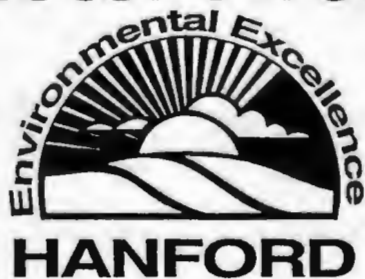


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BHI-00620

Rev. 0

Description of Work and Sampling and Analysis Plan for Pore Water Sampling at Groundwater- River Interface Adjacent to 100-D/DR, -K, and -H Reactor Areas



Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.
Richland, Washington

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Authors

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R. E. Peterson

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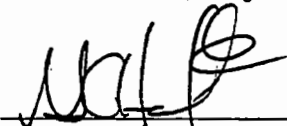
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LIST OF TERMS

AdSV	adsorptive stripping voltametry
BHI	Bechtel Hanford, Inc.
CPVC	chlorinated poly vinyl chloride
DQO	data quality objective
EIP	environmental investigative procedure
ERC	Environmental Restoration Contractor
ICP	inductively coupled plasma
PNNL	Pacific Northwest National Laboratory
QA/QC	quality assurance/quality control
QES	Quanterra Environmental Services
QMP	quality management program
SCUBA	self contained underwater breathing apparatus

1.0 INTRODUCTION

Hexavalent chromium from past Hanford operations is present in the groundwater beneath the site and is discharging into the Columbia River adjacent to several reactor locations. Objectives to investigate chromium-bearing groundwater movement into the Columbia River were determined during data quality objective (DQO) workshops. The following description of work and sampling and analysis plan was developed based on objectives from the DQO process to investigate chromium-bearing groundwater movement into the river. The requirements of step seven of the DQO process were also used.

Interstitial pore water samples from Columbia River substrate will be collected by Environmental Restoration Contractor (ERC) divers, using self-contained underwater breathing apparatus (SCUBA). Samples will be collected from a depth of approximately 46 cm (18 in.) in the substrate using a drive point and syringe to withdraw pore water. Samples are being obtained from nearshore river substrate at the 100-D/DR Area (completed in October/November 1995), 100-K Area, and 100-H Area (Figures 1, 2, and 3). This field investigation is based on similar work accomplished in March and April 1995 at the H Reactor groundwater-river interface (Hope 1995; Hope and Peterson 1995). Pore water samples will be analyzed in the laboratory for hexavalent chromium and total chromium. In addition, pore water, seep, and water column samples will be analyzed for hexavalent chromium, nitrate, dissolved oxygen, pH, hardness, turbidity, temperature, and specific conductance using field analysis techniques and methods.

Sections 2.0, 3.0, and 4.0 describe the study objectives, sample locations, and sample collection methods and parameters for analysis. An optional sampling event, contingent upon differential river flows, is described in Section 5.0. Quality Assurance/Quality Control (QA/QC) sampling is described in Section 6.0. Sampling documentation protocols, drawn from the ERC Quality Management Plan (QMP), (BHI 1995) are summarized in Section 7.0.

2.0 OBJECTIVES

The following represent the objectives of the Columbia River substrate pore water sampling program, which will be integrated with other groundwater quality information to assess the performance of 100-Area groundwater remediation activities.

- Establish a baseline for chromium concentrations in river substrate pore water in areas presumed to be influenced by the 100-Area groundwater contaminated by chromium.
- Provide observational information on the distribution of the salmon spawning habitat adjacent to the 100-D/DR, 100-K, and 100-H Reactors.

- Obtain field measurements of selected water quality indicators in river substrate pore water for comparison with groundwater data from near shore wells, riverbank seeps, and shoreline temporary groundwater sampling tubes.
- Enhance the conceptual site model for 100-Area groundwater plume(s) and interaction(s) with the Columbia River.

Figure 1. River Substrate Sampling Locations for 100-HR-3 (D) Operable Unit.

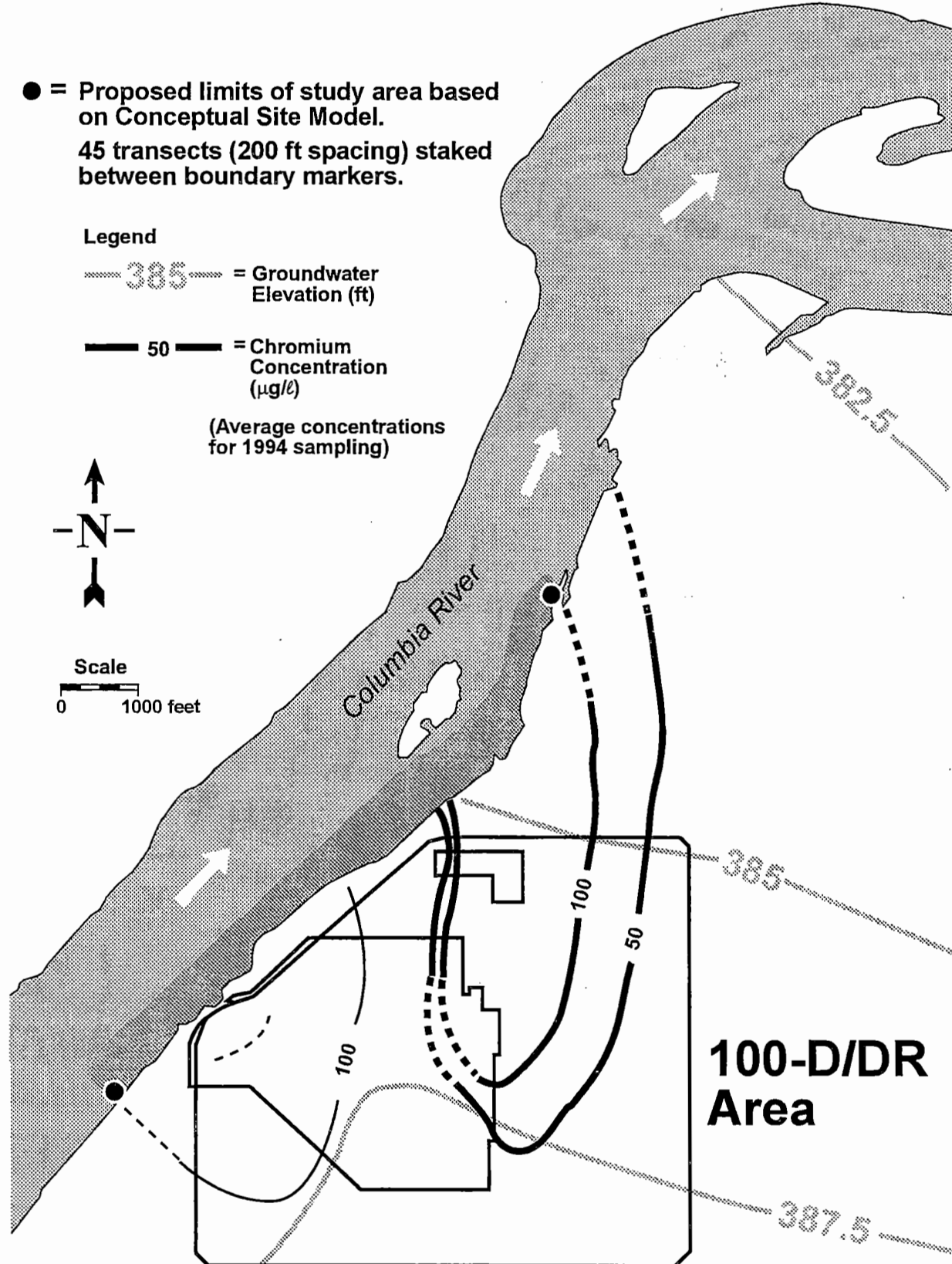


Figure 2. River Substrate Sampling Locations for 100-KR-4 Operable Unit.

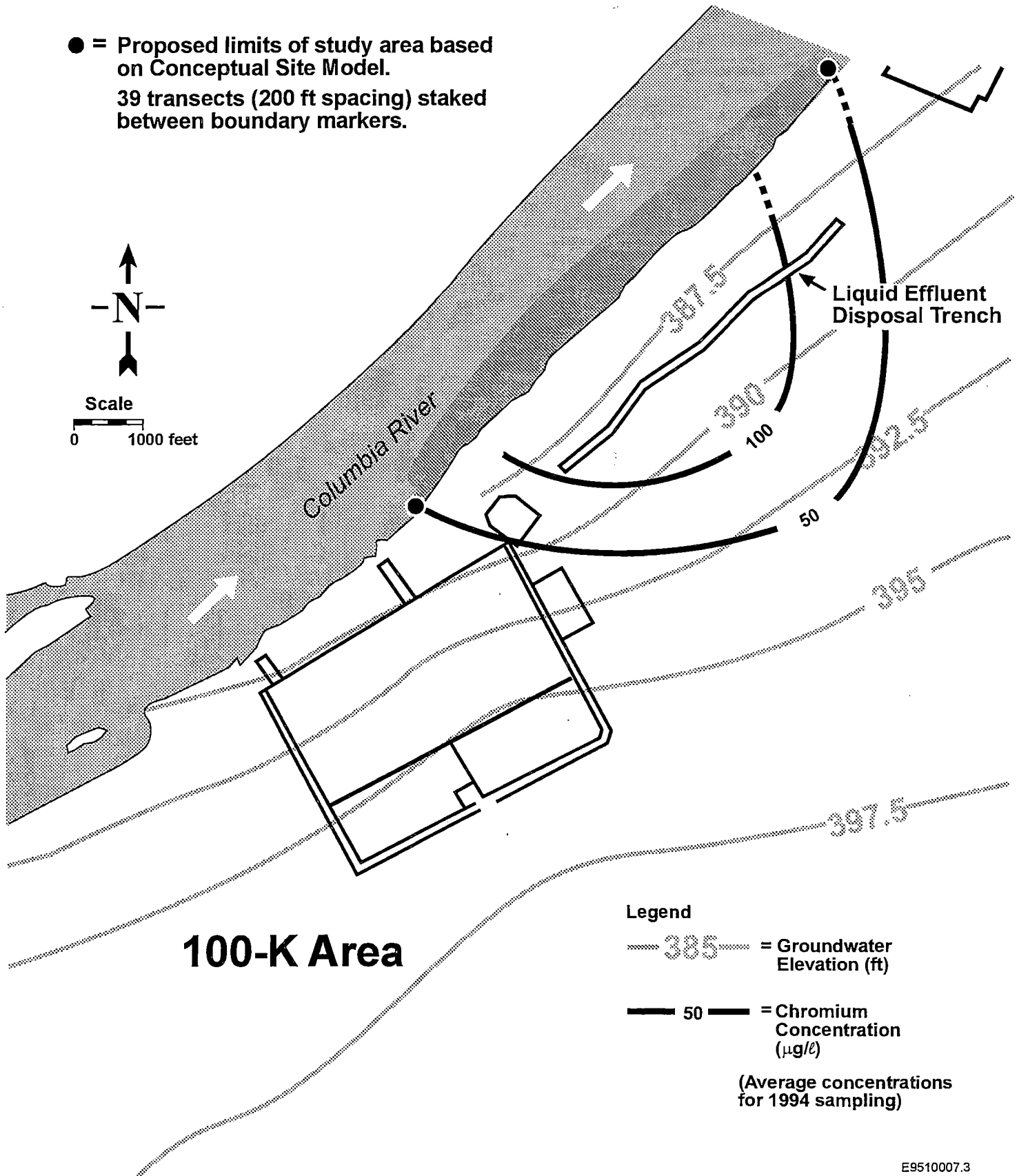
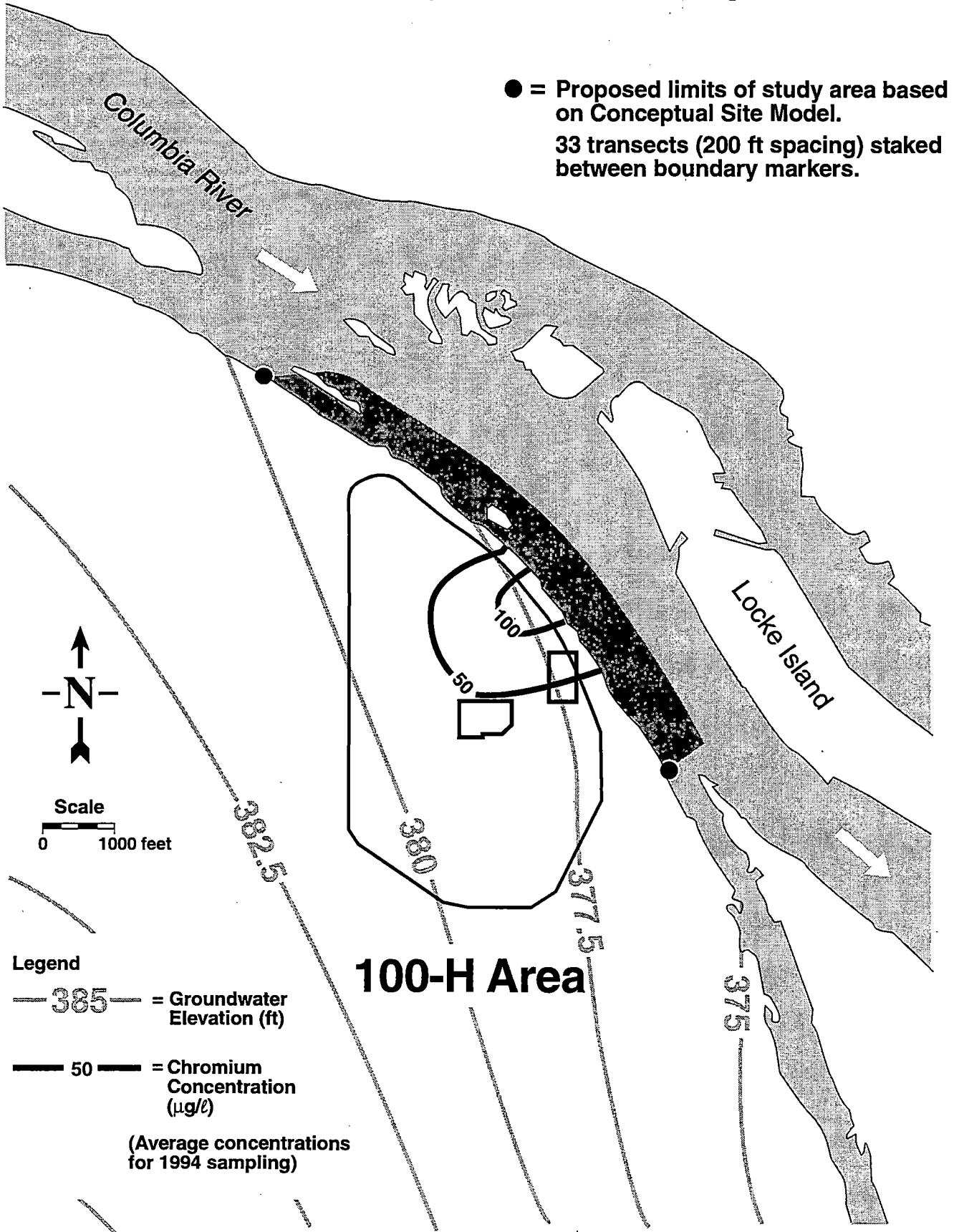


Figure 3. River Substrate Sampling Locations for 100-HR-3 (H) Operable Unit.



3.0 SUBSTRATE PORE WATER SAMPLE LOCATIONS

The major component of the sampling design consists of pore water collections adjacent to reactor and control site areas. Supplementary samples from the surface water column at the pore water collection point, shoreline water column, and seep samples adjacent to pore water sample locations will be used to identify other factors influencing pore water contaminant levels.

3.1 Reactor Area Pore Water Sample Locations

The following describes pore water sample points and is generic for the 100-D/DR, 100-K, and 100-H Reactor Areas. Two contingency locations are also described; sampling of these are subject to specific combinations of results.

Sample transects will be established (via infield measurement marked with stakes) 61 m (200 ft) downstream and upstream of the conceptual contaminant plume boundary, and every 61 m (200 ft) within the conceptual contaminant plume itself.

Initially, two locations will be sampled on each transect. The locations will be selected in the field based on river depth relative to the water level at a flow regime of 1,400 to 1,680 m³/second (50,000 to 60,000 ft³/second) (sampling will be conducted when the discharge rate at the Priest Rapids Dam is about 1,400 to 1,680 m³/second [50,000 to 60,000 ft³/second]). The first sample point nearest the shoreline (location "A") will be located along the transect where river depth is about 1.5 m (5 ft). The second sample point (location "B") will be located where river depth is about 3 m (10 ft). As observed in monitoring wells along the shoreline, these depths correspond to about 1.2 to 2.75 m (4 to 9 ft) into the unconfined aquifer.

Specifics of sample locations (distance from shore, depth, etc.) will be documented in the field logbook.

- Contingency 1: A third sample point (location "C") will be established at, or near, the approximate outer boundary of the conceptual contaminant plume (at a water depth of about 4.5 m [15 ft]) if the other two transect sample points indicate that chromium is present in the substrate pore water.
- Contingency 2: If chromium is found at the upstream or downstream plume boundaries, additional sampling will be conducted to define the extent of the contaminant plume. The sampling strategy presented previously (transects on 61-m [200-ft] centers, two possibly three sample sites per transect) will be used to define the plume boundary.

3.1 Control Pore Water Sample Locations

Background pore water (i.e., control) sites will be established upstream of the Hanford Site at Vernita Bar. Three sample transects (six sample points) will be sampled once during the 1995-1996 field investigation. This sampling will coincide with concurrent pore water sampling activities in the 100 Area to verify background levels of surface and pore water quality.

3.2 Supplemental Sample Locations

Other samples, including the following, will be collected and analyzed with field instruments during the pore water sampling program:

- At each sample point where pore water samples are collected, Columbia River water column samples will be collected just above the riverbed substrate. These samples will be used to characterize any localized differences between pore water and river water quality.
- To confirm the presence/absence of bank storage during pore water sampling and/or to correlate water quality data that could be influenced by bank storage runoff, samples will be collected from active seeps closest to the pore water transect being sampled. Seep samples will be collected twice daily to coincide with the first and last pore water sample taken during a sample day.
- Samples will be collected from temporary sampling tubes driven into the shoreline at selected pore water transects. Samples will be collected from multiple depths and analyzed using the same methods as those used for pore water and riverbank seepage samples.
- During sampling of the study area adjacent to H Reactor, shallow-water samples will be collected periodically (i.e., two to three times/day) from the downstream reach (i.e., downstream of the concrete outfall apron) at the water's edge. These samples will be collected adjacent to the H-Area pore water transects to assess ambient water quality in the shallows where salmon fry take cover.

4.0 SAMPLE COLLECTION AND ANALYSES

4.1 Pore Water Samples

Pore water sampling will be accomplished by penetrating 45.7 cm (18 in.) into the river bottom with a pneumatic chisel and a stainless steel pipe/rod, then inserting a 61-cm (24-in.) chlorinated poly vinyl chloride (CPVC) sampling wellpoint into the substrate.

A syringe sampling apparatus (i.e., 140 mL syringe(s), nylon/tygon tubing with "O" rings, nylon hose barbs and tubing clamps) will be used to extract the pore water sample. The syringe(s) will be filled slowly (i.e., 140 mL/15 seconds) to prevent clogging of the wellpoint screen and/or syringe sampling apparatus with silt/sand. A purge syringe will be filled before sample extraction to withdraw five volumes of water to remove residual surface water that becomes trapped: (1) in the sampling wellpoint during installation in the substrate, and (2) in the syringe sampling apparatus tubing during insertion into the wellpoint.

Sample volumes will be dictated by sampling design, QC sample, and analytical method requirements and will range from 140 mL to 2,100 mL (i.e., 1 to 15 syringes). The requirement for a 15-syringe sample volume will be infrequent and results from an increased sample volume necessary to accommodate combinations of QC samples (i.e., sample splits and samples duplicates). Samples requiring multiple syringes will be homogenized in a single container before being submitted to the laboratories.

Battelle's Pacific Northwest National Laboratory (PNNL) will be the primary analytical laboratory and will analyze all pore water samples for hexavalent chromium using the adsorptive stripping voltametry (AdSV) method. PNNL will also analyze a subset of the same samples (i.e., 10 percent) for total chromium using the standard method inductively coupled plasma (ICP) analysis. As the split laboratory, Quanterra Environmental Services (QES) laboratory will analyze approximately 10 percent of the total number of pore water samples for hexavalent chromium, and a subset of the same samples (i.e., 10 percent) for total chromium. All QES samples will be analyzed using standard methods. In addition, pore water samples will be analyzed for hexavalent chromium, nitrate, pH, dissolved oxygen, conductivity, turbidity, temperature, and hardness using field analysis techniques and methods.

A systematic observation of the gravel types (i.e., grain size) will be made during pore water sampling to document the quality/suitability of the study area's gravels as potential salmon spawning habitat.

4.2 Supplementary Water Column Samples

Water column samples will be collected 2.54 to 5.1 cm (1 to 2 in.) above the substrate at pore water sample locations with a syringe (i.e., 140 mL). Analytical parameters will include field analysis for hexavalent chromium, nitrate, pH, dissolved oxygen, conductivity, temperature, turbidity, and hardness.

4.3 Riverbank Seep Samples

Seep sampling will be done with a syringe (i.e., 20 mL) at a seep closest to the pore water transect being sampled by the divers. Analytical parameters will include field analysis for hexavalent chromium, nitrate, pH, dissolved oxygen, conductivity, turbidity, temperature, and hardness.

4.4 Shoreline Sampling Tube Samples

Temporary sampling tubes will be installed at multiple depths along the shoreline at selected pore water transects. The sampling tubes will be emplaced using one of two methods: steel casing driven by the GeoProbe™ vehicle or, where vehicle access is restricted, driven manually with an air hammer. A two-inch screen will be used at the bottom of the tube as the sample port. Samples drawn from the tubes will be analyzed using the same methods as those for pore water samples.

4.5 Near Shore River Water Samples

Using a 140 mL syringe, shallow water samples will be collected at the waters' edge two to three times a day. To coincide with concurrent H-Area pore water sampling, samples will be collected at the downstream reach of the H Reactor study area. Analytical parameters will include field analysis for hexavalent chromium, nitrate, pH, dissolved oxygen, conductivity, turbidity, temperature, and hardness.

4.6 Control Samples

Substrate pore water samples, for control purposes, will be collected from the Vernita Bar area using the same techniques described above. Analytical parameters for the control samples will be total and hexavalent chromium.

4.7 Data Uses and Quality/Quality Assurance Objectives

The following tables depict data uses and quality (Table 1) and quality assurance objectives (Table 2).

Table 1. Data Uses and Quality

Parameter	Data Use	Required Technical Quantitation Limits ¹	Selected Detection Limit	Appropriate Quality Level
Total Chromium	Comparison to background	5 ppb (Background)	25 ppb ³	Definitive screening
Hexavalent Chromium	Compare substrate water to shoreline water	<10 ppb	0.5 ppb ² 1.2 to 6 ppb ³ 10 ppb ⁴	Definitive screening
Nitrate	Comparison to background	<12,400 ppb (Background)	300 ppb ⁴	Screening
pH	Comparison to background	NA	0.1 pH ⁴	Screening
Dissolved Oxygen	Comparison to background	0.1 ppm	0.1 ppm ⁴	Screening
Conductivity	Comparison to background	<530 uS/cm (Background)	10 uS/cm ⁴	Screening
Turbidity	Comparison to background	NA	0.1 NTU ⁴	Screening
Hardness	Comparison to background	<20 ppm	10 ppm ⁴	Screening
Temperature	Comparison to background	NA	0° C	Screening

1. Based on project specific data uses
2. Detection limit using AdSV method
3. Detection limit using SW846 methods
4. Detection limit using field screening methods

Table 2. Quality Assurance Objectives

Parameter	Method	Target Detection Limit	Accuracy % Recovery	Precision (Relative % Deviation)	Completeness %
Total Chromium	6010	25 ppb	75%-125%	±25%	90%
Hexavalent Chromium	7195	1.2 ppb	75%-125%	±25%	90%
Hexavalent Chromium	AdSV	0.5 ppb	75%-125%	±25%	90%
Hexavalent Chromium	Hach	5-10 ppb	50%-150%	±50%	80%
Nitrate	Hach	300 ppb	50%-150%	±50%	80%
pH	Meter	0.1 pH	N.A.	±50%	80%
Dissolved Oxygen	Meter	0.1 ppm	N.A.	±50%	80%
Conductivity	Meter	10 uS/cm	50%-150%	±50%	80%
Turbidity	Meter	0.1 NTU	N.A.	±50%	80%
Hardness	Chemetts	10 ppm	N.A.	±50%	80%
Temperature	Meter	0° C	N.A.	±50%	80%

5.0 OPTIONAL EVENT

To detect any variance in the groundwater contaminant discharge at the groundwater-river interface between high-and low-flow regimes, sampling of pore water within the river substrate may occur during normal (high) river flows (i.e., about 2,800 to 4,200 m³/second [100,000 to 150,000 ft³/second]). This sampling would occur at sampling points where hexavalent chromium was previously detected during reduced river flows (i.e., about 1,400 to 1,680 m³/second [50,000 to 60,000 ft³/second]).

6.0 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The QA/QC sample requirements include spiked (in the field) samples sent blind to the laboratory, split samples, duplicate, and co-locate samples described below:

- Spiked samples: Spiked hexavalent chromium samples will be submitted to the laboratory at a frequency of 1:10 or 1:20.
- Split samples: Pore water split samples will occur at a frequency of 1:20 samples.
- Duplicate samples: Duplicate samples will be collected at a frequency of 1:10 samples.
- Co-locate Samples: Co-locate samples intended to evaluate the sample spacing design will be collected and submitted to the laboratory at a frequency of approximately one co-locate per five samples. The distance of the co-locate sample will be the approximate diameter of a redd (i.e., 6-12 ft) and will be centered on a node or pore water sampling point.
- Field Analyses QC: All field analyses will incorporate standard QC parameters. These procedures and associated results will be noted in field logbooks.

7.0 SAMPLE DOCUMENTATION PROTOCOLS

Pursuant to the requirements of DOE/RL-90-28, Rev. 2, criteria have been selected for this activity using a graded approach. The criteria are controls described in the ERC *Quality Measurement Plan* (BHI 1995).

The QMP has been prepared and is implemented in compliance with the U.S. Department of Energy/Bechtel Hanford, Inc. (BHI) Contract DE-AC06-93RL12367 and DOE/RL-90-28, Rev. 2. Commensurate with the program/policies promulgated by the QMP, the ERC will manage its work to ensure *Hanford Federal Facility Agreement and Consent Order* requirements and other commitment documents and laws are satisfied in a timely manner. The controls will be implemented by qualified personnel as described in the statement of work and implemented by U. S. Environmental Protection Agency-reviewed environmental investigation procedures (EIPs) contained in BHI-EE-01. Examples of criteria used are listed below with each specified QMP criterion.

BHI QMP (Part 2, Section C) criteria:

Criterion 11, Process Control: Work process, with respect to sample collection, is controlled to ensure that it was accomplished by qualified personnel (e.g., EIP 1.3, "Indoctrination, Training and Qualification"). Logbooks will be maintained (e.g., EIP 1.5, "Logbooks").

Criterion 12, Sample Control: Procedures that control the documenting and tracking of sample possession, from collection through handling, preservation, shipment, transfer, storage analysis, and disposition, will be implemented (e.g., EIP 3.0, "Chain of Custody").

Criterion 13, Control of Measuring and Test Equipment: Tools, gauges, instruments, laboratory equipment, measuring and test equipment, and standards used in the collection/analysis of samples described in this statement of work shall be properly identified, controlled, and maintained (e.g., BHI-SH-05, *Industrial Hygiene Desk Instructions* [BHI 1995]). Logbooks will be used to document calibrations and operating parameters for instruments used in field screening.

Criterion 14, Handling, Storage, Shipping and Disposal: Packaging, handling, storing, shipping, and preserving samples will be accomplished in a manner that prevents damage and/or loss, minimizes deterioration, and provides for final disposal (e.g., EIP 3.1, "Sample Packaging and Shipping").

Criterion 15, Field and Laboratory Inspection and Test Control: BHI procedures will be used for the following:

- Inspecting or otherwise verifying operations for collecting/analyzing data (e.g., EIP 2.5, "Data Package Validation Process").
- Controlling tests performed in the field/laboratory (e.g., BHI-EE-01, all Section 5.0 Field Sampling EIPs).
- Indication of inspection, test, or operating status of items/samples (e.g., EIP 1.5, "Field Logbooks").

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