat within the Hanford Reach (*Chromium in River Substrate Pore Water and Adjacent Groundwater: 100-D/DR Area, Hanford Site, Washington* [BHI-00778]).

After completion of initial porewater studies, the first 14 aquifer sampling tubes were installed along the 100-D/DR Area shoreline and were sampled in October and November 1995. Aquifer sampling tube DD-39, located adjacent to the high hexavalent chromium (632 µg/L) porewater sampling site, reported up to 839 µg/L of hexavalent chromium. The result of this effort was documented in BHI-00778 and led to the discovery of the chromium hot spot plume located west of the D and D/R Reactors.

Aquifer tube location criteria and sampling methodology were developed in a series of data quality objective (DQO) process workshops involving the U.S. Department of Energy, Richland Operations Office (RL); the Environmental Restoration Contractor; the U.S. Environmental Protection Agency (EPA); the Washington Department of Health; and the Washington State Department of Ecology (Ecology) in September 1997 (*Description of Work for Installing Aquifer Sampling Tubes Along the 100 Area and Hanford Townsite Shorelines* [BHI-01090]). As a result of the workshop consensus, aquifer sampling tubes were installed and sampled at 70 of the planned 89 additional locations in September through November 1997. Each location was equipped with one to three tubes, for a total of 178 new aquifer sampling tubes. Per the sampling methodology, a water sample was collected from each newly installed tube, and the sample with the highest specific conductivity greater than 200 µS/cm (judged to be most representative of groundwater) was selected for additional onsite and offsite analysis. The results of this effort are presented in *Aquifer Sampling Tube Completion Report: 100 Area and Hanford Townsite Shorelines* (BHI-01153). Since that time, aquifer sampling tube results were either presented in the annual Hanford Site groundwater monitoring report or in stand-alone documents. Table 1-1 lists the documents that contain the aquifer tube sampling results.

Data gaps resulting from incomplete shoreline coverage and the destruction of tubes by animals and the elements, in addition to project-specific monitoring needs, have required the installation of additional aquifer sampling tubes. Aquifer sampling tubes were installed during 2003 and 2004 in the 100 Areas to monitor additional shoreline and in the 300 Area to support investigation of the 300-FF-5 Groundwater OU. Aquifer tubes were installed in the 100-N Area and 300 Areas by Pacific Northwest National Laboratory's (PNNL's) Science and Technology Program to study groundwater/river interaction. Additional sites were added to extend aquifer sampling tube coverage in 2007 and 2008, as described in *Sampling and Analysis Instruction for Investigating Chromium Groundwater Contamination in the 600 Area Between 100-D and 100-H* (SGW-33224) and *100/300 Areas Aquifer Tube Sampling and Analysis Instruction for Fiscal Year 2008* (SGW-34551). Figures 1-1 through 1-10 show the aquifer sampling tube locations at the end of FY08. Table A-1 in Appendix A lists the aquifer tubes and screen depths for those tubes scheduled for sampling in FY09. A complete list of aquifer tubes, including those not routinely sampled, will be included in the upcoming report, *Aquifer Sampling Tube Results for Fiscal Year 2008* (in publication).

Figure 1-1. Locations of Hanford Site Aquifer Tubes.

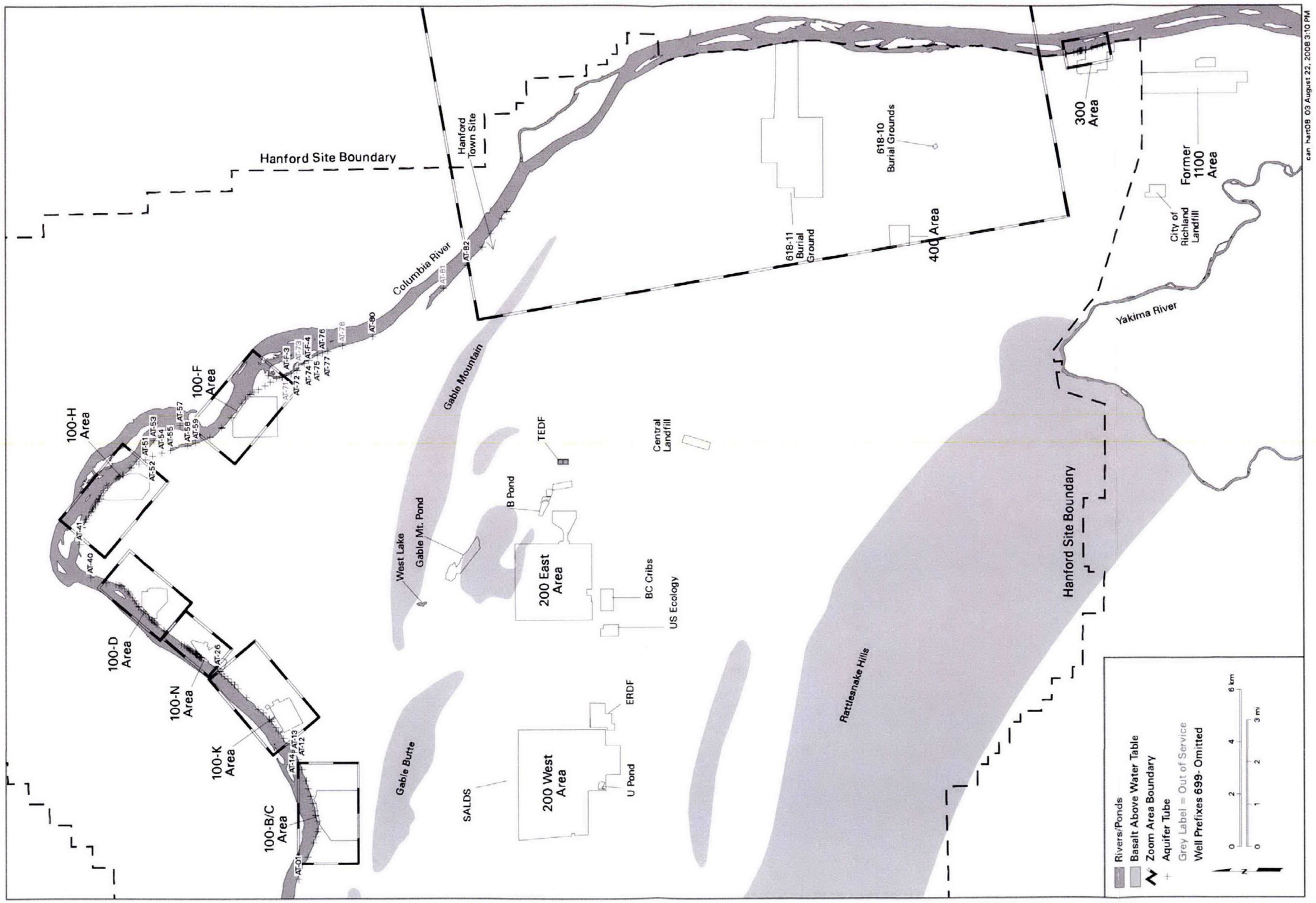


Figure 1-2. 100-B/C Area Aquifer Tubes and Monitoring Wells.

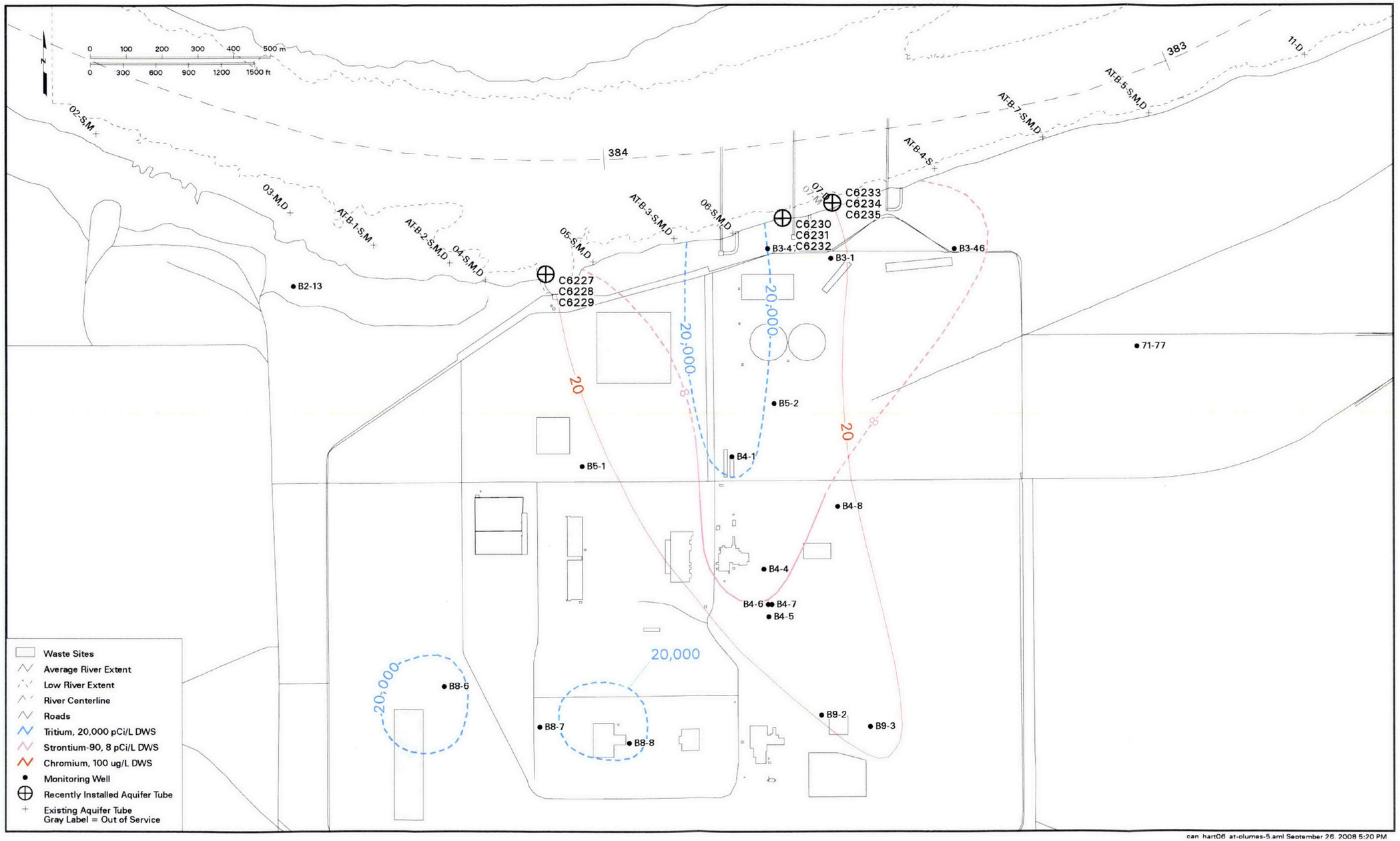


Figure 1-3. 100-K Area Aquifer Tubes and Monitoring Wells.

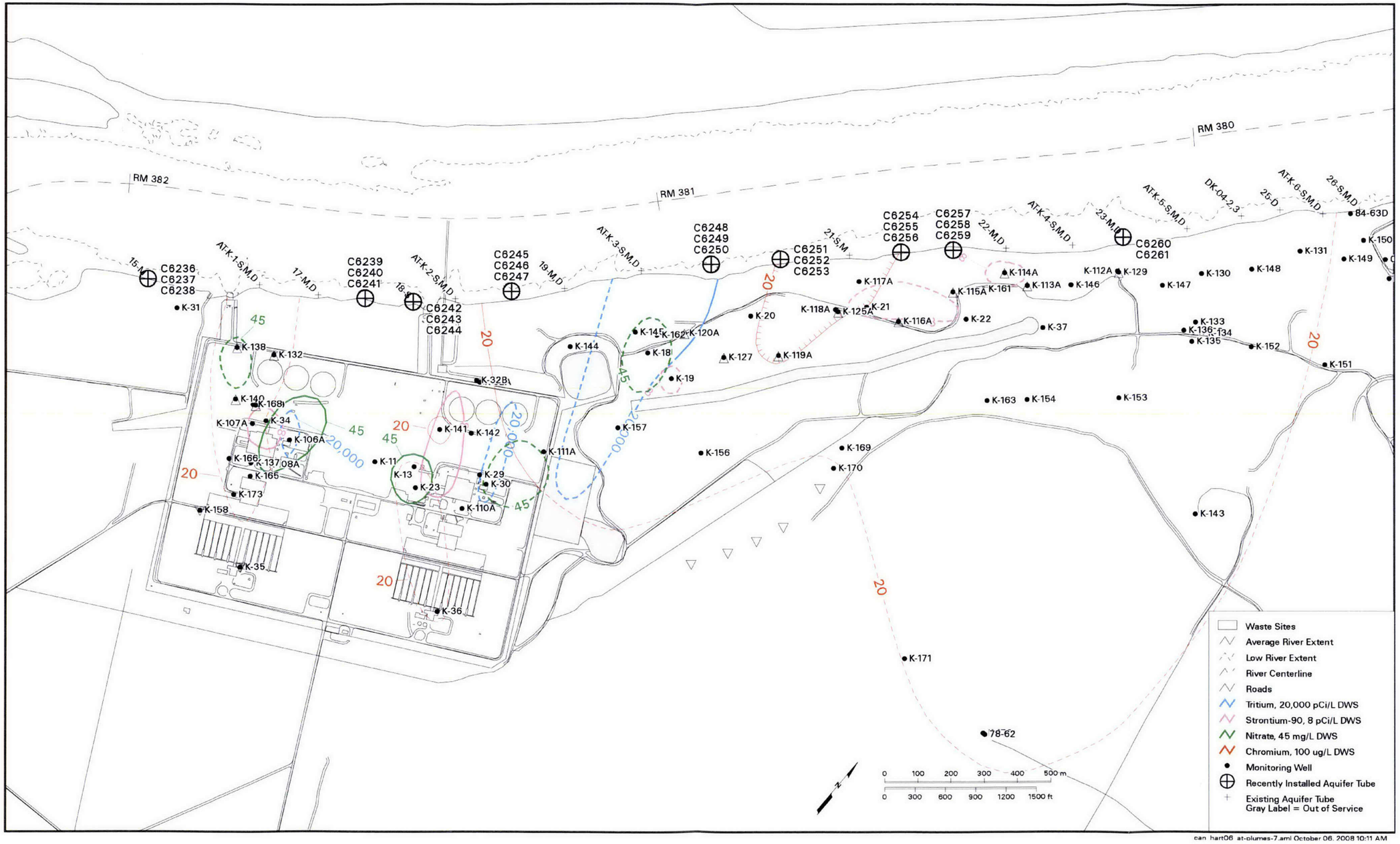


Figure 1-4. 100-N Area Aquifer Tubes and Monitoring Wells.

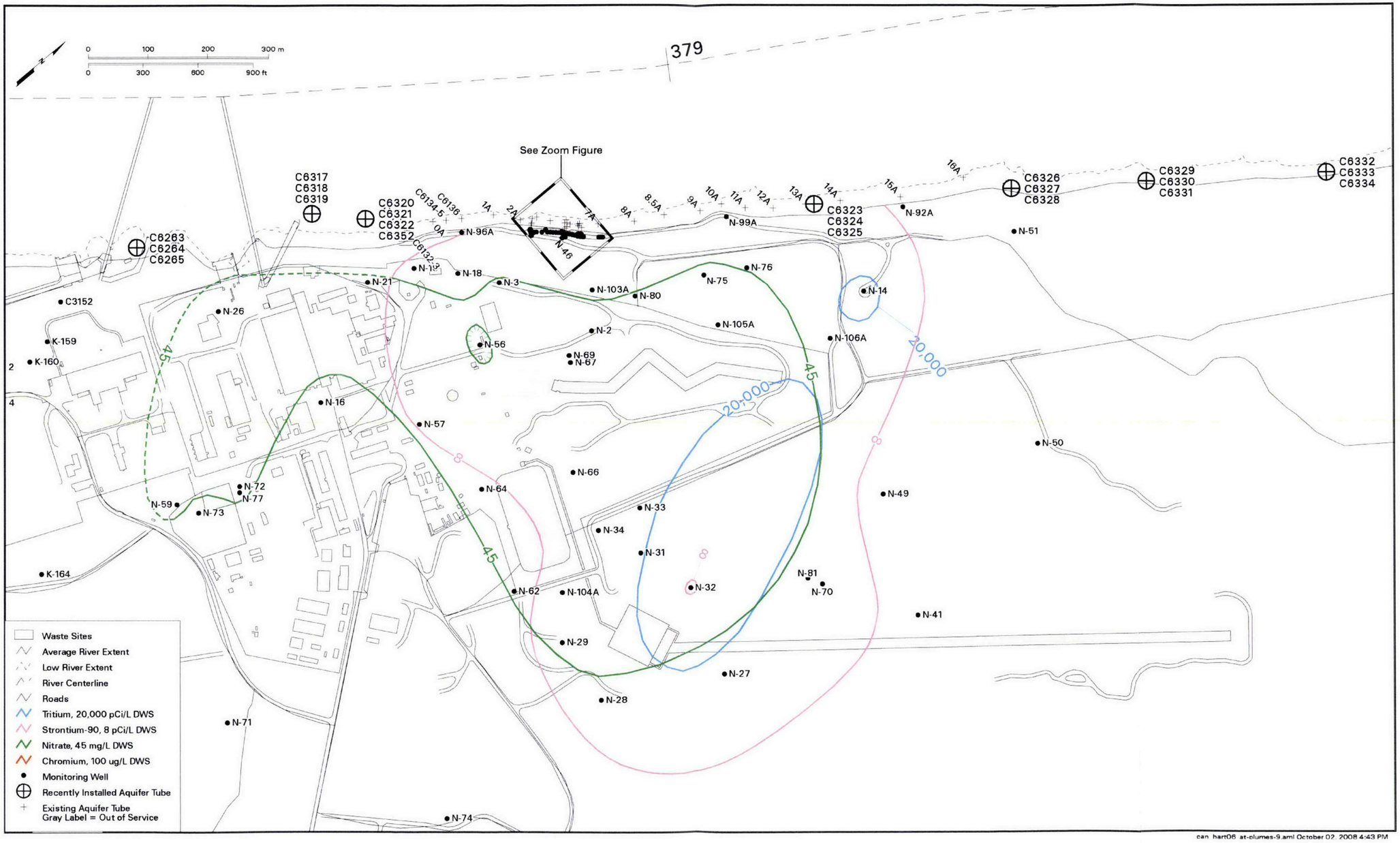


Figure 1-5. 100-N Area Central Shoreline Aquifer Tubes and Wells.

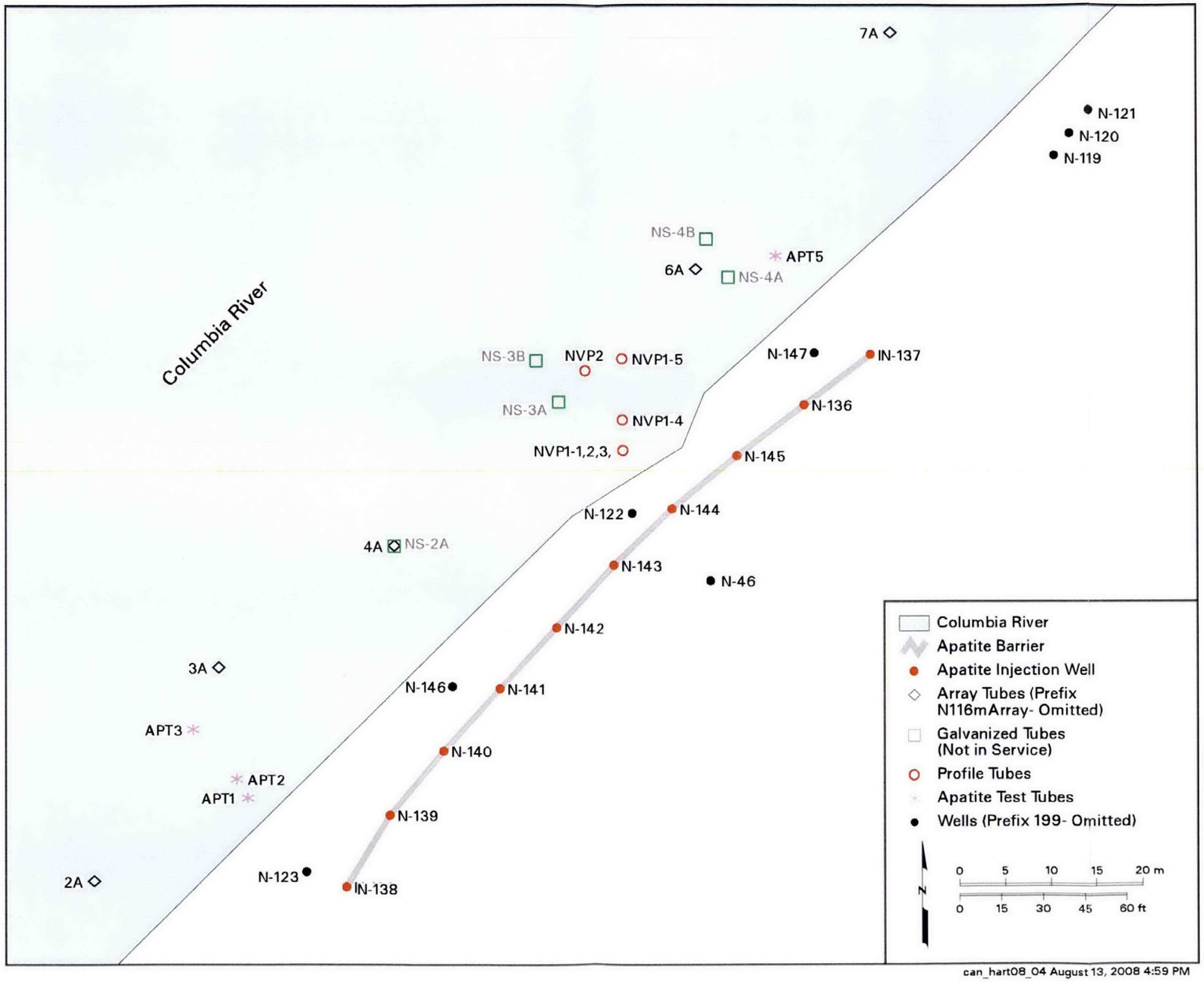


Figure 1-6. 100-D Area Aquifer Tubes and Monitoring Wells.

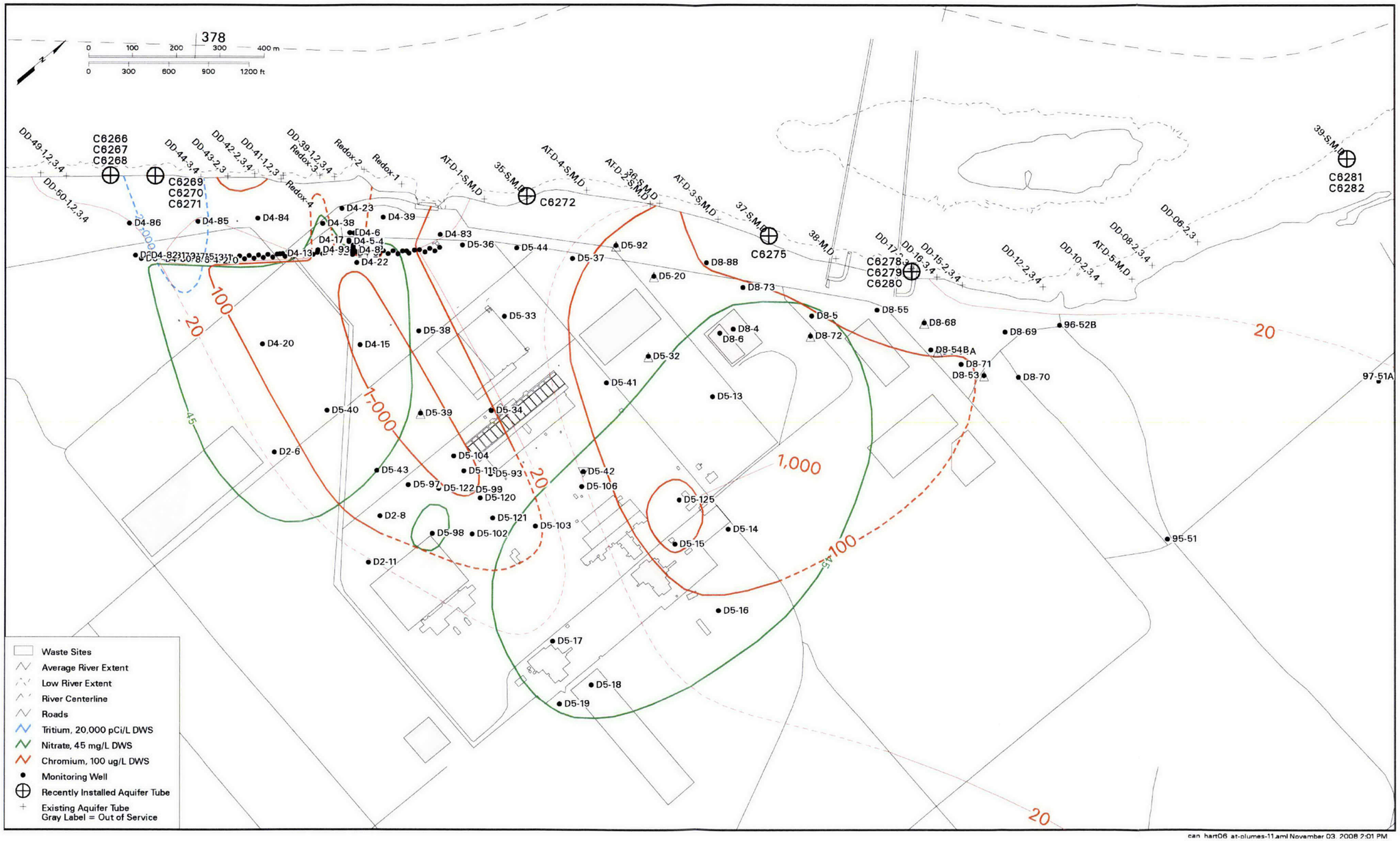


Figure 1-7. 100-H Area Aquifer Tubes and Monitoring Wells.

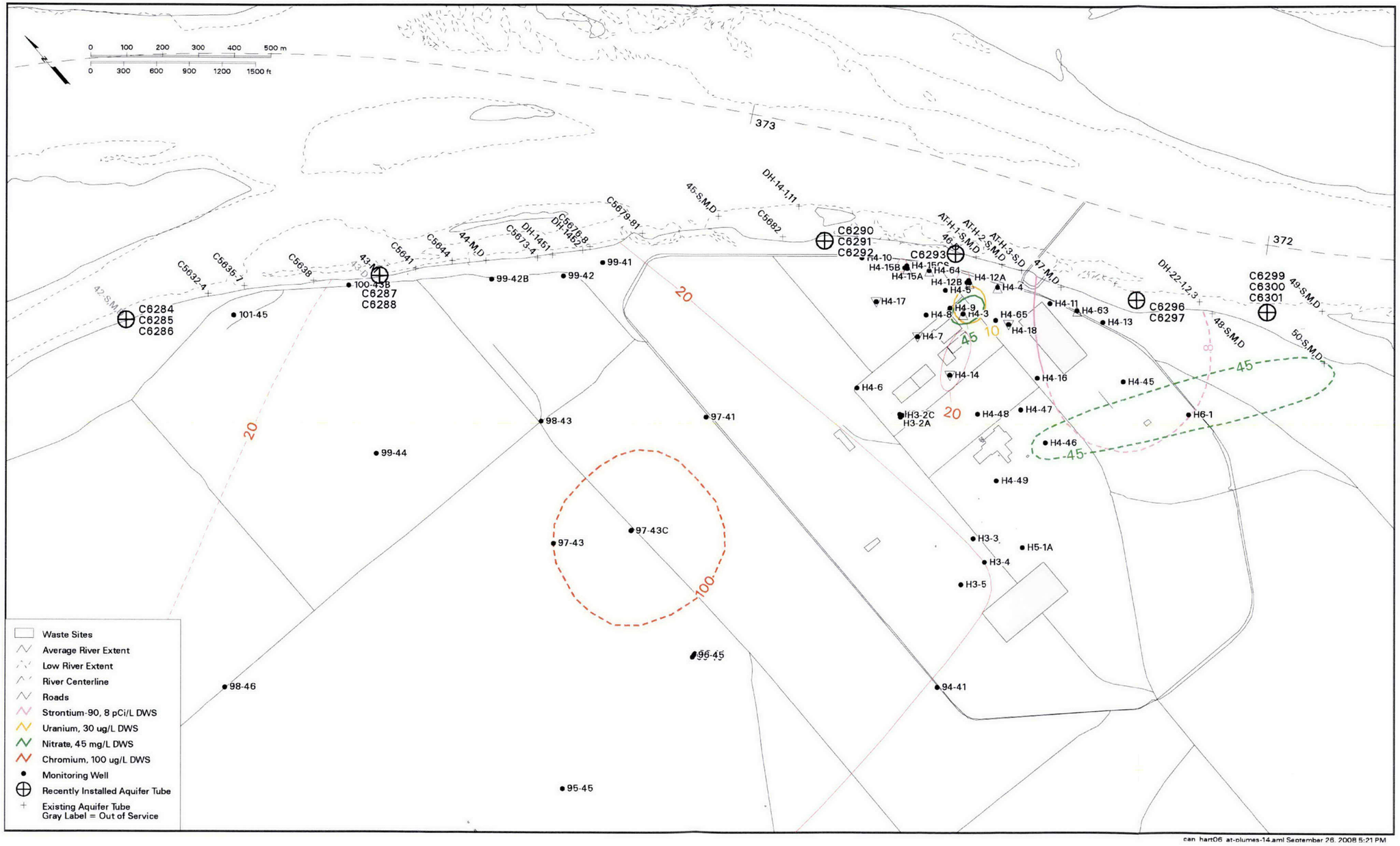


Figure 1-8. 100-F Area Aquifer Tubes and Monitoring Wells.

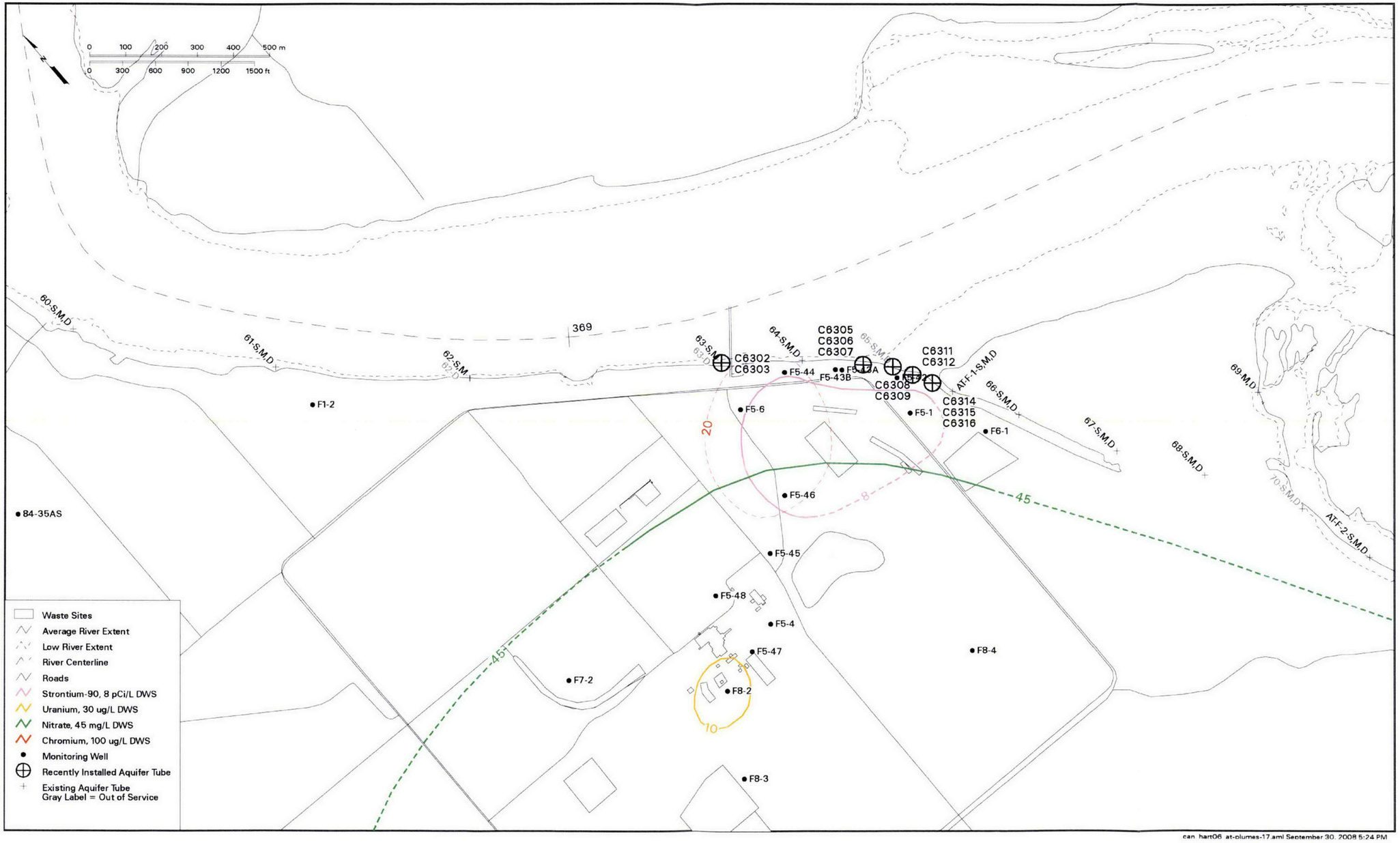


Figure 1-9. 200-PO-1 Aquifer Tubes and Monitoring Wells.

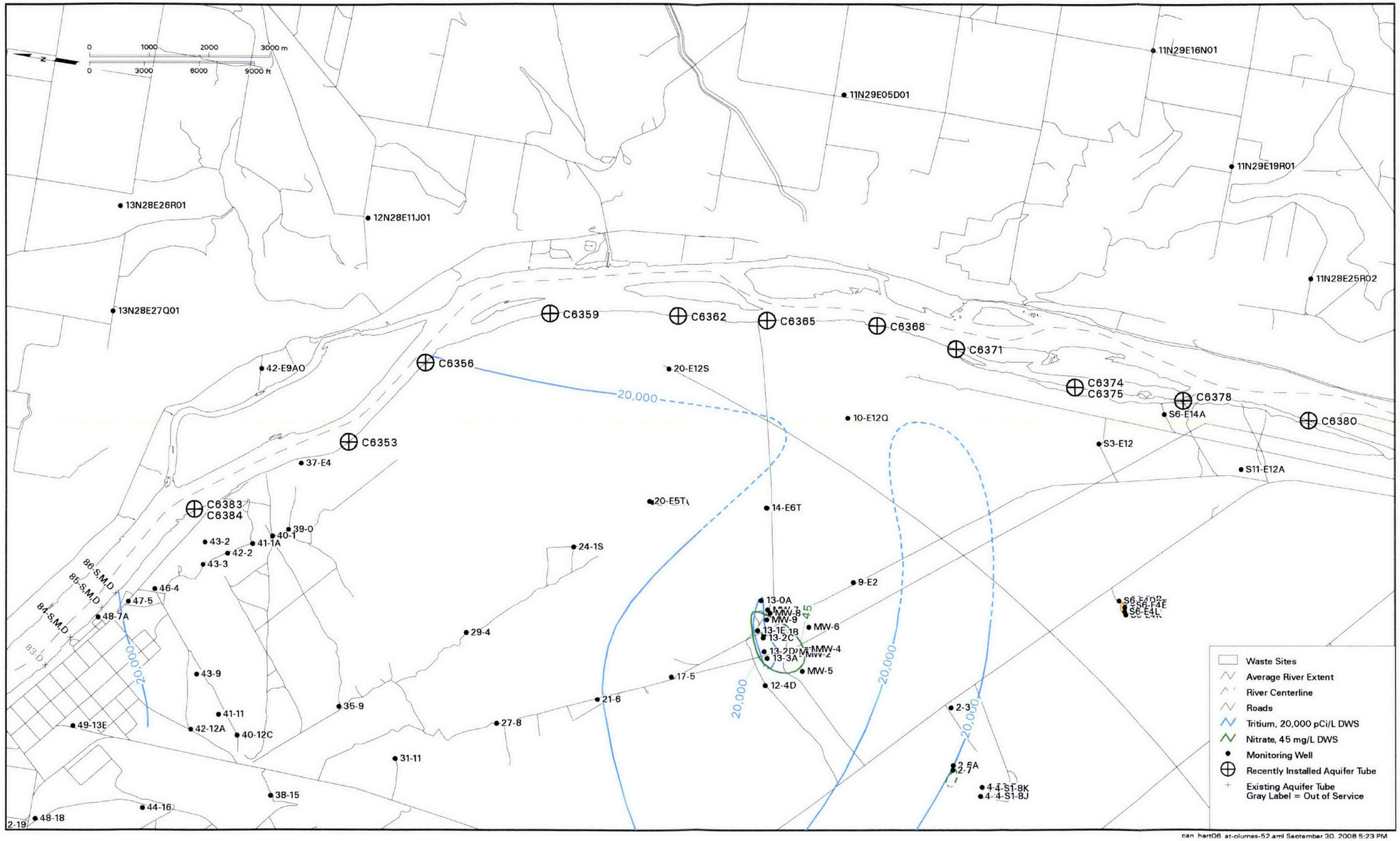


Figure 1-10. 300 Area Aquifer Tubes and Monitoring Wells.

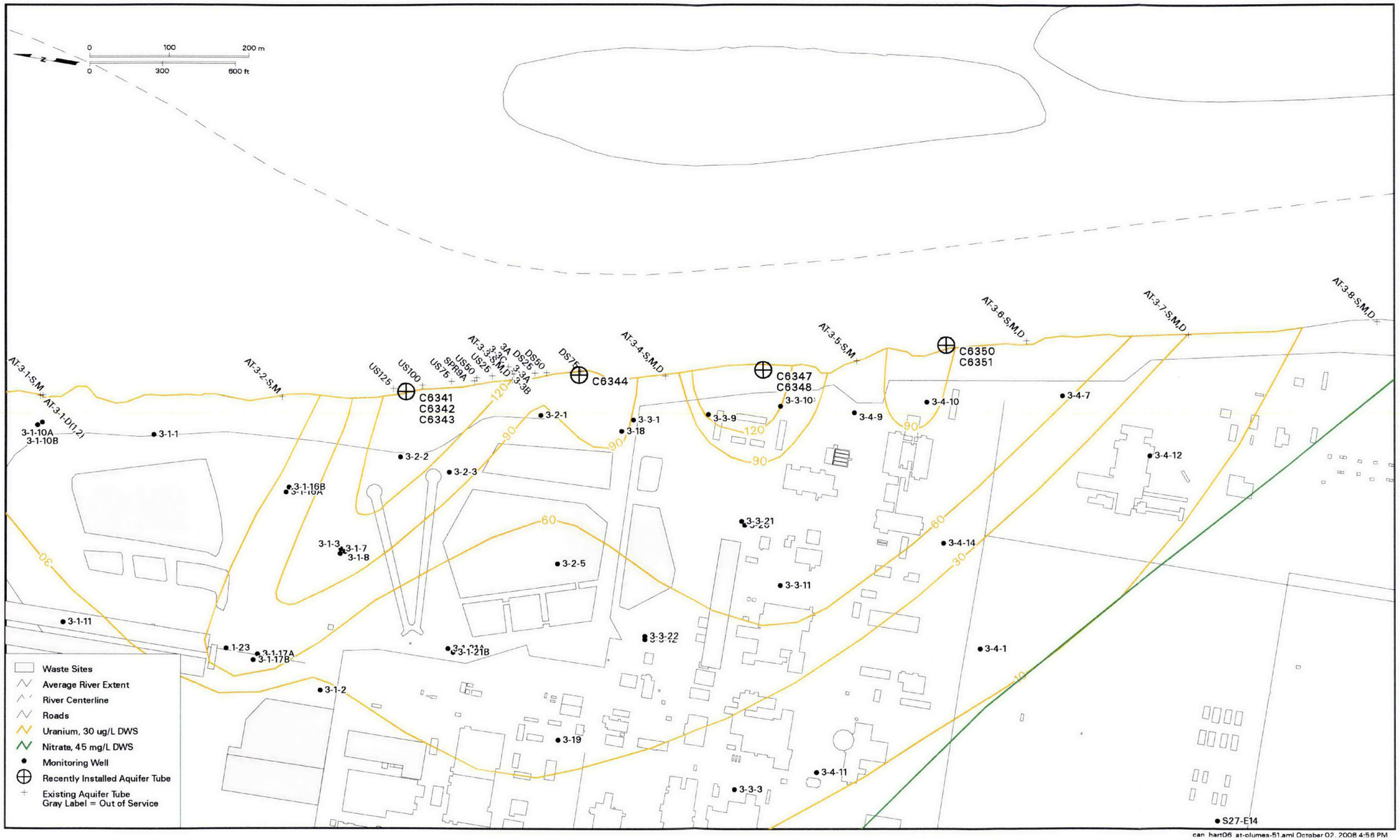


Table 1-1. List of Aquifer Sampling Tube Data Reports.

Fiscal Year 1996:

BHI-00778, 1996, *Chromium in River Substrate Pore Water and Adjacent Groundwater: 100-D/DR Area, Hanford Site, Washington*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Fiscal Year 1998:

BHI-01153, 1998, *Aquifer Sampling Tube Installation Completion Report: 100 Area and Hanford Townsite Shorelines*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Fiscal Year 1999: No report produced.

Fiscal Year 2000:

Lee, T. A., and R. F. Raidl, *Fall 1999 Aquifer Sampling Tube Results at the 100 Area and Hanford Townsite Shoreline*, Technical Memorandum CCN #078404, dated May 2000, Bechtel Hanford, Inc., Richland, Washington.

Fiscal Year 2001:

BHI-01494, 2001, *Aquifer Sampling Tubes Data Summary, Fall 2000*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Fiscal Year 2002:

BHI-01624, 2002, *Aquifer Sampling Tubes Data Summary, Fall 2001*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Fiscal Year 2003:

PNNL-14444, 2003, *Aquifer Sampling Tube Results for Fiscal Year 2003*, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

Fiscal Year 2004:

No separate report produced; interpretations of tube sampling results included in annual groundwater report.

Fiscal Year 2005:

No separate report produced; interpretations of tube sampling results included in annual groundwater report.

Fiscal Year 2006:

No separate report produced; interpretations of tube sampling results included in annual groundwater report.

Fiscal Year 2007:

SGW-35028, 2007, *Aquifer Sampling Tube Results for Fiscal Year 2007*, Rev. 0, Fluor Hanford Inc., Richland, Washington.

Fiscal Year 2008:

In progress, 2008, *Aquifer Sampling Tube Results for Fiscal Year 2008*, CH2M Hill Plateau Remediation Company, Richland, Washington.

1.1.2 Aquifer Sampling Hardware

Aquifer sampling tubes are small-diameter polyethylene tubes that have a screen at the lower end. The tubes are implanted into the aquifer by driving a temporary steel casing into the ground and inserting a tube into the casing. The end of each tube is fitted with a screened section that acts as the sampling port. The temporary steel casing is driven by either a hydraulic ram attached to a vehicle or by a hand-carried pneumatic or hydraulic hammer. The steel casing is then backpulled, leaving the tube (and the stainless-steel drive point) in place. Water is withdrawn from the tube using a peristaltic pump. The tubing exposed at the ground surface is of minimal length (several feet) and is protected from wildlife and the elements by polyvinyl chloride conduit. The main components of aquifer sampling tube installation are shown in Figure 1-11.

1.2 CONTAMINANTS OF CONCERN

Table 1-2 lists the contaminants of concern (COCs), contaminants of potential concern, and/or co-contaminants for each OU along the River Corridor. These contaminants are identified in SAPs or Records of Decision (see footnotes in Table 1-2). Additional information regarding contaminant plumes can be found in *Hanford Site Groundwater Monitoring for Fiscal Year 2007* (DOE/RL-2008-01).

1.3 DATA QUALITY OBJECTIVES

Aquifer tube sampling DQOs were developed in 1997 and are documented in BHI-01090. The DQO process outlines the basic sampling methodology used by this SAP. It also promotes the spacing of 300 to 600 m (1,000 to 2,000 ft) between aquifer tube locations, the use of closer spacing in specific project areas (e.g., 100-N Area), and variation of tube spacing to cover specific sites. In addition, staff reviewed data trends and field notes from aquifer tube sampling from 1997 through 2007 and developed recommendations based on (1) contaminant levels, (2) tube location in relation to existing plumes, (3) tube sampleability, and (4) abundance of historical data. Results of this evaluation are summarized in Table A-2 in Appendix A.

If changes to the sampling methodology for specific project requirements are necessary, the proposed changes will be presented to the regulatory agencies for review. Regulatory approval will be documented in meeting minutes and during the annual sample location review process.

No further DQOs were developed for this SAP; however, additional data objectives may be developed for specific FY aquifer tube sampling. In these cases, new data objectives will be developed with input from the appropriate regulatory agencies and will be documented in meeting minutes and presented in the annually revised Appendix A of this SAP.

Figure 1-11. Main Components of Aquifer Sampling Tube Installation.

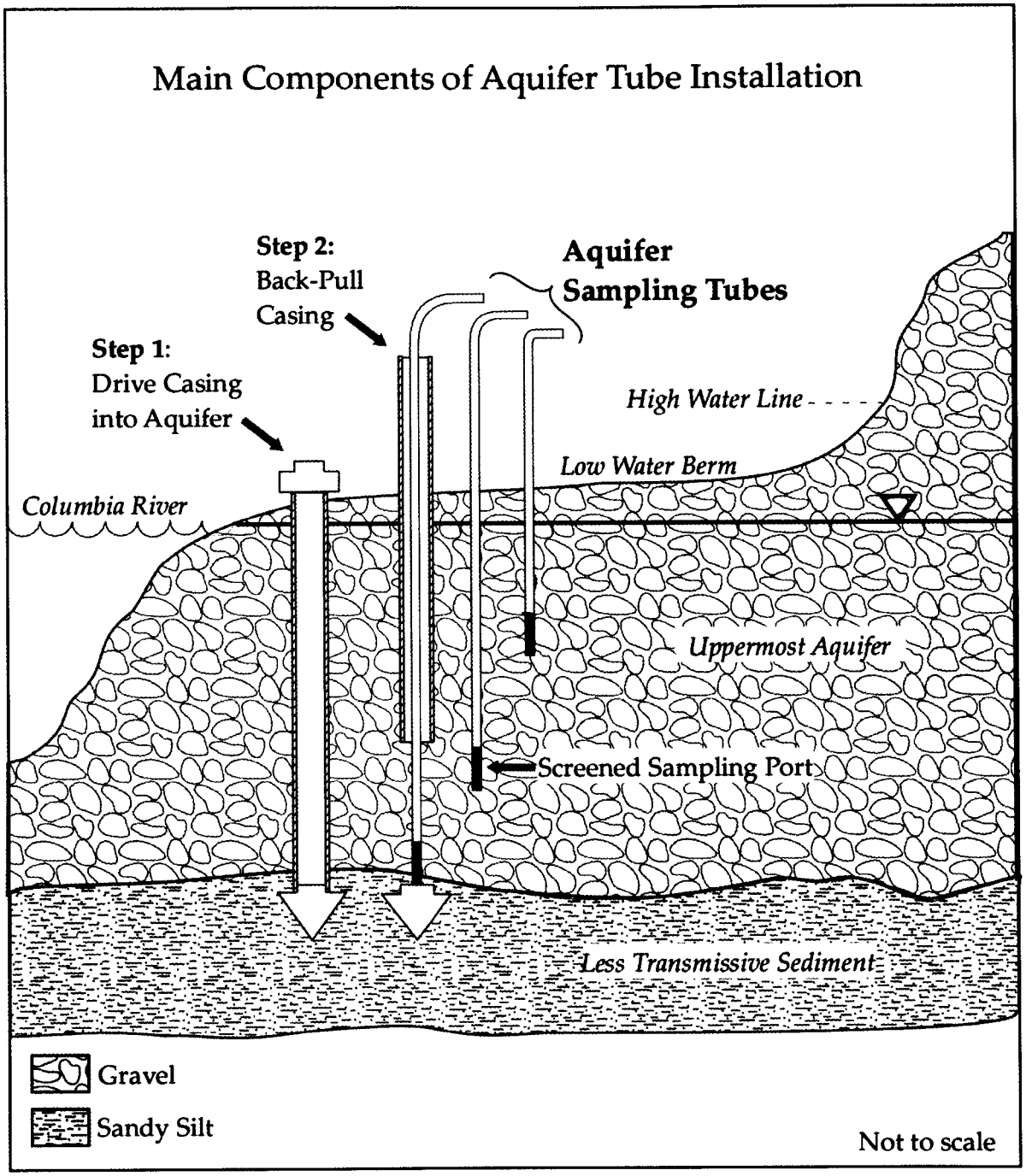


Table 1-2. Contaminants of Concern by Operable Unit.

COCs	100-B/C[a]	100-K[b]	100-N[c]	100-D[d]	100-H[d]	100-F[e]	200-PO-1[f]	300 Area[g]
Carbon-14		p						
cis-1,2-dichloroethene								X
Fluoride								
Hexavalent chromium	X	X	X	X	X	X		
Iodine-129							X	
Manganese			X					
Nitrate	X		X		p	X	X	p
Strontium-90	X	p	X	p	p	X		p
Sulfate			X					
TPH			X					
Technetium-99					p			
Tetrachloroethene								p
Trichloroethene						X		X
Tritium	X	p	X	p	p	X	X	p
Uranium					p	X		X

[a] *100-BC-5 Operable Unit Sampling and Analysis Plan* (DOE/RL-2003-38).
[b] *Interim Action Monitoring Pan for 100-HR-3 and 100-KR-4 Groundwater Operable Units* (DOE/RL-96-90) and *KW Pump-and-Treat System Remedial Design and Remedial Action Work Plan, Supplement to the 100-KR-4 Groundwater Operable Unit Interim Action* (DOE/RL-2006-52).
[c] *Interim Remedial Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units of the Hanford 100-N Area* (EPA et al. 1999).
[d] *Interim Action Monitoring Pan for 100-HR-3 and 100-KR-4 Groundwater Operable Units* (DOE/RL-96-90).
[e] *100-FR-3 Operable Unit Sampling and Analysis Plan* (DOE/RL-2003-49).
[f] *Sampling and Analysis Plan for the 200-PO-1 Groundwater Operable Unit* (DOE/RL-2003-04) (far-field COCs).)
[g] *300-FF-5 Operable Unit Sampling and Analysis Plan* (DOE/RL-2002-11).
COC = contaminant of concern
TPH = total petroleum hydrocarbon
X = contaminant of concern
p = contaminant of potential concern or co-contaminant

1.4 AQUIFER SAMPLING TUBE NOMENCLATURE

Aquifer tube names vary with date of installation. Aquifer tubes installed before 2007 included a site number (e.g., 43 or DD-39) and a suffix. Each site usually included a cluster of tubes and individual tubes had the suffix indicated screen depth. The most commonly used suffixes were "S," "M," and "D," indicating relative depths of shallow, mid-depth, and deep. Some tubes have numerical suffixes, with "1" being shallowest and "4" being deepest. Some tubes in the 100-N Area contain a suffix corresponding to the elevation of the screen in meters above sea level (e.g., NVP2-115.4). Tubes installed in 2007 and 2008 are named by their well identification number (e.g., C6342) and do not include a depth suffix.

2.0 QUALITY ASSURANCE PROJECT PLAN

The QAPjP establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. This QAPjP is consistent with the Soil and Groundwater Remediation Project (S&GRP) QAPjP and complies with the requirements of the following:

- DOE O 414.1C, *Quality Assurance*
- 10 *Code of Federal Regulations* (CFR) 830, Subpart A, "Quality Assurance Requirements"
- *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R5 (EPA/240/B-01/003).

The following sections describe the quality requirements and controls applicable to the aquifer tube sampling activities identified in this SAP.

2.1 PROJECT MANAGEMENT

The following subsections address the basic areas of project management and will ensure that the aquifer tube sampling project has a defined goal, that the participants understand the goal and the approach to be used, and that the planned outputs have been appropriately documented.

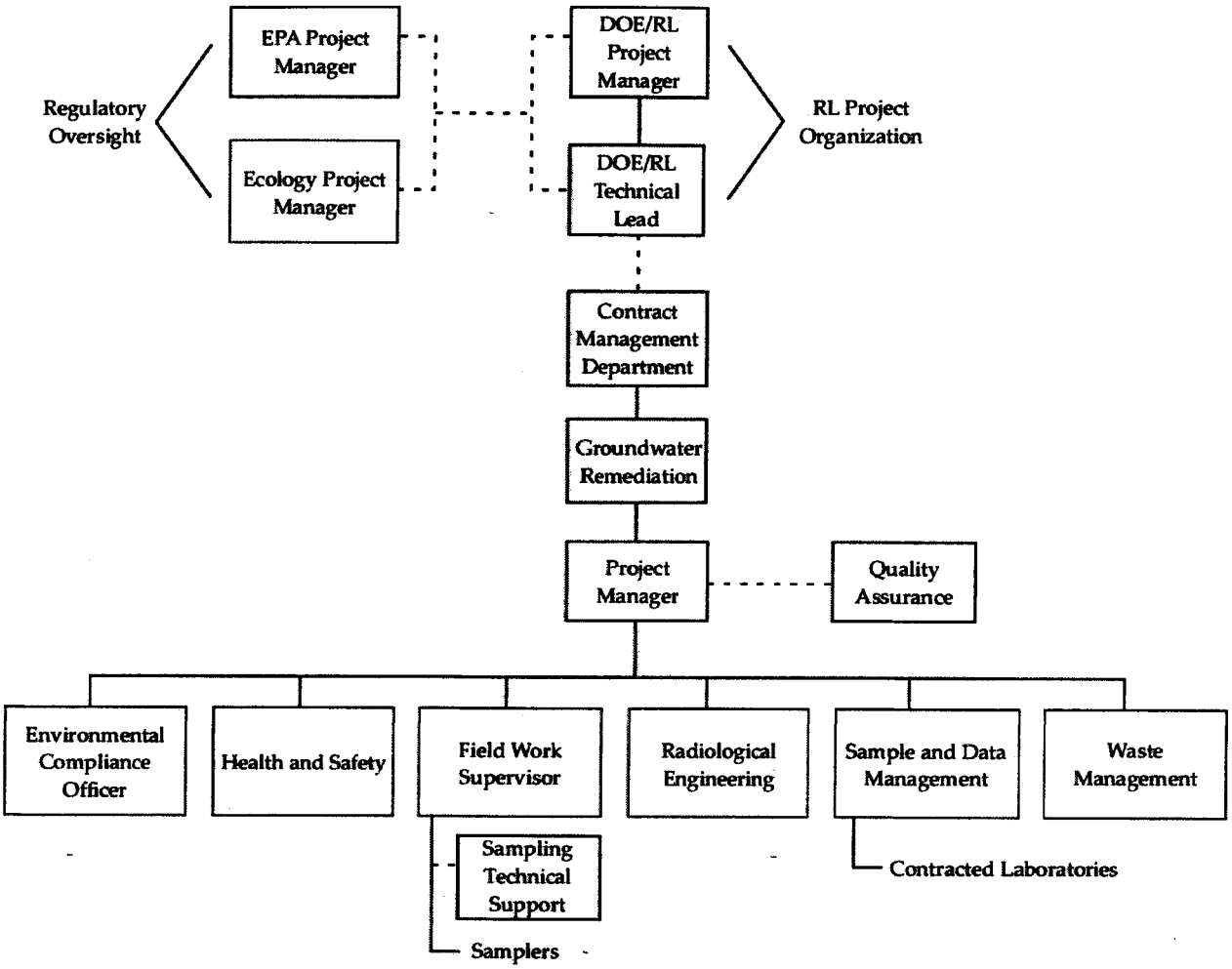
2.1.1 Project/Task Organization

Hanford Site cleanup is the overall responsibility of RL. The primary contractor is responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory. The regulatory agencies, EPA and Ecology, authorize the workscope in accordance with regulations and the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 2003) and provide regulatory compliance oversight. The overall project organization and structure for the aquifer tube sampling activities described in this SAP are described in the following subsections, and the project organization is shown in Figure 2-1. The project organization reflects parts of the overall RL, regulatory, and contractor S&GRP organizations and focuses on those key organizational positions that are directly responsible for the execution and quality of the specific scope of this SAP. For each functional primary contractor role, there is a corresponding oversight role within RL.

2.1.1.1 U.S. Department of Energy, Richland Operations Office Project Organization. The project organization for RL is outlined below.

2.1.1.1.1 RL Project Director. The RL project director is responsible for authorizing the contractor to perform *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); *Resource Conservation and Recovery Act of 1976* (RCRA); *Atomic Energy Act of 1954*; and Tri-Party Agreement activities for the Hanford Site. RL is also responsible for obtaining regulatory agency approval of the SAP that authorizes the specific activities.

Figure 2-1. Project Organization.



2.1.1.1.2 RL Technical Lead. The RL technical lead is responsible for day-to-day oversight of the contractor in performing the workscope, for working with the contractor and the regulatory agencies to identify and work through issues, and for providing technical input to the RL Federal project director.

2.1.1.2 Regulatory Agency Oversight Organization. The project organization for regulatory agency oversight is outlined below.

2.1.1.2.1 Project Managers. Both EPA and Ecology have assigned project managers that are responsible for overseeing the cleanup project and field activities. Either EPA or Ecology has approval authority as lead regulatory agency for activities performed under this SAP depending upon the OU involved; consequently, both agencies share approval authority. The project managers from both regulatory agencies are responsible for working with RL to resolve issues and approve the SAP in accordance with the Tri-Party Agreement primary document schedule.

2.1.1.3 Contractor Organization. The project organization for the contractor is outlined below.

2.1.1.3.1 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 that work is performed safely and cost effectively.

2.1.1.3.2 Groundwater Remediation. Groundwater remediation is responsible for performance of EPA's DQO process (or equivalent) that results in the development of the sampling design and the SAP. Responsibilities include interfacing with the regulators and RL and resolving technical issues and revisions as needed to the SAP or to the sampling schedule in Appendix A.

2.1.1.3.3 Project Manager. The project manager is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks for the work scope identified in this SAP. The project manager works closely with the OU project managers and their organizations to determine the data needs, and with the Quality Assurance (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. The project manager ensures that the sampling design requirements are converted into field instructions (e.g., work packages) that provide specific direction for field activities. The project manager maintains a list of individuals or organizations filling each of the functional elements of the project organization. The project manager also coordinates with and reports to RL and the primary contractor management on all sampling activities. The project manager supports RL in coordinating sampling activities with the regulators. The project manager maintains the approved QAPjP and is responsible for ensuring that procedures are available during field activities.

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

2.1.1.3.5 Environmental Compliance Officer. The environmental compliance officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and also develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The environmental compliance officer reviews plans, procedures, and technical documents to ensure that 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 regulatory agency staff.

2.1.1.3.6 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, Health and Safety provides assistance to project personnel in complying with applicable health and safety standards

and requirements. Health and Safety coordinates with Radiological Controls to determine personnel protective clothing requirements.

2.1.1.3.7 Radiological Engineering Lead. The Radiological Engineering lead is responsible for the 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 Engineering lead identifies radiological hazards and implements appropriate controls to maintain worker exposures ALARA (e.g., requiring personal protective equipment). The Radiological Engineering lead also interfaces with the project health and safety contact, and plans and directs radiological control technician (RCT) support for all activities.

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

2.1.1.3.9 Field Work Supervisor. The field work supervisor has overall responsibility for the planning, coordination, and execution of field characterization activities. The field work supervisor oversees field sampling activities (e.g., sample collection and packaging, and documentation of sampling activities) and ensures that samplers have the appropriate equipment (e.g., sample bottles), including backup supplies, to complete sampling. The field work supervisor is responsible for version control of the SAP and operating procedures to ensure that all personnel are working to the most current job requirements. Additional field work supervisor responsibilities include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified; communicating with the project manager to identify field constraints that could affect the sampling design; and directing the procurement and installation of materials and equipment needed to support the field work.

2.1.1.3.10 Samplers. The samplers collect all samples (including replicates/duplicates) and prepare all sample blanks according to the SAP and 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 they ensure delivery of the samples to the analytical laboratory.

2.1.1.3.11 Sampling Technical Support. Sampling technical support is responsible for providing technical direction and oversight during sample collection and also providing real-time decisions in the field, such as selecting alternative sampling tubes to replace destroyed aquifer tubes. Sampling technical support works with the field work supervisor and samplers to ensure that valid and representative samples are collected.

2.1.1.3.12 Sample and Data Management Organization. The Sample and Data Management organization selects the laboratories that perform the analyses. This organization also ensures that the laboratories conform to Hanford Site internal laboratory QA requirements (or equivalent), as approved by RL, EPA, and Ecology. Sample and Data Management receives the analytical data from the laboratories, performs the data entry into the Hanford Environmental

Information System (HEIS) database, and arranges for data validation. Sample and Data Management is responsible for informing the project manager of any issues reported by the analytical laboratory. Sample and Data Management develops and oversees the implementation of the letter of instruction to the analytical laboratories, oversees data validation, and works with the project manager to prepare a characterization report on the sampling and analysis results.

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

2.1.2 Problem Definition/Background

Aquifer tube sampling allows for characterization of the groundwater seeping into the Columbia River. RL, Ecology, and EPA have agreed on the need to install aquifer tubes at the near-shore margin and to sample the tubes at regular intervals to help define the extent of contamination entering the river. Additional information and details on the problem definition and background are provided in Section 1.0 of this SAP.

2.1.3 Project/Task Description

The overall S&GRP responsibility is to protect the Columbia River while completing the CERCLA remedial investigation/feasibility study and remedial processes for Central Plateau source OUs and all Hanford Site groundwater OUs. This SAP is directed at aquifer tube sampling work conducted along the Hanford shoreline of the Columbia River and provides data on the quality of groundwater entering the Columbia River from near-shore springs and seeps. In accordance with this SAP, aquifer tubes will be sampled to provide depth-discrete quality data of the groundwater to gain a better understanding of the location, extent, and concentration trends of contamination encountered in groundwater along the river.

Aquifer tubes locations will be selected and the aquifer tubes will be constructed to provide groundwater samples that satisfy specific data needs for the individual OUs. The aquifer tubes will be constructed and sampled according to approved SGRP work procedures.

The data collected under this SAP will be managed by the Sample and Data Management organization using the information systems established for the Hanford Site. These systems include the HEIS database (used to store analytical data) and the Hanford Well Information System database (used to store well information).

Analytical data from samples collected under this SAP will be used to support the preparation and/or refinement of CERCLA and other technical documents for the individual OUs and for inclusion in Hanford Sitewide reports.

2.1.4 Quality Objectives and Criteria for Measurement Data

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. The applicable quality control (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 quality guidelines for the analytical data are summarized below:

- "Representativeness" is a measure of how closely the contents of the sample reflect the actual concentration or distribution of the chemical compounds in the immediate vicinity of the sampled aquifer. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) have been developed and are further discussed in this SAP. The proposed documentation will establish that protocols have been followed and that sample identification and integrity are ensured.

- "Comparability" expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using defined procedures, consistent methods, and consistent units. Quantitation limits listed in Table 2-1 are in accordance with standard groundwater analysis at the Hanford Site and will be reported as defined for the specific samples.

- "Accuracy" is an assessment of the closeness of the measured value to true value. Accuracy measurement will be carried out with a minimum frequency of 1 in 20 samples analyzed.

- "Precision" of the data is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference (RPD). The level of effort for precision measurements will be repeated analysis of a minimum of 1 in 20 samples.

- "Completeness" is a measure of the amount of valid data obtained from the analytical measurement system and the complete implementation of defined field procedures. The target completeness objective will be 100%, with 90% as a minimum passing requirement. The completeness of the data will be assessed during QC reviews.

Table 2-1 lists analytical methods, preservation techniques, and quantitation limits. Table 2-2 lists types of QC samples, what they evaluate, and required frequency. Table 2-3 lists QC acceptance criteria by analytical method. Table 2-4 lists recommended recovery and precision for blind standards.

Table 2-1. Preservation Techniques, Analytical Methods Used, and the Current Method Quantitation Limits for Listed Constituents. (4 sheets)

Constituent	Collection and Preservation[a,b]	Analysis Methods[c]	Method Quantitation Limit (µg/L)[d]
Metals Analyzed by the Inductively Coupled Plasma Method – Unfiltered/Filtered			
Beryllium	P, HNO_3 to pH<2	SW-846[e] #6010B/C, SW-846 #6020[f] or EPA/600 #200.8[f]	5
Strontium			10
Bismuth			100
Barium			20
Zinc			10
Calcium			1,000
Cadmium			5
Chromium			10
Silver			10
Sodium			500
Nickel			40
Copper			10
Vanadium			25
Manganese			5
Potassium			4,000
Iron			50
Magnesium			750
Boron			20
Cobalt			20
Lithium			25
Molybdenum			20
Silicon			20
Tin			100
Titanium			5
Zirconium			25
Trace Metals – Unfiltered/Filtered			
Antimony	P, HNO_3 to pH<2	SW-846 #6020 or EPA/600 #200.8	6
Arsenic	P, HNO_3 to pH<2	SW-846 #6020 or EPA/600 #200.8	10
Aluminum	P, HNO_3 to pH<2	SW-846 #6020 or EPA/600 #200.8	50
Barium	P, HNO_3 to pH<2	SW-846 #6020 or EPA/600 #200.8	5
Mercury	G, HNO_3 to pH<2	SW-846, #7470A, EPA/600 #200.8	0.5

Table 2-1. Preservation Techniques, Analytical Methods Used, and the Current Method Quantitation Limits for Listed Constituents. (4 sheets)

Constituent	Collection and Preservation[a,b]	Analysis Methods[c]	Method Quantitation Limit (µg/L)[d]
Selenium	P, HNO_3 to pH<2	SW-846 #6020 or EPA/600 #200.8	10
Lead	P, HNO_3 to pH<2	SW-846 #6020 or EPA/600 #200.8	5
Hexavalent chromium	G/P, cool to 4°C	SW-846 #7196	10
Anions by Ion Chromatography			
Nitrate	P, none	EPA/600 #300.0[g]	250
Sulfate			500
Fluoride			500
Chloride			200
Phosphate			500
Bromide			250
Nitrite			250
Pesticides			
Endrin	G, none	SW-846, #8081A	0.1
Methoxychlor			0.5
Toxaphene			2
Lindane (four isomers)			0.05
Herbicides			
2,4-D	G, none	SW-846, #8151A	20
2,4-5-TP silvex			1
2,4,5-T			1
Volatile Organic Analysis (VOA)			
Carbon tetrachloride	G, no headspace	SW-846, #8260B	5
Benzene			5
Methyl ethyl ketone			10
Toluene			5
1,1,1-trichloroethane			5
1,1,2-trichloroethane			5
Trichloroethylene			5
Tetrachloroethylene			5
Xylene-o, p			10
Chloroform			5
1, 1-dichloroethane			10
1, 2-dichloroethane			5
Trans-1, 2-dichloroethylene			5
Methylene chloride			5
Vinyl chloride			10

Table 2-1. Preservation Techniques, Analytical Methods Used, and the Current Method Quantitation Limits for Listed Constituents. (4 sheets)

Constituent	Collection and Preservation[a,b]	Analysis Methods[c]	Method Quantitation Limit (µg/L)[d]
Xylene-m			10
Methyl isobutyl ketone			10
Acetone by VOA			20
Tetrahydrofuran			50
P-dichlorobenzene			5
Semi-Volatile Organic Analysis (SVOA)			
Bis(2ethylhexyl)phthalate (DEHP)	Amber glass, cool to 4°C	SW-846, #8270D	10
Cresol (o,p,m)			10
n-nitrosodimethylamine			10
Radiological Parameters			
Technetium-99	G/P, HCl to pH<2	Laboratory-specific	15 pCi/L
Cesium-137 (gamma scan)	G/P, HNO_3 to pH<2	Laboratory-specific	15 pCi/L
Cobalt-60 (gamma scan)			25 pCi/L
Europium-152 and -154 (gamma scan)			50 pCi/L
Iodine-129	G/P, none	Laboratory-specific	5 pCi/L
Tritium	P, none	Laboratory-specific	400 pCi/L
Tritium, mid-level	P, none	Laboratory-specific	30 pCi/L
Uranium – isotopic	G/P, HNO_3 to pH<2	Laboratory-specific	1 pCi/L
Uranium – total	G/P, HNO_3 to pH<2	Laboratory-specific	1 µg/L
Plutonium – isotopic	G/P, HNO_3 to pH<2	Laboratory-specific	1 pCi/L
Strontium-90	G/P, HNO_3 to pH<2	Laboratory-specific	2 pCi/L
Selenium-79	G/P, HNO_3 to pH<2	Laboratory-specific	30 pCi/L
Neptunium-237	G/P, HNO_3 to pH<2	Laboratory-specific	1 pCi/L
Carbon-14	G/P, none	Laboratory-specific	200 pCi/L
Nickel-63	G/P, HNO_3 to pH<2	Laboratory-specific	15 pCi/L
Gross alpha	P, HNO_3 to pH<2	Laboratory-specific	3 pCi/L
Gross beta	P, HNO_3 to pH<2	Laboratory-specific	4 pCi/L
Other			
Coliform bacteria	P, none	EPA SM[h] 9223[i]	2.2[j]
Temperature	Field measurement		
Conductivity, laboratory	P, none		1 µohm
Conductivity, field[k]	N/A		1 µohm
pH, laboratory measurement	P, none		0.1
pH, field measurement[k]	N/A		0.1
Turbidity, field measurement[k]	N/A		0.1 NTU
Dissolved oxygen, field[k]	N/A		0 mg/L
Oxidation-reduction potential, field[k]	N/A		

Table 2-1. Preservation Techniques, Analytical Methods Used, and the Current Method Quantitation Limits for Listed Constituents. (4 sheets)

Constituent	Collection and Preservation[a,b]	Analysis Methods[c]	Method Quantitation Limit (µg/L)[d]
Alkalinity	G/P, none	EPA SM[h] 2320 EPA/600 #310.1 EPA/600 #310.2	5,000
Total organic halogen	G, H_2SO_4 to pH<2, no headspace	SW-846, #9020	20
Total organic carbon	G, HCL or H_2SO_4 to pH<2	SW-846, #9060	1,000
Ammonium ion	P, H_2SO_4 to pH<2	EPA/600 #350.1 EPA/600 #300.7	50
Phenol	G, none	SW-846, #8040, SW-846, #8041, SW-846, #8270C	5 5 10
Cyanide	P, NaOH to pH>12	SW-846, #9012 EPA SM[h] 4500, EPA/600 #335.2	5
Hydrazine	G, HCl	ASTM D1385	100
Total dissolved solids	P, none	EPA/600 #160.1	1,0000
Total petroleum hydrocarbon	G, HCl	WTPH-DX	500

[a] P = plastic; G = glass.
[b] All samples will be cooled to 4°C upon collection.
[c] Constituents grouped together are analyzed by the same method unless otherwise indicated.
[d] Detection limit units except where indicated.
[e] EPA SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.*
[f] EPA SW-846 #6010 is the preferred method; however, #6020 or EPA/600 #200.8 may be used so long as the method quantitation limit listed is met.
[g] Analytical method adapted from Method 300.0 (*Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography* [EPA-600/4-84-017]).
[h] *Standard Methods for the Examination of Water and Wastewater, 20th Edition* (APHA et al. 1998).
[i] Enzyme substate test.
[j] Most probable number.
[k] Constituents of "field parameters."
ASTM = American Society for Testing and Materials
EPA = U.S. Environmental Protection Agency
N/A = not applicable
NTU = nephelometric turbidity unit
SVOA = semi-volatile organic analysis
VOA = volatile organic analysis

Table 2-2. Quality Control Samples.

Sample Type	Primary Characteristics Evaluated	Frequency
Field QC		
Full trip blank (FTB)	Contamination from containers or transportation	1 per 20 well trips
Field transfer blank (FXR)	Contamination from sampling site	1 each day VOCs sampled
Equipment blank (EB)	Contamination from non-dedicated equipment	As needed[a]
Replicate/duplicate samples	Reproducibility	1 per 20 well trips
Laboratory QC		
Method blanks	Laboratory contamination	1 per batch
Laboratory duplicates	Laboratory reproducibility	[b]
Matrix spikes	Matrix effect and laboratory accuracy	[b]
Matrix spike duplicates	Laboratory reproducibility/accuracy	[b]
Surrogates	Recovery/yield	[b]
Laboratory control samples	Method accuracy	1 per batch

[a] For portable peristaltic pumps, equipment blanks are collected one per 10 well trips. Whenever a new type of non-dedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the non-dedicated equipment.

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

QA = quality assurance
QC = quality control
VOC = volatile organic compound.

Table 2-3. Field and Laboratory Quality Control Elements and Acceptance Criteria. (3 sheets)

Method[a]	QC Element	Acceptance Criteria	Corrective Action
General Chemical Parameters			
Alkalinity	MB[b]	< MDL	Flagged with "C"
Chemical oxygen demand	LCS	80-120% recovery[c]	Data reviewed[d]
Conductivity	DUP	±20% RPD[c]	Data reviewed[d]
Oil and grease	MS[e]	75-125% recovery[c]	Flagged with "N"
pH	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	±20% RPD[f]	Flagged with "Q"
Total dissolved solids			
Total organic carbon			
Total organic halides			

Table 2-3. Field and Laboratory Quality Control Elements and Acceptance Criteria. (3 sheets)

Method[a]	QC Element	Acceptance Criteria	Corrective Action
Ammonia and Anions			
Ammonia	MB	< MDL	Flagged with "C"
Anions by IC	LCS	80-120% recovery[c]	Data reviewed[d]
Cyanide	DUP	±20% RPD[c]	Data reviewed[d]
	MS	75-125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	±20% RPD[f]	Flagged with "Q"
Metals			
Arsenic	MB	< CRDL	Flagged with "C"
Cadmium	LCS	80-120% recovery[c]	Data reviewed[d]
Chromium	MS	75-125% recovery[c]	Flagged with "N"
Lead	MSD	±20% RPD[c]	Data reviewed[d]
Mercury	EB, FTB	<2 times MDL	Flagged with "Q"
Selenium	Field duplicate	±20% RPD[f]	Flagged with "Q"
Thallium			
ICP metals			
ICP/MS metals			
Volatile Organic Compounds			
Volatiles by GC/MS	MB	< MDL	Flagged with "B"
Total petroleum hydrocarbons by GC	LCS	Statistically derived[g]	Data reviewed
	MS	Statistically derived[g]	Flagged with "N"
	MSD	Statistically derived[g]	Data reviewed[d]
	SUR	Statistically derived[g]	Data reviewed[d]
	EB, FTB, FXR	<2 times MDL[h]	Flagged with "Q"
	Field duplicate	±20% RPD[f]	Flagged with "Q"
Semi-Volatile Organic Compounds			
Herbicides by GC	MB	<2 times MDL	Flagged with "B"
PCBs by GC	LCS	Statistically derived[g]	Data reviewed[d]
Pesticides by GC	MS	Statistically derived[g]	Flagged with "N"
Phenols by GC	MSD	Statistically derived[g]	Data reviewed[d]
Semi-volatiles by GC/MS	SUR	Statistically derived[g]	Data reviewed[d]
	EB, FTB	<2 times MDL[h]	Flagged with "Q"
	Field duplicate	±20% RPD[(f)]	Flagged with "Q"
Radiological Parameters			
Gamma scan	MB	<2 times MDA	Flagged with "B"
Gross alpha	LCS	70-130% recovery	Data reviewed[c]
Gross beta	DUP	±20% RPD	Data reviewed[c]
Iodine-129	MS[(i)]	60-140% recovery	Flagged with "N"

Table 2-3. Field and Laboratory Quality Control Elements and Acceptance Criteria. (3 sheets)

Method[a]	QC Element	Acceptance Criteria	Corrective Action
Plutonium (isotopic)	EB, FTB	<2 times MDA	Flagged with "Q"
Strontium-89/90	Field duplicate	±20% RPD[e]	Flagged with "Q"
Technetium-99			
Tritium			
Tritium (low-level)			
Uranium (isotopic)			
Uranium (total)			

[a] Refer to Table 2-1 for specific analytical methods.
[b] Does not apply to pH.
[c] Laboratory-determined, statistically derived control limits may also be used. Such limits are reported with the data.
[d] After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect ("Y" flag) or rejected ("R" flag).
[e] Applies to total organic carbon and total organic halides only.
[f] Applies only in cases where one or both results are greater than five times the detection limit.
[g] Determined by the laboratory based on historical data. Control limits are reported with the data.
[h] For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is less than five times the MDL.
[i] Applies only to technetium-99 and total uranium analyses.

Data flags:

B, C = possible laboratory contamination (analyte was detected in the associated method blank)
N = result may be biased (associated matrix spike result was outside the acceptance limits)
Q = problem with associated field QC sample (blank and/or duplicate results were out of limits)
DUP = laboratory matrix duplicate
EB = equipment blank
FTB = full trip blank
FXR = field transfer blank
GC = gas chromatography
ICP = inductively coupled plasma
ICP/MS = inductively coupled plasma-mass spectrometry
LCS = laboratory control sample
MB = method blank
MDA = minimum detectable activity
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PCBs = polychlorinated biphenyls
RPD = relative percent difference
SUR = surrogate

Table 2-4. Blind-Standard Constituents and Schedule.

Constituents	Frequency	Recommended Recovery (%)[a]	Precision (%RSD)[a]
Carbon tetrachloride	Quarterly	±25%	±25%
Chloroform	Quarterly	±25%	±25%
Trichloroethylene	Quarterly	±25%	±25%
Fluoride	Quarterly	±25%	±25%
Nitrate	Quarterly	±25%	±25%
Cyanide	Quarterly	±25%	±25%
Chromium	Annually	±20%	±20%
Total organic carbon[b]	Quarterly	Varies according to spiking compound	Varies according to spiking compound
Total organic halides[c]	Quarterly	Varies according to spiking compound	Varies according to spiking compound
Gross alpha[d]	Quarterly	70 - 130%	±20%
Gross beta[e]	Quarterly	70 - 130%	±20%
Tritium	Annually	70 – 130%	±20%
Tritium (low level)	Semi-annual	70 – 130%	±20%
Cobalt-60	Annually	70 – 130%	±20%
Strontium-90	Quarterly	70 – 130%	±20%
Technetium-99	Quarterly	70 – 130%	±20%
Iodine-129	Semi-annually	70 – 130%	±20%
Cesium-137	Annually	70 – 130%	±20%
Uranium	Quarterly	70 – 130%	±20%
Plutonium-239/240	Quarterly	70 – 130%	±20%

[a] If the results are less than five times the required detection limit, then the criteria is that the difference of the results of the replicates is less than the required detection limit.
[b] The spiking compound generally used for total organic carbon is potassium phthalate. Other spiking compounds may also be used.
[c] Two sets of spikes for total organic halides will be used. The spiking compound for one set should be 2,4,5-trichlorophenol. The spiking compound for the second set should include the constituents used for the volatile organic compounds sample (i.e., carbon tetrachloride, chloroform, and trichloroethylene).
[d] The gross alpha sample will be prepared from plutonium-239.
[e] The gross beta sample will be prepared from strontium-90.
RSD = relative standard deviation

2.1.5 Special Training Requirements/Certification

A graded approach is used to ensure that workers receive a level of training that is commensurate with their responsibilities and that complies with applicable DOE orders and government regulations. The project manager (or designee) will coordinate with line management to ensure that all field personnel meet all special training requirements.

Typical training requirements or qualifications have been instituted by the contractor to meet training requirements imposed by the Project Hanford Management Contract, regulations, DOE orders, DOE contractor requirements documents, American National Standards Institute/ American Society of Mechanical Engineers, and the *Washington Administrative Code*. 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 Site General Employee Radiation Training
- Hanford Site General Employee Training
- Radiological Worker Training (as required).

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 training and/or experience in the type of sampling that is being performed in the field (e.g., aquifer tube sampling).
- 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.

Project-specific safety training, geared specifically to the project and the day's activity, will be provided. 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 recorded for each individual in an electronic training record database. The contractor training organization maintains the training records system. Line management will confirm that an individual employee's training is appropriate and up to date before any fieldwork is performed.

2.1.6 Documentation and Records

The project manager is responsible for ensuring that the current version of the SAP is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process.

The project manager is responsible for ensuring that the project data file is properly maintained. The project files will contain the records or references to their storage locations. The project file will also include the following, as appropriate:

- Field logbooks or operational records
- Aquifer tube global positioning system location data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports.

The analytical laboratory is responsible for maintaining and having available upon request:

- 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 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 presents the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory QC. Instrument calibration, maintenance supply inspection, and data management requirements also are addressed.

2.2.1 Sampling Process Design

The sampling process design describes the data-collection design for the project, including types and numbers of samples required, sampling locations and frequency, sample matrices, and the rationale for the design. The sampling design is described in the following subsections.

2.2.1.1 Sampling Locations and Frequency. Appendix A presents the locations and the collection schedule of the aquifer tubes to be sampled during the FY in accordance with this SAP. The list of aquifer tubes and sampling schedule will be reviewed annually and revised as needed to satisfy the individual OU project requirements.

2.2.1.2 Constituents to Be Monitored. Samples collected for laboratory analysis under this SAP will be analyzed for the COCs listed in Table 1-2 and for the supporting constituents listed in Appendix A. This constituent list will be updated as needed as part of the Appendix A annual review process. Table 2-1 lists analytical methods and related requirements for the groundwater OU projects.

2.2.2 Sampling Methods Requirements

Water samples will be collected according to the current revision of an SGRP operating procedure. Water collected from the aquifer tubes is a mixture of Hanford Site groundwater and Columbia River water that has infiltrated the riverbank (bank storage). The specific conductance of groundwater (typically >400 μS/cm) is higher than that of river water (typically about 130 to 140 μS/cm). Thus, field conductance measurements can be used to estimate the fractional amount of groundwater in water from an aquifer tube. At most aquifer tube sites, if the specific conductance for a tube is 160 μS/cm or less, samples for the laboratory need not be collected from that tube. Aquifer tubes that are sampled regardless of specific conductance are indicated as such in Table A-1 (Appendix A). Sampling technical support personnel will provide onsite confirmation.

Water samples are collected after the specific conductance of the groundwater has stabilized (i.e., after two consecutive measurements are within 10%). For certain types of samples, preservatives are required. While the preservative may be added to the collection bottles before their use in the field, it is allowable to add the preservative at the sampling vehicle immediately after collection. Samples may require filtering in the field, as noted on the chain-of-custody.

To ensure sample and data usability, the sampling associated with this SAP will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling. The project manager and the functional directors and managers are responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP. The project manager or sampling technical support designee must document all deviations from procedures or other problems pertaining to sample collection, chain-of-custody, target analytes, sample transport, or noncompliant monitoring. 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 designee) will be responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

2.2.3 Decontamination of Sampling Equipment

To prevent contamination of any sample, care should be taken to use clean equipment for each sampling activity. In general, disposable sampling equipment will be used where appropriate. Some sampling equipment may be decontaminated in accordance with decontamination procedures.

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.

2.2.4 Sample Handling, Shipping, and Custody Requirements

Field sample handling, shipping, and custody requirements will be consistent with established procedures. Sample containers used for chemical analysis shall be certified clean prior to use. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits.

If the samples are to be shipped to an offsite laboratory, RCTs will measure the contamination levels and dose rates associated with the sample containers after the samples are returned from the field. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria.

Sample preservation, container, and holding-time requirements will be prepared for specific sample events as specified on the sampling authorization forms and chain-of-custody forms in accordance with procedures and the specific analytical methods. The final container types and volumes will be indicated on the sampling authorization form prepared by Sample and Data Management; however, field changes can be made if necessary. Containers for all samples to be submitted to the laboratory will be labeled with the following information, using a waterproof marker on firmly affixed, water-resistant labels:

- Sampling authorization form
- HEIS number
- Sample collection date/time
- Name of person collecting the sample
- Preservation method (if applicable).

Except for volatile organic analyte samples, a custody seal (i.e., evidence tape) will be affixed to the lid of each sample jar. The container seal will be inscribed with the sampler's initials and the date. Custody tape is not applied directly to volatile organic analyte bottles collected because of the potential for fouling the laboratory equipment.

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

After the sample reaches the laboratory, sample custody is maintained using the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by Sample and Data Management.

The sample data tracking database will be used to track the samples from the point of collection through the laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for the project. Each sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook. All field sample handling, shipping, and custody requirements will be consistent with established procedures.

2.2.5 Analytical Methods Requirements

Constituents and analytical methods are listed in Table 2-1. These analytical methods are implemented in accordance with the laboratory's QA plan and the requirements of this QAPjP. While most analyses are expected to be performed at an onsite laboratory, offsite laboratories may be identified for special analyses or during especially busy times at the onsite laboratory. The contractor conducts oversight of analytical laboratories to qualify the laboratories for performing Hanford Site analytical work.

Specific laboratory and field screening methods required for analytical activities are specified in this SAP. Deviations from the analytical methods noted in Table 2-1 must be approved by the project manager. If the laboratory uses a nonstandard or unapproved method, the laboratory must provide method validation data to confirm that 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.

Laboratories providing analytical services in support of this SAP will have a corrective action program in place that addresses analytical system failures and documents the effectiveness of any corrective actions. Errors reported by the laboratories are reported to the Sample and Data Management project coordinator, who is responsible to document analytical errors and to establish the resolution in coordination with the project manager. Communications with the laboratory will be managed by the Sample and Data Management organization and will include project-specific detection limits. Sample and Data Management will be responsible for communicating the status, issues, corrective actions, and other pertinent laboratory information to the project manager.

2.2.6 Quality Control Requirements

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Table 2-2 lists types of field and laboratory QC samples and their required frequencies.

Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field replicates (duplicates), trip or field blanks, and equipment blanks.

The QC procedures in the laboratories will be according to contractual requirements between the contractor and the laboratory. The laboratory method blanks, laboratory control sample/blank spike, and matrix spike are defined in Chapter 1 of EPA's SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, and will be run at the frequency specified in that reference. These "blind" standard samples contain known amounts of selected constituents and are included in sample sets to assess laboratory performance without prior notification to the laboratory. Table 2-4 lists the sampling frequencies and performance requirements.

The QC data are evaluated based on established acceptance criteria for each QC sample type. For field and method blanks, the acceptance limit is generally two times the instrument detection limit (metals), method detection limit (other chemical parameters), or minimum detectable activity (radiochemistry parameters); however, for common laboratory contaminants (e.g., acetone, methylene chloride, 2-butanone, and phthalate esters), the limit is five times the method detection limit. Groundwater samples that are associated (i.e., collected on the same date and analyzed by the same method) with out-of-limit field blanks are flagged with a "Q" in the database to indicate a potential contamination problem.

2.2.6.1 Field Duplicates. Field duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently.

The duplicate should be collected generally from an interval that is expected to have some contamination so valid comparisons between the samples can be made (i.e., at least some of the constituents will be above detection limit). Field duplicates will be collected from the same aquifer tube and placed in separate containers for analysis. Field duplicates will be analyzed for the same constituents as the sample in accordance with analytical requirements in Tables 2-1 and 2-2.

2.2.6.2 Field Splits. The collection of field splits for aquifer tube water samples is not considered necessary under this SAP. However, during sampling, sample personnel could identify a need to collect a split sample to verify the performance of the primary laboratory or an outside agency could request a split sample. If so, the aquifer tube water sample will be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. Split samples, if any, will be analyzed in accordance with the analytical requirements listed in Table 2-1.

2.2.6.3 Equipment Rinsate Blanks. A minimum of one equipment rinsate blank will be collected from each sampling trip where decontamination activities are conducted. The aquifer tube sampling technical lead may request that additional equipment blanks be taken. Equipment blanks will consist of pure deionized water washed through decontaminated sampling equipment and placed in containers, as identified on the project sampling authorization form.

Equipment rinsate blanks will be analyzed for the constituents of potential concern and target analytes identified for this sampling and analysis activity.

2.2.6.4 Field Transfer Blanks. A minimum of one field transfer blank will be collected at aquifer tubes where the samples will undergo volatile organic compound (VOC) analysis. The field transfer blank will consist of pure deionized water added to clean sample containers at the location where the VOC sample was collected. The field transfer blank will be analyzed only for VOCs.

2.2.7 Sampling Quality Control Requirements

Field QC requirements for sampling will be established in accordance with direction from the Sample and Data Management organization. If only disposable equipment is used or equipment is dedicated to a particular OU, then an equipment rinsate blank is not required. If no VOC samples are collected, then a field blank is not required. Field blanks are not required when simply transferring samples to the field gas chromatograph for analysis.

Field duplicates must agree within 20%, as measured by the RPD, 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 EPA's SW-846. Typical acceptance limits are within 25% of the expected values, although the limits may vary with the method and analyte. For radiological analyses, typical acceptance limits are within 30% to 35% of the expected values, although the limits may vary with the method and analyte.

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 *Methods of Chemical Analysis of Water and Wastes* (EPA/600/4-79/020). Holding times are specified in laboratory contracts. Data associated with exceeded holding times are flagged with an "H" in the HEIS database.

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 S&GRP 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.

2.2.8 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization QA plan or operating procedures (as appropriate). Calibration of laboratory instruments will be performed in a manner consistent with SW-846 (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.

2.2.9 Instrument Calibration and Frequency

All onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan. In addition, instrument response checks are performed on a routine basis using known standards.

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

- Daily response checks will be performed and documented for each field instrument used during the sample collection, such as probes and meters used to measure water quality parameters (e.g., pH, conductivity, dissolved oxygen, and turbidity). These response checks will be performed according to the equipment manufacturer's specifications using known standards. The results from all instrument response checks are recorded in logbooks and/or work packages.

- Calibration of field instruments is conducted with equipment or standards with known valid relationships to nationally recognized performance standards. Field equipment used in this data collection activity that requires calibration will be listed in the field work package. Such equipment is uniquely identified and calibrated in accordance with the equipment-specific calibration procedure, including the program for maintaining calibration records traceable to the uniquely identified piece of equipment. The results from all instrument calibration activities are recorded in logbooks and/or work packages.

2.2.10 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables that are used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the contractor acquisition system. The procurement process ensures that purchased items and services comply with applicable procurement specifications; thereby, ensuring that structures, systems, and components, or other items and services procured or acquired, meet the specific

technical and quality requirements. Supplies and consumables are appropriately issued to the field, checked, and accepted before use.

2.2.11 Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Nondirect measurements (e.g., HEIS, historical records, and reports) were used in identifying data needs and DQOs for this SAP. The HEIS database was used to support preparation of this SAP. Nondirect measurements are not planned to be acquired under this SAP; however, any incidental nondirect measurement used as data acquired during this SAP activity (e.g., weather data from other sources) and used in decision making will be documented.

2.3 DATA MANAGEMENT

Analytical data resulting from the implementation of this QAPjP will be managed and stored in accordance with the applicable programmatic requirements governing data management procedures. Data collected under this SAP will be stored and maintained in the HEIS database. Electronic data access will be via the HEIS database. In the unlikely event that electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement.

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 that specific procedures do not exist for a particular work evolution, or that 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:

- Chain-of-custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks and checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document field activities when this SAP is implemented. All field activities will be recorded in field logbooks or appropriate forms invoked by procedure.

Errors are reported to the contractor's office of Sample and Data Management on a routine basis. Laboratory errors are reported to the Sample and Data Management project coordinator, who initiates a sample disposition record in accordance with contractor procedures. This process is used to document analytical errors and to establish their resolution with the aquifer tube sampling technical lead project manager. The Sample and Data Management project coordinator provides the sample disposition record to the project manager for review and signature. The sample disposition records become a permanent part of the analytical data package for future reference and for records management.

2.4 ASSESSMENT AND OVERSIGHT

This section identifies the activities for assessing project and associated QA and QC activities for compliance with QAPjP requirements.

2.4.1 Assessments and Response Actions

The contractor's 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. No project-specific management assessments are currently planned for activities conducted under this SAP. Assessments may be conducted, however, on a random basis or as needed.

If circumstances should arise in the field that dictate the need for additional assessment activities, these activities would be performed and recorded in accordance with approved procedures. 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 management action program, and associated approved procedures that implement these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. To ensure that laboratory QA requirements are met, contractor personnel conduct periodic oversight activities for offsite analytical laboratories in accordance with Hanford Site QA program requirements to qualify them for performing Hanford Site analytical work.

2.4.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified by self-assessments or other types of assessments. Errors reported by the laboratories are communicated to the Sample and Data Management organization, who initiates a sample disposition record in accordance with primary contractor procedures. This process is used to document analytical errors and to establish resolution with the aquifer tube sampling technical lead and project manager.

Assessments of data quality will be prepared as needed to evaluate whether the type, quality, and quantity of the data that were collected meet the quality objectives described in this SAP.

2.5 DATA VALIDATION AND USABILITY

Data validation and usability activities occur after the data collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying the project objectives.

2.5.1 Data Review, Validation, and Verification

Data will be reviewed, and data verification and validation will be performed on analytical data sets. These activities confirm that sampling and chain-of-custody documentation is complete and that sample numbers can be tied to the specific sampling locations (described in Sections 1.0 and 3.0), that samples were analyzed within required holding times identified on the sampling authorization form to be prepared for each sampling event, and that sample analyses met the data quality requirements specified in this QAPjP.

Data verification will be performed on all analytical data sets to ensure and document that the reported results reflect the sampling and analyses that were actually completed. The criteria for verification include, but are not limited to, review for completeness (i.e., all samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory and contractor personnel will perform data verification activities.

Data validation will be performed on analytical data sets to ensure that the data quality goals established during the planning phase are achieved. As recommended in EPA guidance (*Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* [EPA/540/R-94/083], *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses* [EPA/540/R-94/082]), the criteria for data validation are based on a graded approach. The 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% review of all data (e.g., calibration data, calculations of representative samples from the data set). Validation of data generated from activities associated with this plan will be performed to Level C.

Level C validation includes a review of the QC data and specifically requires verification of deliverables, 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. Independent Level C validation will be performed for at least 5% of the data by matrix and analyte group. Analyte group refers to categories (e.g., radionuclides, volatile chemicals, semi-volatile chemicals, polychlorinated biphenyls, metals, and anions). The goal is to cover the range of analyte groups and matrices during the validation.

No validation of physical data and/or field screening results will be performed; however, field QA/QC will be reviewed to ensure that the data are useable. Data will be accepted, rejected, or listed as qualified based on the results of the review.

Groundwater monitoring staff perform checks on laboratory electronic data files for formatting, allowed values, data flagging (qualifiers), and completeness. Hardcopy results are verified to check for (1) completeness, (2) notes on condition of samples upon receipt by the laboratory, (3) notes on problems that arose during the analysis of the samples, and (4) correct reporting of results. If data are incomplete or deficient, staff will work with the laboratory to correct the problem raised during the analysis.

The data validation process provides requirements and guidance for validation of groundwater data that are routinely collected. Validation is a systematic process of reviewing verified data against a set of criteria (listed in Table 2-3) to determine whether the data are acceptable for their intended use.

Results of laboratory and field QC evaluations, double-blind sample results, laboratory performance evaluation samples, and holding-time criteria are considered when determining data usability. Staff review the data to identify whether observed changes reflect changes in groundwater quality or potential data errors, and they may request data reviews of laboratory, field, or water-level data for usability purposes. The laboratory may be asked to check calculations or re-analyze the sample, or the well may be re-sampled. Results of the data reviews are used to flag the data appropriately in the HEIS database (e.g., "R" for reject, "Y" for suspect, "G" for good) and/or to add comments. Upon final data acceptance, both the raw data and the accepted/validated data shall be incorporated into the Hanford Facility Operating Record unit file.

The responses to data quality defects are identified through the verification/validation process. Corrective actions are shown in Table 2-3.

2.5.2 Validation and Verification Methods

Validation activities will be based on EPA functional guidelines (EPA/540/R-94/082 and EPA/540/R-94/083.). When outliers or questionable results are identified, additional data validation will be performed. The additional validation will be performed for up to 5% (or more if needed) 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 the data are usable. (Note that 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 data set.) Data validation will be documented in data validation reports, which will be provided to the Sample and Data Management organization and in the data quality assessment (DQA) report (see Section 2.4.3). Sample and Data Management is responsible for distributing the data validation report to the project manager and others as necessary. The determination of data usability will be documented in the DQA report.

2.5.3 Reconciliation with User Requirements

Following data verification and validation, the data need to be evaluated to see if they answer the original questions (e.g., DQOs). 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 if quantitative data are of the correct type, adequate quality, and adequate quantity to meet the project DQOs. The project manager is responsible for ensuring that a DQA is performed. The results of the DQA will be reported to the project manager and will be used in interpreting the data and determining if the objectives of this activity have been met.

The EPA's DQA process (*Data Quality Assessment: A Reviewer's Guide*, EPA QA/G-9R [EPA/240/B-06/002]; and *Data Quality Assessment: Statistical Methods for Practitioners* [EPA/240/B-06/003]) identifies five steps for evaluating data generated from this project, as summarized below:

- Step 1, Review DQOs and Sampling Design: This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO summary report and SAP.

- Step 2, Conduct a Preliminary Data Review: In this step, a comparison is made between the actual QA/QC achieved (e.g., detection limits, precision, and accuracy) and the requirements determined during the DQO process. Any significant deviations will be documented. Basic statistics will be calculated from the analytical data at this point, as appropriate to the data set, including an evaluation of the distribution of the data and in accordance with the DQOs.

- Step 3, Select the Statistical Test: Using the data evaluated in Step 2, an appropriate statistical hypothesis test is selected and justified.

- Step 4, Verify the Assumptions: In this step, the validity of the data analyses is assessed by determining if the data support the underlying assumptions necessary for the analyses or if the data set must be modified (e.g., transposed or augmented with additional data) before further analysis. If one or more assumptions are questioned, Step 3 is repeated.

- Step 5, Draw Conclusions from the Data: The statistical test is applied in this step, and the results either reject the null hypothesis or fail to reject the null hypothesis. If the latter is true, the data should be analyzed further. If the null hypothesis is rejected, the overall performance of the sampling design should be evaluated by forming a statistical power calculation to assess the adequacy of the sampling design.

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3.0 FIELD SAMPLING PLAN

This section provides the field sampling approach and includes discussion of the sampling locations and procedures applicable during aquifer tube sampling adjacent to and within the Columbia River. The FY-specific determination of sampling locations and analyses for aquifer sampling tubes to implement this SAP are provided in Appendix A.

3.1 SAMPLING OBJECTIVES

The results from the aquifer tube sampling are used for the following:

- Verifying the presence or absence of COCs at locations along the Columbia River shoreline
- Increasing knowledge of the nature, concentration, and extent of chemical and radiological indicators and the COCs in the groundwater at locations adjacent to the Columbia River
- Increasing understanding of the vertical distribution of contamination in the aquifer adjacent to the Columbia River
- Supplying data for risk assessments
- Supporting remedial action decision processes currently under way at the various OUs
- Supporting monitoring efforts for other Hanford Site projects
- Satisfying requirements of OU monitoring documents.

3.2 SAMPLING LOCATIONS AND FREQUENCY

Over 500 aquifer sampling tubes have been installed since the mid-1990s to assist in describing the nature and extent of contamination in groundwater near the Columbia River. Because of ecological and cultural concerns at some tube locations, all ecological and cultural resource restrictions placed on the project during previous reviews will be followed. Cultural and ecological reviews will be conducted for planned sampling activities prior to initiating work.

Sampling locations and frequency for FY09 are provided in Appendix A, Table A-1. The choice of which tubes to sample and which constituents to analyze was based on several factors:

- Water yield (some tubes do not yield water and cannot be sampled)
- Location of tube in relation to contaminant plumes
- Depth of tube in relation to contaminant distribution
- Historical trends

- Abundance of data (other factors being equal, tubes with more historical data are favored over those with less)
- Tubes installed in FY08 are sampled to fill in data gaps.

The result of a recent analysis of tube data and the resulting recommendations for sampling are summarized in Table A-2, Appendix A.

Since sample locations may be lost due to natural causes and data needs may change, the aquifer tube sampling list in Appendix A may vary from year to year. An annual evaluation of the recent sampling results and a determination of the upcoming needs of the OUs will be conducted each FY and the appendix will be revised as needed. Additional analytes/ samples may also be specified by the project manager and provided in Appendix A. The appendix will be presented to the regulatory agencies for review and concurrence prior to the start of sampling. Regulatory approval of Appendix A will be documented through records of meeting minutes. Sampling frequency will be as described in Appendix A, unless required for verification sampling or by other Hanford Site projects.

3.3 SAMPLING AND ONSITE ENVIRONMENTAL MEASUREMENT PROCEDURES

Aquifer tubes are sampled according to a documented procedure as summarized in Section 2.2.2.

3.4 SAMPLE MANAGEMENT

Sample management activities are summarized in Section 2.2.3.

3.5 WASTE MANAGEMENT

Investigation derived waste from these sampling activities will be managed according to *Environmental Restoration Program Strategy for Management of Investigation Derived Waste*, (Ecology et al. 1999) and existing regulator-approved waste management plans or waste control plans. For the aquifer sampling tubes, approved plans include the following:

- *Interim Action Waste Management Plan for the 100-HR-3 and 100-KR-4 Operable Unit* (DOE/RL-97-01), as modified by TPA-CN-222
- *Waste Control Plan for the 100-BC-5 Operable Unit* (DOE/RL-2004-30)
- *Waste Control Plan for the 100-FR-3 Operable Unit* (DOE/RL-2004-31), as modified by TPA-CN-228
- *Waste Control Plan for the 200-PO-1 Operable Unit* (DOE/RL-2004-18)
- *Interim Action Waste Management Plan for the 100-NR-2 Operable Unit* (DOE/RL-2000-41), as modified by TPA-CN-231
- *Waste Management Plan for the 300-FF-5 Operable Unit* (DOE/RL-2000-56).

The anticipated waste streams associated with the activities incorporated in this SAP include the following:

- Miscellaneous solid waste such as filters, wipes, gloves and other personal protective equipment, sampling and measuring equipment, and pump tubing
- Purgewater generated during groundwater sampling
- Liquids generated during field analysis.

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4.0 HEALTH AND SAFETY

All personnel working at the activities addressed by this SAP will have completed, at a minimum, the following:

- Occupational Safety and Health Administration Act 40-Hour Hazardous Waste Site Worker training program (29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response")
- Hanford General Employee Training
- Hanford Radiation Worker Training (as required).

Work will be performed in accordance with the following policies, specifications, or procedures:

- OU- or site-specific plans, as applicable:
  - Health and safety plans
  - Radiological work permit
  - Activity hazard analysis/job safety analysis
  - Site-specific waste management plans
  - Site-specific waste packaging instruction
- Applicable SGRP remediation support procedures
- Project Hanford Management Contract radiological control manual
- S&GRP environmental procedures.

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5.0 REFERENCES

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

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APPENDIX A

AQUIFER TUBES TO BE SAMPLED IN FISCAL YEAR 2009

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APPENDIX A

AQUIFER TUBES TO BE SAMPLED IN FISCAL YEAR 2009

This appendix list the sampling sites and analyses proposed for the fiscal year 2009 (FY09) aquifer tube sampling campaign (Table A-1). This list is based on requirements of operable unit (OU) sampling and analysis plans (SAPs), where applicable, and an analysis of aquifer tube sampling results from previous years. Table A-1 sorts the aquifer tubes by OU and lists the proposed analyses for each tube. By design, this appendix will be reviewed for each upcoming FY and will be revised as needed to reflect the changing needs of the OUs and the Soil and Groundwater Remediation Project.

The list of proposed sites and analyses (Table A-1) was prepared in consultation with the OU project managers and forwarded to the U.S. Environmental Protection Agency and the Washington State Department of Ecology for review and concurrence. Their recommendations have generally been incorporated into this appendix to finalize the proposed FY09 locations and analyses.

Table A-2 contains background information that was used to develop the FY09 sampling and analysis schedule. Staff reviewed the data trends and field notes from aquifer tube sampling from 1997 through 2007 and developed recommendations based on (1) contaminant levels, (2) tube location in relation to existing plumes, (3) tube sampleability, and (4) abundance of historical data. The planned sampling for FY09 (Table A-1) is based on results presented in Table A-2. The table does not include tubes installed in FY08 because there was no data record available. The new tubes will be added to the table future revisions of this SAP.

Sampling of aquifer tubes has historically been planned for the fall months of October and November to take advantage of low river-stage conditions that usually occur during these months. Sampling in FY09 began in November 2008. Approximate sampling dates are listed in Table A-1. Actual sampling dates are subject to approval of the schedule, river conditions, access to the sampling sites, and staff availability.

During sample collection, specific conductance is measured at each individual tube at a tube site. Samples are not collected if specific conductance is less than 160 μS/cm, unless otherwise specified in Tables A-1 and A-2. At many tube clusters, all tubes are sampled for field parameters and chromium, and one tube is selected for further analyses. Often, the tube with the highest specific conductance is selected because it is likely to have higher levels of contaminants (less mixed with river water). In other cases, a specific tube is chosen based on the historical record. Table A-2 provides the basis for the selection.

Changes between FY08 (*100/300 Areas Aquifer Tube Sampling and Analysis Instruction for Fiscal Year 2008* [SGW-34551]) and FY09 include the following:

- Addition of aquifer tubes installed in FY08
- Changes based on results of evaluations summarized in Table A-2.

The 100-N Area tubes downgradient of the apatite barrier are governed by the treatability test plan (*Treatability Test Plan Addendum for 100-NR-2 Groundwater Operable Unit* [DOE/RL-2005-96 addendum]). Those tubes are included in this document for information purposes only.

Location maps for each of the shoreline segments covered by the aquifer tube network are shown in Figures 1-1 through 1-10 of the main text.

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Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
100-BC-5 Segment																						
01-M		Nov	A	1	1	1					1											
03-D		Nov	A	1		1					1											
AT-B-1-M		Nov	A	1		1					1											
AT-B-2-D		Nov	A	1		1					1											
04-D		Nov	A	1	1	1	1	1			1											
C6227[c]	S	Nov	A	1		1											1					
C6228[c]	M	Nov	A	1		1											1					
C6229[c]	D	Nov	A	1		1					1						1					
05-S[c]		Nov	A	1		1											1					
05-M[c]		Nov	A	1	1	1	1	1			1	1					1					
05-D[c]		Nov	A	1		1											1					
AT-B-3-S[c]		Nov	A	1		1											1					
AT-B-3-M[c]		Nov	A	1		1											1					
AT-B-3-D[c]		Nov	A	1	1	1	1	1			1	1					1					
06-S[c]		Nov	A	1		1											1					
06-M[c]		Nov	A	1	1	1	1	1			1	1					1					
06-D[c]		Nov	A	1		1											1					
C6230[c]	S	Nov	A	1		1											1					
C6231[c]	M	Nov	A	1		1											1					

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C6232[c]	D	Nov	A	1		1					1						1					
C6233[c]	S	Nov	A	1		1											1					
C6234[c]	M	Nov	A	1		1											1					
C6235[c]	D	Nov	A	1		1					1						1					
AT-B-7-M		Nov	A	1	1	1					1	1					~~1~~					
AT-B-5-D		Nov	A	1	1	1					1	1					~~1~~	1				
12-D		Nov	A	1	1	1					1							1				
100-KR-4 Segment																						
14-D		Nov	A	1	1	1					1	1						1				
C6236	S	Nov	A	1		1																
C6237	M	Nov	A	1		1																
C6238	D	Nov	A	1	1	1					1			1								
AT-K-1-D		Nov	A	1	1	1	1	1			1	1		1				1				
17-D		Nov	A	1	1	1	1	1			1	1		1				1				
C6239	S	Nov	A	1		1																
C6240	M	Nov	A	1		1																
C6241	D	Nov	A	1	1	1					1			1								
C6242[c]	S	Nov	A	1		1											1					
C6243[c]	M	Nov	A	1		1											1					
C6244[c]	D	Nov	A	1	1	1					1			1			1					
AT-K-2-D		Nov	A	1	1	1	1	1			1	1		1								

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C6245[c]	S	Nov	A	1		1											1					
C6246[c]	M	Nov	A	1		1											1					
C6247[c]	D	Nov	A	1	1	1					1			1			1					
19-M		Nov	A	1		1											1					
19-D		Nov	A	1	1	1					1	1		1								
AT-K-3-S		Nov	A	1	1	1																
AT-K-3-M		Nov	A	1	1	1											1					
AT-K-3-D		Nov	A	1	1	1	1	1			1			1								
C6248	S	Nov	A	1		1																
C6249	M	Nov	A	1		1																
C6250	D	Nov	A	1	1	1					1			1								
C6251	S	Nov	A	1		1																
C6252	M	Nov	A	1		1																
C6253	D	Nov	A	1	1	1					1			1								
21-S		Nov	A	1		1																
21-M		Nov	A	1	1	1					1						1					
C6254[c]	S	Nov	A	1		1											1					
C6255[c]	M	Nov	A	1		1											1					
C6256[c]	D	Nov	A	1	1	1					1			1			1					
C6257[c]	S	Nov	A	1		1											1					
C6258[c]	M	Nov	A	1		1											1					

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C6259[c]	D	Nov	A	1	1	1					1			1			1					
22-M		Nov	A	1		1											1					
22-D		Nov	A	1	1	1					1											
AT-K-4-S		Nov	A	1		1																
AT-K-4-M		Nov	A	1	1	1					1						1					
23-M			A	1	1	1											1					
23-D			A	1	1	1					1											
C6260	S	Nov	A	1	1	1																
C6261	M	Nov	A	1	1	1					1			1								
AT-K-5-S		Nov	A	1	1	1																
AT-K-5-M		Nov	A	1	1	1											1					
AT-K-5-D		Nov	A	1	1	1				1	1											
DK-04-2		Nov	A	1	1	1				1	1											
25-D		Nov	A	1	1	1					1											
AT-K-6-S		Nov	A	1		1																
AT-K-6-M		Nov	A	1	1	1					1											
AT-K-6-D		Nov	A	1		1																
26-S		Nov	A	1		1																
26-M		Nov	A	1		1																
26-D		Nov	A	1	1	1					1											
C6263	S	Nov	A	1		1																

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C6264	M	Nov	A	1		1																
C6265	D	Nov	A	1	1	1					1			1								
100-NR-2 Segment																						
C6317	S	Dec	A	1																		
C6318	M	Dec	A	1																		
C6319	D	Dec	A	1	1	1	1	1													1	
C6320	S	Dec	A	1																		
C6321	M1	Dec	A	1																		
C6352	M2	Dec	A	1																		
C6322	D	Dec	A	1	1	1	1	1													1	
C6132[c]		Dec, Mar, Jun, Sep	Q	4									4								4	4
N116mArray-0A[c]		*Dec, Mar, Jun, Sep*	*Q/A*	*4*	*4*		*1*	*1*	*1*			*1*	*4*				*4*				*4*	*4*
C6135[c]		Dec, Mar, Jun, Sep	Q	4									4								4	4
N116mArray-1A[c]		*Dec, Mar, Jun, Sep*	*Q/A*	*4*	*1*		*1*	*1*	*1*			*1*	*4*				*1*				*4*	*4*
N116mArray-2A[a,c]		*Dec, Mar, Jun, Sep*	*Q/A*	*4*	*4*		*1*	*1*	*1*			*1*	*4*				*1*				*4*	*4*
N116mArray-3A[a,c]		*Monthly*	*M/Q*	*12*	*4*		*4*	*4*	*4*			*4*	*12*		*4*		*4*					
N116mArray-4A[a,c]		*Monthly*	*M/Q*	*12*	*4*		*4*	*4*	*4*			*4*	*12*		*4*		*4*					

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
NVP1-1[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP1-2[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP1-3[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP1-4[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP1-5[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP2-116.3[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP2-116.0[a,c]		*Monthly*	*M/Q*	*12*	*4*		*4*	*4*	*4*			*4*	*12*		*4*		*4*					
NVP2-115.7[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP2-115.4[c]		Dec, Mar, Jun, Sep	Q	4									4									
NVP2-115.1[c]		Dec, Mar, Jun, Sep	Q	4									4									
N116mArray-6A[a,c]		*Monthly*	*M*	*12*									*12*									
N116mArray-7A[a,c]		*Dec, Mar, Jun, Sep*	*Q/A*	*4*	*1*		*1*	*1*	*1*			*1*	*4*				*1*					
N116mArray-8A[c]		Dec, Mar, Jun, Sep	Q/A	4	1		1	1	1			1	4				1					

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
N116mArray-8.5A[c]		Dec, Mar, Jun, Sep	Q/A	4	1		1	1	1			1	4				1					
N116mArray-9A[c]		Dec, Mar, Jun, Sep	Q/A	4	1		1	1	1			1	4				1					
N116mArray-10A[c]		Dec, Mar, Jun, Sep	Q/A	4	1		1	1	1			1	4				1					
N116mArray-11A[c]		Dec, Mar, Jun, Sep	Q/A	4	1		1	1	1			1	4				1					
N116mArray-12A[c]		Dec, Mar, Jun, Sep	Q/A	4	1		1	1	1			1	4				1					
N116mArray-13A[c]		Dec, Mar, Jun, Sep	Q/A	4	1		1	1	1			1	4				1					
C6323[c]	S	Dec	A	1													1					
C6324[c]	M	Dec	A	1													1					
C6325[c]	D	Dec	A	1	1	1	1	1			1						1					
N116mArray-14A[c]		Dec, Mar, Jun, Sep	Q	4	1		1	1	1		1	1	4				1					
N116mArray-15A[c]		Dec, Mar, Jun, Sep	Q	4	1		1	1	1		1	1	4				1					
C6326	S	Dec	A	1																		
C6327	M	Dec	A	1																		
C6328	D	Dec	A	1		1	1	1			1											
C6329	S	Dec	A	1																		
C6330	M	Dec	A	1																		

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C6331	D	Dec	A	1			1	1			1											
C6332	S	Dec	A	1																		
C6333	M	Dec	A	1																		
C6334	D	Dec	A	1			1	1			1											
100-HR-3-D Segment																						
DD-50-1		Oct	A	1		1																
DD-50-2		Oct	A	1		1																
DD-50-3		Oct	A	1	1	1					1											
DD-50-4		Oct	A	1		1																
DD-49-1		Oct	A	1		1																
DD-49-2		Oct	A	1		1																
DD-49-3		Oct	A	1		1																
DD-49-4		Oct	A	1	1	1					1											
C6266	S	Oct, Jan, Apr, Jul	Q	4		4																
C6267	M	Oct, Jan, Apr, Jul	Q	4		4																
C6268	D	Oct, Jan, Apr, Jul	Q/A	4	4	4					1											
C6269	S	Oct, Jan, Apr, Jul	Q	4		4																
C6270	M	Oct, Jan, Apr, Jul	Q	4		4																
C6271	D	Oct, Jan, Apr, Jul	Q/A	4	4	4					1											

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
DD-44-3		Oct, Jan, Apr, Jul	Q/A	4		4																
DD-44-4		Oct, Jan, Apr, Jul	Q/A	4	4	4	1	1		1	1											
DD-43-2		Oct, Jan, Apr, Jul	Q	4		4																
DD-43-3		Oct, Jan, Apr, Jul	Q/A	4	4	4	1	1			1											
DD-42-2		Oct, Jan, Apr, Jul	Q	4		4																
DD-42-3		Oct, Jan, Apr, Jul	Q	4		4																
DD-42-4		Oct, Jan, Apr, Jul	Q/A	4	4	4	1	1			1											
DD-41-1		Oct, Jan, Apr, Jul	Q	4		4																
DD-41-2		Oct, Jan, Apr, Jul	Q/A	4	4	4	1	1		1												
DD-41-3		Oct, Jan, Apr, Jul	Q	4		4																
REDOX-4-3.0		Oct, Jan, Apr, Jul	Q	4		4																
REDOX-4-6.0		Oct, Jan, Apr, Jul	Q/A	4	1	4	1	1														
REDOX-3-3.3		Oct, Jan, Apr, Jul	Q	4		4																
REDOX-3-4.6		Oct, Jan, Apr, Jul	Q/A	4	4	4	4	4		4												
DD-39-1		Oct, Jan, Apr, Jul	Q	4		4																
DD-39-2		Oct, Jan, Apr, Jul	Q	4		4																
DD-39-3		Oct, Jan, Apr, Jul	Q/A	4	4	4	4	4		4												

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
REDOX-2-3.0		Oct, Jan, Apr, Jul	Q	4		4																
REDOX-2-6.0		Oct, Jan, Apr, Jul	Q/A	4	4	4	1	1														
REDOX-1-3.3		Oct, Jan, Apr, Jul	Q	4		4																
REDOX-1-6.0		Oct, Jan, Apr, Jul	Q/A	4	4	4	1	1		1												
AT-D-1-S		Oct	A	1		1																
AT-D-1-M		Oct	A	1		1																
AT-D-1-D		Oct	A	1	1	1	1	1														
C6272	S	Oct	A	1	1	1																
AT-D-4-S		Oct	A	1																		
AT-D-4-M		Oct	A	1																		
AT-D-4-D		Oct	A	1	1	1																
AT-D-2-S		Oct	A	1		1																
AT-D-2-M		Oct	A	1	1	1																
36-S		Oct	A	1		1																
36-M		Oct	A	1	1	1																
36-D		Oct	A	1		1																
AT-D-3-S		Oct	A	1		1																
AT-D-3-M		Oct	A	1		1																
AT-D-3-D		Oct	A	1	1	1																
C6275	S	Oct	A	1	1	1																

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
38-M		Oct	A	1	1	1																
38-D		Oct	A	1																		
DD-17-2[c]		Oct	A	1		1											1					
DD-17-3[c]		Oct	A	1		1	1	1									1					
C6278[c]	S	Oct	A	1	1	1											1					
DD-16-3[c]		Oct	A	1		1											1					
DD-16-4[c]		Oct	A	1		1											1					
DD-15-2[c]		Oct	A	1		1											1					
DD-15-3[c]		Oct	A	1	1	1											1					
DD-15-4[c]		Oct	A	1		1											1					
DD-12-2			A	1		1																
DD-12-4		Oct	A	1	1	1																
AT-D-5-M		Oct	A	1		1																
AT-D-5-D		Oct	A	1	1	1																
DD-06-2		Oct	A	1		1																
DD-06-3		Oct	A	1		1																
C6281	S	Oct	A	1		1																
C6282	M	Oct	A	1	1	1																

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
100-HR-3-H Segment																						
C6284	S	Oct	A	1		1																
C6285	M	Oct	A	1		1																
C6286	D	Oct	A	1		1																
C5632	Horn; S	Oct	A[b]	1		1																
C5633	Horn; M	Oct	A[b]	1		1																
C5634	Horn; D	Oct	A[b]	1		1																
C5635	Horn; S	Oct	A[b]	1		1																
C5636	Horn; M	Oct	A[b]	1		1																
C5637	Horn; D	Oct	A[b]	1		1																
C5638	Horn; S	Oct	A[b]	1		1																
C6287	S	Oct	A	1		1																
C6288	M	Oct	A	1	1	1																
C5641	Horn; S	Oct	A[b]	1		1																
C5644	Horn; S	Oct	A[b]	1		1	1	1														
44-M		Oct	A	1		1																
44-D			A	1	1	1	1	1														
C5673	Horn; S	Oct	A[b]	1		1																
C5674	Horn; M	Oct	A[b]	1		1	1	1														
C5676	Horn; S	Oct	A[b]	1		1																
C5677	Horn; M	Oct	A[b]	1		1																

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C5678	Horn; D	Oct	A[b]	1		1																
C5679	Horn; S	Oct	A[b]	1		1																
C5680	Horn; M	Oct	A[b]	1		1																
C5681	Horn; D	Oct	A[b]	1		1																
45-S		Oct	A	1		1																
45-M		Oct	A	1		1																
45-D		Oct	A	1	1	1																
C5682	Horn; S	Oct	A[b]	1		1																
C6290	S	Oct	A	1		1																
C6291	M	Oct	A	1	1	1																
C6293[c]	S	Oct	A	1	1	1											1	1	1			
AT-H-1-S		Oct	A	1		1																
AT-H-1-M		Oct	A	1		1																
AT-H-1-D		Oct	A	1	1	1												1	1			
AT-H-2-S		Oct	A	1																		
AT-H-2-M		Oct	A	1																		
AT-H-2-D		Oct	A	1	1	1												1	1			
AT-H-3-S[c]		Oct	A	1		1											1					
AT-H-3-D[c]		Oct	A	1	1	1						1					1	1	1			
47-M[c]		Oct	A	1		1											1					
47-D[c]		Oct	A	1	1	1						1					1					

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C6296[c]	S	Oct	A	1		1											1					
C6297[c]	M	Oct	A	1		1											1					
48-S[c]		Oct	A	1		1											1					
48-M[c]		Oct	A	1	1	1						1					1					
C6299	S	Oct	A	1		1																
C6300	M	Oct	A	1		1																
C6301	D	Oct	A	1	1	1																
49-D		Oct	A	1	1	1																
50-S			A	1		1																
50-M		Oct	A	1	1	1																
51-S		Oct	A	1		1																
51-M		Oct	A	1	1	1																
51-D		Oct	A	1		1																
52-S			A	1		1																
52-M			A	1		1																
52-D			A	1	1	1																
54-S			A	1		1																
54-M			A	1		1																
54-D			A	1		1																

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
100-FR-3 Segment																						
62-M		Oct	A	1	1	1	1	1	1													
C6302[c]	S	Oct	A	1		1											1					
C6303[c]	M	Oct	A	1	1	1					1						1					
64-S[c]		Oct	A	1		1											1					
64-M[c]		Oct	A	1		1											1					
64-D[c]		Oct	A	1	1	1	1	1	1								1					
C6305[c]	S	Oct	A	1		1											1					
C6306[c]	M	Oct	A	1		1											1					
C6307[c]	D	Oct	A	1	1	1					1						1					
C6308[c]	S	Oct	A	1		1											1					
C6309[c]	M	Oct	A	1	1	1	1	1			1						1					
C6311[c]	S	Oct	A	1		1											1					
C6312[c]	M	Oct	A	1	1	1	1	1			1						1					
C6314[c]	S	Oct	A	1		1											1					
C6315[c]	M	Oct	A	1		1											1					
C6316[c]	D	Oct	A	1	1	1	1	1			1						1					
AT-F-1-S[c]		Oct	A	1		1											1					
AT-F-1-M[c]		Oct	A	1		1											1					
AT-F-1-D[c]		Oct	A	1	1	1	1	1	1								1					
66-S			A	1																		

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
66-M			A	1																		
66-D		Oct	A	1	1	1	1	1	1													
67-S		Oct	A	1																		
67-M		Oct	A	1	1	1	1	1	1													
68-S		Oct	A	1																		
68-M		Oct	A	1																		
68-D		Oct	A	1	1	1	1	1	1		1											
AT-F-2-M		Oct	A	1	1	1	1	1	1		1											
74-D		Oct	A	1	1	1																
75-D		Oct	A	1	1	1					1											
76-D		Oct	A	1	1	1																
77-D		Oct	A	1	1	1																
200-PO-1 Segment																						
85-D			A	1	1						1	1				1		1				
86-D		Dec	A	1	1						1	1				1		1				
C6383	S	Dec	A	1																		
C6384	M	Dec	A	1	1	1					1	1				1		1				
C6353	S	Dec	A	1	1	1					1	1				1		1				
C6356	S	Dec	A	1	1	1					1	1				1		1				
C6359	S	Dec	A	1	1	1					1	1				1		1				
C6362	S	Dec	A	1	1	1					1	1				1		1				

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
C6365	S	Dec	A	1	1	1					1	1				1		1				
C6368	S	Dec	A	1	1	1					1	1				1		1				
C6371	S	Dec	A	1	1	1					1	1				1		1				
C6374	S	Dec	A	1																		
C6375	M	Dec	A	1	1	1					1	1				1		1				
C6380	S	Dec	A	1	1	1					1	1				1		1				
C6380	S	Dec	A	1	1	1					1	1				1		1				
300-FF-5 Segment																						
AT-3-1-S		Oct	A	1															1			
AT-3-1-M		Oct, Mar	SA	2	2		2	2	2		1	2							2	2		
AT-3-1-D(1)		Oct	A	1															1			
AT-3-2-S		Oct	A	1															1			
AT-3-2-M		Oct, Mar	SA	2	2		2	2	2		1	2							2	2		
C6341	S	Oct, Mar	SA	2															2	2		
C6342	M	Oct, Mar	SA	2	2		2	2	2		1	2							2	2		
C6343	D	Oct, Mar	SA	2															2	2		
AT-3-3-S		Oct, Mar	SA	2	2		2	2	2		1	2							2	2		
AT-3-3-M		Oct, Mar	SA	2															2	2		
AT-3-3-D		Oct, Mar	SA	2															2	2		
C6344	S	Oct, Mar	SA	2	2		2	2	2		1	2							2	2		
AT-3-4-S		Oct, Mar	SA	2	2		2	2	2		1	2							2	2		

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC
AT-3-4-M		Oct, Mar	SA	2															2	2		
AT-3-4-D		Oct, Mar	SA	2															2	2		
C6347	S	Oct, Mar	SA	2															2	2		
C6348	M	Oct, Mar	SA	2	2		2	2	2		1	2							2	2		
AT-3-5-S		Oct, Mar	SA	2	2		2	2	2			2							2			
C6350	S	Oct, Mar	SA	2															2	2		
C6351	M	Oct, Mar	SA	2	2		2	2	2		1	2							2	2		
AT-3-6-S		Oct, Mar	SA	2	2		2	2	2			2							2			
AT-3-6-M		Oct	A	1															1			
AT-3-6-D		Oct, Mar	SA	2															2	2		
AT-3-7-S		Oct	A	1															1			
AT-3-7-M		Oct, Mar	SA	2	2		2	2	2			2							2			
AT-3-7-D		Oct, Mar	SA	2															2	2		
AT-3-8-S		Oct, Mar	SA	2	2		2	2	2			2							2			
AT-3-8-M		Oct	A	1															1			
AT-3-8-D		Oct	A	1															1	1		

[a] Sampled by apatite project staff (DOE/RL-2005-95, April 2008 addendum). Included in this sampling and analysis plan for information.
[b] Horn area sampling and analysis instruction (SGW-33224) specifies frequency of quarterly for one year (last quarter will be November 2008), then review data and determine frequency. Will schedule annually for FY09 (i.e., November). Can add more if Horn area evaluation warrants.
[c] Sample regardless of specific conductance.

NOTES:

Choice of tube depths to sample for full suite of constituents may vary depending on field conditions. See Table A-2 for recommendations of tube depths to sample.

Notes for tubes installed 2007 or 2008: Horn area tubes in accordance with SGW-33224; others in accordance with SGW-36398. "S," "M," and "D" indicate relative depths of tubes.

Table A-1. Aquifer Tube Sampling Sites and Analyses Proposed for Fiscal Year 2009. (19 sheets)

Tube Name	Note for Tubes Installed 2007 or 2008	Scheduled Collection Month	Frequency	Field Parameters	Anions	Hexavalent Chromium	Metals (Unfiltered)	Metals (Filtered)	Alkalinity	Arsenic	Tritium	Gross Alpha/ Beta	Gross Beta	Carbon-14	Gamma Scan	Iodine-129	Strontium-90[c]	Technetium-99	Total Uranium	VOA	TPH	TOC

Frequency: A = annual; SA = semi-annual; Q = quarterly; M = monthly
Q/A = quarterly for key constituents; annually (during low river stage) for full suite
M/Q = monthly for key constituents; quarterly (coordinated with nearby tubes) for full suite
Numerals in the constituent columns indicate number of samples to be collected during FY09 (e.g., 1 = annual, 4 = quarterly).

FY = fiscal year
TOC = total organic carbon
TPH = total petroleum hydrocarbon
VOA = volatile organic analysis

Field parameters include the following:

Dissolved oxygen	Specific conductance
Oxidation-reduction potential	Temperature
pH	Turbidity

Metals analysis includes the following:

Barium	Molybdenum
Beryllium	Nickel
Bismuth	Potassium
Boron	Silicon
Cadmium	Silver
Calcium	Sodium
Chromium	Strontium
Cobalt	Tin
Copper	Titanium
Iron	Vanadium
Lithium	Zinc
Magnesium	Zirconium
Manganese	

Anions analysis includes the following:

Nitrate	Phosphate
Sulfate	Bromide
Fluoride	Nitrite
Chloride	

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
BC5	B8115	01-S	b	2.60	7.0	Screen sometimes >WT	None; upstream of reactor areas	Sample M - best record
BC5	B8114	01-M	b	2.60	16.0	Active		
~~BC5~~	~~B8113~~	~~01-D~~		~~2.60~~	~~24.0~~	Screen plugged		
BC5	B8118	02-S		3.13	6.0	No data	None; upstream of reactor areas	Do not need
BC5	B8117	02-M		3.13	14.9	No data		
BC5	B8120	03-M	b	3.45	7.0	Few data	Upstream; tritium <2,000 pCi/L	Sample D - best record
BC5	B8119	03-D	b	3.45	13.0	Active		
BC5	C4376	AT-B-1-S		3.57	8.0	Screen sometimes >WT; no data	Tritium >2,000 pCi/L	Sample M - best record
BC5	C4375	AT-B-1-M	b	3.57	13.3	Active		
BC5	C4378	AT-B-2-S	b	3.66	8.6	Few data	Tritium >2,000 pCi/L	Sample D - best record
BC5	C4379	AT-B-2-M	b	3.66	14.0	Few data		
BC5	C4377	AT-B-2-D	b	3.66	19.0	Active		
BC5	B8124	04-S	b	3.73	8.3	Active; most data	Cr <20 µg/L, typically highest in M or D; tritium >2,000 pCi/L	Sample M or D
BC5	B8123	04-M	b	3.73	13.0	Active		
BC5	B8122	04-D	b	3.73	25.0	Active		
BC5	B8127	05-S[c]	b	3.89	8.5	Active	Cr >20, highest in M; Sr-90 >8, highest in M	Sample all for Cr, Sr-90; M for full suite
BC5	B8126	05-M[c]	b	3.89	17.0	Active		
BC5	B8125	05-D[c]	b	3.89	25.5	Active		
BC5	C4382	AT-B-3-S[c]	b	4.02	8.1	Active	Cr >20, highest in D; Sr-90 >8, highest in S	Sample all for Cr, Sr-90; D for full suite
BC5	C4381	AT-B-3-M[c]	b	4.02	14.2	Active		
BC5	C4380	AT-B-3-D[c]	b	4.02	23.2	Active		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
BC5	B8130	06-S[c]	b	4.12	8.8	Screen sometimes above WT; no data	Cr >20, highest in M; Sr-90 >8, highest in M	Sample all for Cr, Sr-90; M for full suite
BC5	B8129	06-M[c]	b	4.12	15.5	Active		
BC5	B8128	06-D[c]	b	4.12	23.0	Active		
~~BC5~~	~~B8132~~	~~07-M~~		~~4.27~~	~~8.0~~	Destroyed	Cr <20 µg/L; tritium >2,000 pCi/L	Don not need; redundant with new tubes
BC5	B8131	07-D	b	4.27	20.0	Active		
BC5	C4368	AT-B-4-S	b	4.44	7.5	Active	Cr usually <20 µg/L; tritium >2,000 pCi/L	Do not need
BC5	C4371	AT-B-7-S	b	4.62	6.8	Active	Cr usually <20 µg/L; tritium >2,000 pCi/L from 200 Areas plume; Sr-90 undetected	Sample M - best record
BC5	C4370	AT-B-7-M	b	4.62	13.3	Active; best record		
BC5	C4369	AT-B-7-D	b	4.62	18.1	Active		
BC5	C4374	AT-B-5-S	b	4.77	9.6	Active	Tritium >10,000 pCi/L from 200 Areas plume; Sr-90 undetected	Sample D - best record
BC5	C4373	AT-B-5-M	b	4.77	16.2	Active		
BC5	C4372	AT-B-5-D	b	4.77	24.0	Active; most data		
BC5	B8143	11-D	b	5.07	10.5	Active	Tritium >2,000 pCi/L from 200 Areas plume	Do not need
BC5	B8146	12-D	b	5.33	10.0	Active; few data	Tritium >10,000 pCi/L from 200 Areas plume	Sample
BC5	B8151	13-S		5.61	8.3	No data	No data	Do not need
~~BC5~~	~~B8149~~	~~13-D~~		~~5.61~~	~~22.9~~	No yield		
~~KR4~~	~~B8154~~	~~14-S~~		~~5.88~~	~~7.5~~	No yield	Cr <20 µg/L; tritium >2,000 pCi/L	Sample D - best record
KR4	B8153	14-M		5.88	14.5	Active		
KR4	B8152	14-D		5.88	21.5	Active; most data		
KR4	B8156	15-M		6.08	13.7	Active	None	Do not need; redundant with new tubes

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
KR4	C4341	AT-K-1-S		6.27	9.2	Few data	Some Cr >20 µg/L; downgradient of KW	Sample D - best record
KR4	C4340	AT-K-1-M		6.27	15.0	Active; few data		
KR4	C4339	AT-K-1-D		6.27	21.7	Active; most data		
KR4	B8162	17-M		6.47	11.0	Active; few data	One Cr >20 µg/L in D; downgradient of KW	Sample D - best record
KR4	B8161	17-D		6.47	19.5	Active; most data		
KR4	B8204	18-S		6.56	8.5	Active	None	Do not need; redundant with new tubes
KR4	C4329	AT-K-2-S		6.64	15.0	No data	No plumes; downgradient of KE	Sample D - best record
KR4	C4327	AT-K-2-M		6.64	18.2	Active; few data		
KR4	C4328	AT-K-2-D		6.64	22.3	Active; most data		
KR4	B8206	19-M		6.85	10.0	Active; few data	No plumes; downgradient of KE	Sample M for Sr-90; D for full suite
KR4	B8205	19-D		6.85	22.0	Active		
KR4	C4344	AT-K-3-S		7.00	13.4	Active	Cr >20 µg/L; tritium >2,000 pCi/L; Sr-90 undetected	Sample all for Cr; M for Sr-90; D for full suite
KR4	C4343	AT-K-3-M		7.00	17.8	Active		
KR4	C4342	AT-K-3-D		7.00	23.0	Active		
KR4	B8213	21-S		7.42	11.0	Active; no Sr-90 data	Cr <20 µg/L; Sr-90 >DL	Sample both for Cr; M for Sr-90
KR4	B8212	21-M		7.42	15.0	Active		
KR4	B8215	22-M		7.73	7.5	Active	Cr formerly >20 µg/L; Sr-90 >8 pCi/L in M	Sample both for Cr; M for Sr-90
KR4	B8214	22-D		7.73	12.3	Active		
KR4	C4338	AT-K-4-S		7.88	11.0	Active; few data	None	Sample M for Cr
KR4	C4337	AT-K-4-M		7.88	13.2	Active; few data		
~~KR4~~	~~C4336~~	~~AT-K-4-D~~		~~7.88~~	~~15.3~~	No yield		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
KR4	B8218	23-M		7.90	7.0	Active	Cr formerly >20 µg/L in D; Sr-90 undetected	Sample for comparison to new tubes; Sample both for Cr; M for Sr-90; highest SC full suite
KR4	B8217	23-D		7.90	12.0	Active		
KR4	C4335	AT-K-5-S		8.09	10.5	Active	Cr >20 µg/L, highest in D; Sr-90 undetected	Sample all for Cr; D for full suite
KR4	C4331	AT-K-5-M		8.09	15.7	Active		
KR4	C4330	AT-K-5-D		8.09	21.1	Active		
KR4	B8526	DK-04-2		8.14	11.5	Active	Cr >20 µg/L	Sample
~~KR4~~	~~B8527~~	~~DK-04-3~~		~~8.14~~	~~15.0~~	No yield		
KR4	B8223	25-D		8.26	7.5	Active	One Cr >20 µg/L	Sample for Cr
KR4	C4333	AT-K-6-S		8.31	11.4	Active	Cr >20 µg/L, highest in M; tritium >2,000 pCi/L	Sample all for Cr; M for full suite
KR4	C4334	AT-K-6-M		8.31	15.3	Active; most data		
KR4	C4332	AT-K-6-D		8.31	21.6	Active		
KR4	B8228	26-S		8.39	6.0	Active	Cr >20 µg/L, highest in D; tritium >2,000 pCi/L	Sample all for Cr; D for full suite; annual frequency sufficient
KR4	B8227	26-M		8.39	14.0	Active		
KR4	B8226	26-D		8.39	23.0	Active		
NR2	C6131	N0A-US50-137cm		8.82	4.5	Not currently in use	Possibly trace diesel	Do not need
NR2	C6132	N0A-US25-167cm		8.83	5.5	Not currently in use	Diesel undetected	Sample
NR2	C5514	N116mArray-0A[c]	c	8.831	5.4	Active	Trace diesel; bounds Sr-90 plume.	Sample
NR2	C6133	N116mArray-0A-81cm		8.831	2.7	Not currently in use	Possibly trace diesel	Do not need
NR2	C6134	N0A-DS25-76cm		8.836	2.5	Not currently in use	Possibly trace diesel	Do not need
NR2	C6135	N0A-DS25-149cm		8.836	4.9	Not currently in use	Trace diesel	Sample
NR2	C6136	N0A-DS50-149cm		8.841	4.9	Not currently in use	Possibly trace diesel	Do not need
NR2	C5255	N116mArray-1A[c]	c	8.865	3.9	Active; tube broken?	Sulfate	Check tube; sample

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
NR2	C5256	N116mArray-2A[c]	c, d	8.882	2.1	Active	Sulfate, Sr-90	Sample tube; no tritium - distribution in aquifer well defined.
NR2	C5269	APT-1	d	8.891	8.9	Apatite monitoring	Sr-90	Currently sampled for apatite; re-evaluate annually for routine sampling.
NR2	C5270	APT-2		8.892	5.2	Not currently in use	Sr-90	
NR2	C5271	APT-3		8.893	2.8	Not currently in use	Sr-90	
NR2	C5257	N116mArray-3A[c]	c, d	8.895	2.0	Active	Sr-90; core of plume	Sample frequently
NR2	C5258	N116mArray-4A[c]	c, d	8.907	3.3	Active	Sr-90; core of plume	Sample frequently
~~NR2~~	~~C4585~~	~~NS-2A-23cm~~		~~8.910~~	~~0.8~~	Tube removed.	Sr-90; core of plume	N/A
~~NR2~~	~~C4586~~	~~NS-2A-87cm~~		~~8.910~~	~~2.9~~	Corroded	Sr-90; core of plume	Do not sample
~~NR2~~	~~C4587~~	~~NS-2A-168cm~~		~~8.910~~	~~5.5~~	Corroded	Sr-90; core of plume	Do not sample
~~NR2~~	~~C4588~~	~~NS-3A-10cm~~		~~8.919~~	~~0.3~~	Tubes removed.	Sr-90; core of plume	N/A
~~NR2~~	~~C4590~~	~~NS-3A-87cm~~		~~8.919~~	~~2.9~~		Sr-90; core of plume	
~~NR2~~	~~C4589~~	~~NS-3A-176cm~~		~~8.919~~	~~5.8~~		Sr-90; core of plume	
~~NR2~~	~~C4892~~	~~NS-3B-40cm~~		~~8.921~~	~~1.3~~		Sr-90; core of plume	
~~NR2~~	~~C4893~~	~~NS-3B-52cm~~		~~8.921~~	~~1.7~~		Sr-90; core of plume	
NR2	C5245	NVP1-1[c]	c	8.918	3.3	Screens often above WT	Sr-90; core of plume	Sample all during high WT for vertical distribution
NR2	C5246	NVP1-2[c]	c	8.918	4.1		Sr-90; core of plume	
NR2	C5247	NVP1-3[c]	c	8.918	5.6		Sr-90; core of plume	
NR2	C5248	NVP1-4[c]	c	8.922	5.7	Active	Sr-90; core of plume	Sample for vertical distribution
NR2	C5249	NVP1-5[c]	c	8.925	7.2	Active	Sr-90; core of plume	
NR2	C5250	NVP2-116.3[c]	c	8.924	2.3	Active	Sr-90; core of plume	
NR2	C5251	NVP2-116.0[c]	c, d	8.924	3.3	Active; same depth as Array	Sr-90; core of plume	Sample frequently

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
NR2	C5252	NVP2-115.7[c]	c	8.924	4.3	Active	Sr-90; core of plume	Sample for vertical distribution
NR2	C5253	NVP2-115.4[c]	c	8.924	5.3	Active	Sr-90; core of plume	
NR2	C5254	NVP2-115.1[c]	c	8.924	6.2	Active	Sr-90; core of plume	
NR2	C5259	N116mArray-6A[c]	c, d	8.931	2.3	Active	Sr-90	Sample frequently
~~NR2~~	~~C4640~~	~~NS-4A-17cm~~		~~8.932~~	~~0.6~~	Tubes removed.	Sr-90	N/A
~~NR2~~	~~C4641~~	~~NS-4A-138cm~~		~~8.932~~	~~4.5~~		Sr-90	
~~NR2~~	~~C4894~~	~~NS-4B-31cm~~		~~8.933~~	~~1.0~~		Sr-90	
NR2	C5386	APT-5	d	8.935	10.0	Apatite monitoring	Sr-90	Currently sampled for apatite; re-evaluate annually for routine sampling
NR2	C6457	APT5S		8.935	5.3	Not currently in use	Sr-90	Do not need
NR2	C5260	N116mArray-7A[c]	c, d	8.950	3.0	Active	Sr-90	Sample tube; no tritium - distribution in aquifer well defined
NR2	C5261	N116mArray-8A[c]	c	8.983	3.3	Active	Sr-90	Sample
NR2	C5262	N116mArray-8.5A		9.012	3.5	Active	Sr-90	Sample
NR2	C5263	N116mArray-9A[c]	c	9.044	3.3	Active	Sr-90	Sample
NR2	C5264	N116mArray-10A[c]	c	9.065	3.3	Active	Sr-90	Sample
NR2	C5265	N116mArray-11A[c]	c	9.090	3.3	Active	Sr-90	Sample
NR2	C5266	N116mArray-12A[c]	c	9.118	3.5	Active	Sr-90	Sample
NR2	C5267	N116mArray-13A[c]	c	9.149	5.2	Active	Sr-90	Sample
NR2	C5268	N116mArray-14A[c]	c	9.183	5.2	Active	Sr-90; tritium >2,000 pCi/L	Sample tube; tritium only annually - distribution well defined
NR2	C5512	N116mArray-15A		9.217	5.5	Active; few data	No plumes; bounds Sr-90	Sample occasionally
NR2	C5513	N116mArray-16A		9.251	5.4	Active; few data	None	Do not need

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
HR3D	B8515	DD-50-1		9.80	15.0	Active	Cr >20 µg/L; tritium >2,000 pCi/L, highest in 2 and 3	Sample all for Cr, -3 for full suite - best record
HR3D	B8516	DD-50-2		9.80	20.0	Active		
HR3D	B8517	DD-50-3		9.80	24.7	Active; best record		
HR3D	B8518	DD-50-4		9.80	31.0	Active		
HR3D	B8511	DD-49-1		9.83	12.0	Active	Cr >20 µg/L; tritium >2,000 pCi/L	Sample 1, 2, 3, 4 for Cr, tube with highest SC for full suite
HR3D	B8512	DD-49-2		9.83	15.7	Active		
HR3D	C6912	DD-49-2.5		9.83	21.3	Active; no data		
HR3D	B8513	DD-49-3		9.83	25.0	Active		
HR3D	B8514	DD-49-4		9.83	31.0	Active		
HR3D	B8509	DD-44-3		10.01	12.0	Active	ISRM; Cr & SC higher in -4; tritium >20,000 pCi/L	Sample both for Cr; 4 for full suite - best record
HR3D	B8510	DD-44-4		10.01	18.0	Active; best record		
HR3D	B8507	DD-43-2		10.05	10.0	Active	ISRM; Cr & SC higher in -3	Sample both for Cr; 3 for full suite
HR3D	B8508	DD-43-3		10.05	13.9	Active		
HR3D	B8504	DD-42-2		10.09	10.2	Active	ISRM; Cr & SC higher in -4	Sample all for Cr; 4 for full suite - best record
HR3D	B8505	DD-42-3		10.09	15.2	Active; few data		
HR3D	B8506	DD-42-4		10.09	18.2	Active; most data		
HR3D	B8503	DD-41-1		10.12	8.1	Active	ISRM; Cr higher in -2 and -3; SC higher in -2	Sample all for Cr; highest SC full suite
HR3D	B8483	DD-41-2		10.12	13.6	Active		
HR3D	B8484	DD-41-3		10.12	18.6	Active		
HR3D	C3383	Redox-4-3.0		10.13	3.0	Active	ISRM	Sample both for Cr; highest SC full suite
HR3D	C3515	Redox-4-6.0		10.13	6.0	Active		
HR3D	C3384	Redox-3-3.3		10.18	3.3	Active	ISRM; Cr same in both	Sample both for Cr; highest SC full suite
HR3D	C3514	Redox-3-4.6		10.18	4.6	Active		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
HR3D	B8479	DD-39-1		10.21	5.5	Active	ISRM; Cr same in -2 and -3	Sample all for Cr, highest SC full suite
HR3D	B8480	DD-39-2		10.21	10.5	Active		
HR3D	B8481	DD-39-3		10.21	15.0	Active		
~~HR3D~~	~~B8482~~	~~DD-39-4~~		~~10.21~~	~~21.0~~	No yield		
~~HR3D~~	~~(none)~~	~~TDP-39-S~~		~~10.21~~	~~1.0~~	No longer in use	ISRM	N/A
~~HR3D~~	~~(none)~~	~~TDP-39-M~~		~~10.21~~	~~1.5~~			
~~HR3D~~	~~(none)~~	~~TDP-39-D~~		~~10.21~~	~~2.0~~			
HR3D	C3385	Redox-2-3.0		10.24	3.0	Active	ISRM; Cr more variable in -3.0	Sample both for Cr; highest SC full suite
HR3D	C3513	Redox-2-6.0		10.24	6.0	Active		
HR3D	C3382	Redox-1-3.3		10.30	3.3	Active	ISRM; Cr same in both	Sample both for Cr; highest SC full suite
HR3D	C3512	Redox-1-6.0		10.30	6.0	Active		
HR3D	C4307	AT-D-1-S		10.42	7.0	Active	Cr <20 µg/L	Sample all for Cr; highest SC full suite
HR3D	C4306	AT-D-1-M		10.42	10.8	Active		
HR3D	C4305	AT-D-1-D		10.42	13.3	Active		
HR3D	B8255	35-S		10.48	8.0	Few data	None; between plumes	Do not need; redundant with new tube
~~HR3D~~	~~B8254~~	~~35-M~~		~~10.48~~	~~14.0~~	No yield		
~~HR3D~~	~~B8253~~	~~35-D~~		~~10.48~~	~~21.0~~	No yield		
HR3D	C4314	AT-D-4-S		10.58	12.4	Few data; low SC	None; between plumes	Sample occasionally.
HR3D	C4315	AT-D-4-M		10.58	13.8			
HR3D	C4316	AT-D-4-D		10.58	15.7			
HR3D	C4310	AT-D-2-S		10.66	14.3	Active	Cr >20 µg/L	Sample both for Cr; highest SC full suite
HR3D	C4309	AT-D-2-M		10.66	16.3	Active		
~~HR3D~~	~~C4308~~	~~AT-D-2-D~~		~~10.66~~	~~26.5~~	No yield		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
HR3D	B8258	36-S		10.67	8.0	Active	Cr >100 µg/L, highest in D, then M	Sample all for Cr; highest SC full suite
HR3D	B8257	36-M		10.67	14.0	Active		
HR3D	B8256	36-D		10.67	21.0	No yield FY08		
HR3D	C4313	AT-D-3-S		10.75	7.3	Active	Cr >20 µg/L, highest in D	Sample all for Cr; highest SC full suite
HR3D	C4312	AT-D-3-M		10.75	8.8	Active		
HR3D	C4311	AT-D-3-D		10.75	11.8	Active		
HR3D	B8261	37-S		10.83	6.5	Active; few data	None; very low SC	Do not need
~~HR3D~~	~~B8260~~	~~37-M~~		~~10.83~~	~~13.5~~	No yield		
~~HR3D~~	~~B8259~~	~~37-D~~		~~10.83~~	~~19.5~~	No yield		
HR3D	B8263	38-M		10.92	10.0	Active	Cr >20 µg/L	Sample tube w/ highest SC
HR3D	B8262	38-D		10.92	16.5	Active		
HR3D	B8477	DD-17-2		11.03	10.5	Active	Cr >20 µg/L	Sample both for Cr, Sr-90; highest SC full suite; metals to check 1998 anomaly
HR3D	B8478	DD-17-3		11.03	15.0	Active		
HR3D	B8475	DD-16-3		11.06	17.5	Active	Cr >20 µg/L	Sample both for Cr; highest SC full suite
HR3D	B8476	DD-16-4		11.06	25.5	Active		
HR3D	B8472	DD-15-2		11.10	15.0	Active; few data	Cr <20 µg/L; bounds plume	Sample all for Cr and Sr-90; highest SC full suite
HR3D	B8473	DD-15-3		11.10	21.0	Active		
HR3D	B8474	DD-15-4		11.10	25.5	Active		
HR3D	B8469	DD-12-2		11.20	10.0	Active	Cr <20 µg/L; bounds plume	Sample both for Cr; highest SC full suite
~~HR3D~~	~~B8470~~	~~DD-12-3~~		~~11.20~~	~~15.0~~	Not found		
HR3D	B8471	DD-12-4		11.20	21.0	Active		
HR3D	B8819	DD-10-2		11.27	12.0	Active	None	Do not need
HR3D	B8820	DD-10-3		11.27	17.0	Active		
HR3D	B8468	DD-10-4		11.27	22.0	Active		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation*
HR3D	C4318	AT-D-5-M		11.31	6.8	Active	None	Sample both for Cr; highest SC full suite
HR3D	C4317	AT-D-5-D		11.31	8.8	Active		
HR3D	B8821	DD-08-2		11.34	11.2	Active; few data	None	Do not need
HR3D	B8466	DD-08-3		11.34	17.2	Active		
HR3D	B8467	DD-08-4		11.34	22.3	Active		
HR3D	B8464	DD-06-2		11.40	12.0	Low yield	Cr <20 µg/L	Sample both for Cr
HR3D	B8465	DD-06-3		11.40	16.0	Active		
HR3D	B8267	39-S		11.62	8.0	1 data point	No plumes; located north or 100-D	Do not need currently - redundant with new tubes' re-evaluate annually
HR3D	B8266	39-M		11.62	18.0	1 data point		
HR3D	B8265	39-D		11.62	28.0	No data		
HR3D	B8270	40-S		11.98	8.0	Few data	No plumes; located north or 100-D	Do not need currently - redundant with new tubes' re-evaluate annually
HR3D	B8269	40-M		11.98	15.5	No data		
HR3D	B8273	41-S		13.10	10.0	No data	No plumes; located at tip of Horn	Do not need currently - redundant with new tubes' re-evaluate annually
HR3D	B8272	41-M		13.10	15.0	No data		
HR3D	B8271	41-D		13.10	25.0	No data		
~~HR3H~~	~~B8276~~	~~42-S~~		~~13.55~~	~~10.0~~	Destroyed	N/A	N/A
~~HR3H~~	~~B8275~~	~~42-M~~		~~13.55~~	~~15.0~~			
~~HR3H~~	~~B8274~~	~~42-D~~		~~13.55~~	~~24.0~~			
HR3H	B8278	43-M		14.04	7.5	Active	Cr >20 µg/L; located northwest of 100-H	Do not need currently - redundant with new tubes' re-evaluate annually
~~HR3H~~	~~B8277~~	~~43-D~~		~~14.04~~	~~9.7~~	Destroyed		
HR3H	B8281	44-M		14.26	8.5	Active	Cr >20 µg/L; located northwest of 100-H	Sample both for Cr; highest SC full suite
HR3H	B8280	44-D		14.26	12.7	No yield FY08		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
~~HR3H~~	~~B8521~~	~~DH 1451-1~~		~~14.39~~		One tube located 2008; not recently sampled	N/A	N/A
~~HR3H~~	~~B8522~~	~~DH 1452-1~~		~~14.45~~				
HR3H	B8285	45-S		14.66	8.0	Active	No plume; helps bound Cr plumes	Sample all for Cr; highest SC full suite
HR3H	B8284	45-M		14.66	15.0	Active		
HR3H	B8283	45-D		14.66	23.0	Active		
~~HR3H~~	~~B8519~~	~~DH 14-1~~		~~14.87~~	~~32.0~~	One tube located 2008; not recently sampled	N/A	N/A
~~HR3H~~	~~B8520~~	~~DH 14-11~~		~~14.87~~				
~~HR3H~~	~~B8286~~	~~46-D~~		~~15.12~~	~~10.5~~	No yield	N/A	N/A
HR3H	C4321	AT-H-1-S		15.16	6.2	Active	Cr recently >20 µg/L	Sample all for Cr; tube with highest SC for full suite
HR3H	C4320	AT-H-1-M		15.16	11.0	Active		
HR3H	C4319	AT-H-1-D		15.16	12.8	Active		
HR3H	C4324	AT-H-2-S		15.20	5.3	Active	None; downgradient of 183-H	Sample all for SC; highest SC full suite
HR3H	C4323	AT-H-2-M		15.20	9.2	Active		
HR3H	C4322	AT-H-2-D		15.20	12.0	Active		
HR3H	C4326	AT-H-3-S		15.23	5.3	Active	Detectable Sr-90; higher in S	Sample both for Cr and Sr-90; highest SC full suite
HR3H	C4325	AT-H-3-D		15.23	7.3	Active		
HR3H	B8290	47-M		15.30	8.0	Active	Sr-90 >8 pCi/L in M; Cr <20 µg/L	Sample both for Cr and Sr-90; highest SC full suite
HR3H	B8289	47-D		15.30	14.5	Active		
~~HR3H~~	~~B8523~~	~~DH 22-1~~		~~15.50~~	~~4.0~~	No longer in use	N/A	N/A
~~HR3H~~	~~B8524~~	~~DH 22-2~~		~~15.50~~	~~8.0~~			
~~HR3H~~	~~B8525~~	~~DH 22-3~~		~~15.50~~	~~13.5~~			

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
HR3H	B8294	48-S		15.52	9.0	Active	Cr >20 µg/L; Sr-90 undetected	Sample both for Cr and Sr-90; highest SC full suite
HR3H	B8293	48-M		15.52	17.0	Active		
~~HR3H~~	~~B8292~~	~~48-D~~		~~15.52~~	~~25.0~~	No yield		
HR3H	B8297	49-S		15.68	8.5	Active	Cr <20 µg/L	Sample only D - best record
HR3H	B8296	49-M		15.68	17.5	Active		
HR3H	B8295	49-D		15.68	25.5	Active; best record		
HR3H	B8300	50-S		15.71	8.5	No yield FY08	Cr >20 µg/L; NO3 near DWS	Sample M; attempt S
HR3H	B8299	50-M		15.71	17.5	Active		
~~HR3H~~	~~B8298~~	~~50-D~~		~~15.71~~	~~26.5~~	No yield		
HR3H	B8303	51-S		15.89	9.5	Active	Cr >20 µg/L; NO3 near DWS	Sample all for Cr, M for full suite - best record
HR3H	B8302	51-M		15.89	17.5	Active; best record		
HR3H	B8301	51-D		15.89	25.5	Active		
HR3H	B8306	52-S		16.10	7.0	Active	Cr < 20 µg/L; increased in D FY08	Sample all for Cr; highest SC for full suite
HR3H	B8305	52-M		16.10	15.0	Active		
HR3H	B8304	52-D		16.10	24.0	Active		
HR3H	B8309	53-S		16.37	8.0	No data	None; located downstream of 100-H	Do not need
HR3H	B8308	53-M		16.37	17.0	No data		
HR3H	B8307	53-D		16.37	26.0	No data		
HR3H	B8312	54-S		16.40	7.5	Active	Cr = 20 µg/L in D FY08	Sample all for Cr; highest SC for full suite
HR3H	B8311	54-M		16.40	17.0	Active		
HR3H	B8310	54-D		16.40	26.0	Active		
HR3H	B8315	55-S		16.67	10.0	Not currently in use	None; located downstream of 100-H	Do not need
HR3H	B8314	55-M		16.67	18.0	Not currently in use		
HR3H	B8313	55-D		16.67	26.0	Not currently in use		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
HR3H	B8321	57-S		17.10	7.0	Not currently in use	None; located downstream of 100-H	Do not need
HR3H	B8320	57-M		17.10	18.0	Not currently in use		
HR3H	B8319	57-D		17.10	29.0	Not currently in use		
HR3H	B8324	58-S		17.16	11.0	Not currently in use	None; located downstream of 100-H	Do not need
HR3H	B8323	58-M		17.16	19.5	Not currently in use		
HR3H	B8322	58-D		17.16	26.5	Not currently in use		
HR3H	B8327	59-S		17.38	11.0	Not currently in use	None; located downstream of 100-H	Do not need
HR3H	B8326	59-M		17.38	16.5	Not currently in use		
HR3H	B8325	59-D		17.38	23.0	Not currently in use		
HR3H	B8330	60-S		17.74	8.5	Not currently in use	None; located northwest of 100-F	Do not need
HR3H	B8329	60-M		17.74	17.5	Not currently in use		
HR3H	B8328	60-D		17.74	26.5	Not currently in use		
FR3	B8333	61-S		18.10	8.5	Not currently in use	None; located northwest of 100-F	Do not need
FR3	B8332	61-M		18.10	15.5	Not currently in use		
FR3	B8331	61-D		18.10	24.0	Not currently in use		
FR3	B8336	62-S	e	18.40	8.0	Active	NO3 >20 mg/L; located upstream of 100-F	Sample M
FR3	B8335	62-M	e	18.40	18.0	Active		
~~FR3~~	~~B8334~~	~~62-D~~		~~18.40~~	~~28.0~~	No yield		
FR3	B8339	63-S	e	18.81	10.0	Active	None	Do not need; redundant with new tubes
~~FR3~~	~~B8338~~	~~63-M~~		~~18.81~~	~~16.0~~	No yield		
~~FR3~~	~~B8337~~	~~63-D~~		~~18.81~~	~~23.0~~	No yield		
FR3	B8342	64-S		18.94	7.5	1 data point	Sr-90 <8 pCi/L; Cr <10 µg/L	Sample all for Sr-90; D for full suite
FR3	B8341	64-M[c]	e	18.94	17.0	Few data		
FR3	B8340	64-D[c]	e	18.94	27.0	Active		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
~~FR3~~	~~B8345~~	~~65-S~~	e	~~19.10~~	~~8.5~~	Destroyed	N/A	N/A
~~FR3~~	~~B8344~~	~~65-M~~	e	~~19.10~~	~~16.0~~			
~~FR3~~	~~B8343~~	~~65-D~~	e	~~19.10~~	~~27.0~~			
FR3	C4391	AT-F-1-S[c]	e	19.22	10.3	Active	Sr-90 <8 pCi/L; Cr <10 µg/L	Sample all for Sr-90; D for full suite
FR3	C4390	AT-F-1-M[c]	e	19.22	18.1	Active		
FR3	C4389	AT-F-1-D[c]	e	19.22	26.1	Active		
FR3	B8348	66-S[c]	e	19.37	10.0	Active	None; Sr-90 undetected; Cr <10 µg/L	Sample highest SC
FR3	B8347	66-M[c]	e	19.37	19.2	Active		
FR3	B8346	66-D[c]	e	19.37	28.1	Active		
FR3	B8351	67-S	e	19.58	10.0	Active	None; samples all very dilute and dominated by river water	Sample highest SC
FR3	B8350	67-M	e	19.58	20.0	Active		
~~FR3~~	~~B8349~~	~~67-D~~		~~19.58~~	~~30.0~~	No yield		
FR3	B8354	68-S	e	19.76	10.5	Not currently in use	None; samples all very dilute and dominated by river water	Sample highest SC
FR3	B8353	68-M	e	19.76	18.3	Not currently in use		
FR3	B8352	68-D	e	19.76	25.0	Active		
FR3	B8356	69-M		19.80	15.0	Not currently in use	None; samples all very dilute	Do not need
FR3	B8355	69-D		19.80	31.0	Not currently in use		
~~FR3~~	~~B8360~~	~~70-S~~		~~19.95~~	~~17.0~~	Destroyed	N/A	N/A
~~FR3~~	~~B8359~~	~~70-M~~		~~19.95~~	~~24.0~~			
~~FR3~~	~~B8358~~	~~70-D~~		~~19.95~~	~~31.0~~			
FR3	C4394	AT-F-2-S	e	20.11	7.5	No data	None; located downstream of 100-F	Sample highest SC
FR3	C4393	AT-F-2-M	e	20.11	13.6	Active		
FR3	C4392	AT-F-2-D	e	20.11	19.3	Few data		
~~FR3~~	~~B8361~~	~~71-D~~		~~20.26~~	~~7.5~~	Destroyed	N/A	N/A

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
FR3	C4385	AT-F-3-S	e	20.42	6.0	Few data	None; located downstream of 100-F	Do not need
FR3	C4384	AT-F-3-M	e	20.42	10.8	Few data		
FR3	C4383	AT-F-3-D	e	20.42	14.1	Active		
~~FR3~~	~~B8366~~	~~72-S~~		~~20.67~~	~~9.5~~	Not found	None; located downstream of 100-F	Do not need
FR3	B8365	72-M	e	20.67	18.0	Active		
FR3	B8364	72-D	e	20.67	28.0	Low yield		
~~FR3~~	~~B8369~~	~~73-S~~	e	~~20.81~~	~~10.5~~	Not found	N/A	N/A
~~FR3~~	~~B8368~~	~~73-M~~	e	~~20.81~~	~~19.0~~			
~~FR3~~	~~B8367~~	~~73-D~~	e	~~20.81~~	~~27.0~~			
FR3	C4388	AT-F-4-S	e	21.00	7.2	No data	None; located downstream of 100-F	Don't need
FR3	C4387	AT-F-4-M	e	21.00	18.0	No data		
FR3	C4386	AT-F-4-D	e	21.00	32.3	Active		
~~FR3~~	~~B8372~~	~~74-S~~		~~21.16~~	~~11.0~~	No yield	NO3 occasionally >10 mg/L; located downstream of 100-F	Sample D - best record
FR3	B8371	74-M	e	21.16	17.0	Few data		
FR3	B8370	74-D	e	21.16	29.0	Active		
FR3	B8375	75-S	e	21.49	11.0	One data point	NO3 >45 mg/L; located downstream of 100-F	Sample M or D
FR3	B8374	75-M	e	21.49	19.0	Active		
FR3	B8373	75-D	e	21.49	27.0	Active		
FR3	B8378	76-S	e	21.68	11.0	Few data	NO3 once >20 mg/L; located downstream of 100-F	Sample D - best record
FR3	B8377	76-M	e	21.68	19.0	Few data		
FR3	B8376	76-D	e	21.68	25.0	Active		
FR3	B8381	77-S	e	21.86	8.5	Few data	NO3 >20 mg/L; located downstream of 100-F	Sample D - best record
FR3	B8380	77-M	e	21.86	16.5	Few data		
FR3	B8379	77-D	e	21.86	24.5	Active		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
~~FR3~~	~~B8384~~	~~78-S~~	e	~~22.30~~	~~8.0~~	Not found	N/A	N/A
~~FR3~~	~~B8383~~	~~78-M~~	e	~~22.30~~	~~16.0~~			
~~FR3~~	~~B8382~~	~~78-D~~	e	~~22.30~~	~~24.0~~			
FR3	B8390	80-S		23.10	5.0	No data	None; located between 100-F and Hanford townsite	Do not need
~~FR3~~	~~B8389~~	~~80-M~~	e	~~23.10~~	~~15.5~~	Not found		
FR3	B8388	80-D	e	23.10	25.5	Active		
~~PO1~~	~~B8393~~	~~81-S~~	f	~~25.12~~	~~8.5~~	Not found	N/A	N/A
~~PO1~~	~~B8392~~	~~81-M~~	f	~~25.12~~	~~16.5~~			
~~PO1~~	~~B8391~~	~~81-D~~	f	~~25.12~~	~~24.5~~			
PO1	B8396	82-S	f	25.72	8.5	1 data point	Tritium undetected; located at Hanford townsite	Do not need
PO1	B8395	82-M	f	25.72	14.5	Low yield		
~~PO1~~	~~B8397~~	~~83-D~~	f	~~26.23~~	~~20.0~~	Not found	N/A	N/A
PO1	B8402	84-S	f	26.64	8.0	No data	Tritium mostly undetected; located at Hanford townsite	Do not need; doesn't help define plumes
PO1	B8401	84-M	f	26.64	14.0	No data		
PO1	B8400	84-D	f	26.64	22.0	Active		
PO1	B8405	85-S	f	27.13	8.0	No data	Tritium near detection limit; located at Hanford townsite	Sample highest SC; help bound plumes
PO1	B8404	85-M	f	27.13	17.0	1 data point		
PO1	B8403	85-D	f	27.13	26.0	1 data point		
PO1	B8408	86-S	f	27.39	7.0	1 data point	Tritium >2,000 pCi/L; located at Hanford townsite	Sample D - best record
PO1	B8407	86-M	f	27.39	10.0	Active		
PO1	B8406	86-D	f	27.39	26.0	Active; best record		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
3FF5	C4347	AT-3-1-S	g	42.08	11.6	Active	U >30 µg/L; tritium >2,000 pCi/L	No recommendation -- defer to SAP.
3FF5	C4346	AT-3-1-M	g	42.08	16.8	Active		
3FF5	C4345	AT-3-1-D(1)	g	42.08	21.1	Active		
3FF5	C4348	AT-3-1-D(2)		42.08	21.0	No data		
3FF5	C4350	AT-3-2-S	g	42.24	10.8	Active	U >30 µg/L, same in both; tritium >2,000 pCi/L	
3FF5	C4349	AT-3-2-M	g	42.24	16.6	Active		
3FF5	C5277	103mArray-US125		42.313	2.7	Active	U <30 µg/L; SC low	
3FF5	C5276	103mArray-US100		42.332	6.0	Active	U <30 µg/L; SC low	
3FF5	C5275	103mArray-US75		42.350	6.2	Active	U >30 µg/L; tritium >2,000 pCi/L	
3FF5	C4642	300SPR9A-19cm		42.365	0.6	Active	U >30 µg/L; tritium >2,000 pCi/L; NO3 >20 mg/L; highest in 142cm	
3FF5	C4643	300SPR9A-86cm		42.365	2.8	Active		
3FF5	C4644	300SPR9A-142cm		42.365	4.7	Active		
3FF5	C5274	103mArray-US50		42.367	6.1	Active	U >30 µg/L; tritium >2,000 pCi/L	
3FF5	C5273	103mArray-US25		42.377	5.6	Active	U >30 µg/L; tritium >2,000 pCi/L	
3FF5	none	300-3-3B-120cm		42.389	3.9	No data	Tube 376cm: U >30 µg/L; tritium >2,000 pCi/L; NO3 sometimes >20 mg/L	
3FF5	C4646	300-3-3B-376cm		42.389	12.3	Active		
3FF5	C4740	300-3-3B-518cm		42.389	17.0	1 data point		
3FF5	C4741	300-3-3C-409cm		42.390	13.4	Active	Tube 409cm: U >30 µg/L	
3FF5	C4742	300-3-3C-589cm		42.390	19.3	Few data		
3FF5	none	300-3-3-80cm		42.391	2.6	No data	N/A	

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
3FF5	C4690	300-3-3A-124cm		42.391	4.1	Active	U >30 µg/L; tritium >2,000 pCi/L; NO3 sometimes >20 mg/L	
3FF5	C4645	300-3-3A-410cm		42.391	13.5	Active		
3FF5	C4739	300-3-3A-579cm		42.391	19.0	Few data		
3FF5	C5272	103mArray-AT3A		42.391	6.9	Active	U >30 µg/L; tritium >2,000 pCi/L	
3FF5	C4353	AT-3-3-S	g	42.39	6.9	Active	U >30 µg/L; TCE >100 µg/L in D; tritium >2,000 pCi/L in S and M	
3FF5	C4352	AT-3-3-M	g	42.39	15.1	Active		
3FF5	C4351	AT-3-3-D	g	42.39	29.1	Low yield		
3FF5	C5278	103mArray-DS25		42.404	5.6	Active	U >30 µg/L; tritium >2,000 pCi/L	
3FF5	C5279	103mArray-DS50		42.412	5.2	Active	U >30 µg/L; tritium >2,000 pCi/L	
3FF5	C5280	103mArray-DS75		42.434	6.6	Active	U >30 µg/L; tritium >2,000 pCi/L	
3FF5	C4356	AT-3-4-S	g	42.49	7.0	Active	U >30 µg/L; TCE >5 µg/L in M and D; tritium >2,000 pCi/L in S	
3FF5	C4355	AT-3-4-M	g	42.49	9.2	Low yield		
3FF5	C4354	AT-3-4-D	g	42.49	12.0	Low yield		
3FF5	C4358	AT-3-5-S	g	42.61	7.7	Active	U >30 µg/L: TCE <1 µg/L; tritium >2,000 pCi/L	
~~3FF5~~	~~C4357~~	~~AT-3-5-M~~		~~42.61~~	~~12.2~~	No yield		
3FF5	C4361	AT-3-6-S	g	42.72	9.6	Active	U >30 µg/L in S&M; TCE <1 µg/L; tritium >2,000 pCi/L	
3FF5	C4360	AT-3-6-M	g	42.72	21.8	Active		
3FF5	C4359	AT-3-6-D	g	42.72	38.6	Active		
3FF5	C4364	AT-3-7-S	g	42.82	8.6	Active	U <30 µg/L; TCE <1 µg/L; NO3 >20 mg/L in M	
3FF5	C4363	AT-3-7-M	g	42.82	20.8	Active		
3FF5	C4362	AT-3-7-D	g	42.82	37.3	Active		

Table A-2. Sampling Recommendations Based on Evaluation of Aquifer Tube Historical Data. (19 sheets)

Shore Segment	Well ID	Tube Name	SAP	Hanford River Mile	Screen Depth (ft Below Land Surface)	Status	Plumes or Monitoring Purpose	Recommendation[a]
3FF5	C4367	AT-3-8-S	g	42.94	8.0	Active	U <30 µg/L; TCE <1 µg/L; NO3 >20 mg/L	
3FF5	C4366	AT-3-8-M	g	42.94	14.0	Active		
~~3FF5~~	~~C4365~~	~~AT-3-8-D~~	g	~~42.94~~	~~20.1~~	No yield		

NOTE: Tubes shown with strike-out text are out of service or do not consistently yield water.
[a] Subject to approval by regulatory agencies.
[b] TPA-CN-182, dated September 6, 2007.
[c] PNNL-15798, *100-N Shoreline Groundwater Monitoring Plan.*
[d] DOE/RL-2005-95, *Removal Action Work Plan #2 for the 324/327 Buildings and Ancillary Facilities,* Addendum (dated April 2008).
[e] DOE/RL-2003-49, *100-FR-3 Operable Unit Sampling and Analysis Plan.*
[f] DOE/RL-2003-04, *Sampling and Analysis Plan for the 200-PO-1 Groundwater Operable Unit.*
[g] DOE/RL-2002-11, *300-FF-5 Operable Unit Sampling and Analysis Plan.*
[c] Sampling and analysis plan specifies these tubes to be sampled regardless of specific conductance.
DWS = drinking water standard
FY = fiscal year
ISRM = In Situ Redox Manipulation
N/A = not applicable
S&M = surveillance and maintenance
SAP = sampling and analysis plan
SC = specific conductance
TCE = trichloroethene
WT = water table

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