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Sampling Instruction: Investigation of Hexavalent Chromium Flux to Groundwater at the 100-C-7:1 Excavation Site

MJ Truex
VR Vermeul

May 2012



Pacific Northwest
NATIONAL LABORATORY

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Pacific Northwest National Laboratory
Richland, Washington 99352

Concurrence

Sampling Instruction:

Investigation of Hexavalent Chromium Flux to Groundwater at the 100-C-7 Excavation Site

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5/15/12
Date

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1.0 Introduction

Deep excavation of soil at the 100-C-7 and 100-C-7:1 waste sites within the 100-BC Operable Unit to remove hexavalent chromium (Cr(VI)) contamination has been conducted with the excavations reaching to near the water table. Sampling shows that Cr(VI) contamination is still present at the bottom of the excavations. In addition, Cr(VI) concentrations in a downgradient monitoring well have increased since the excavation was initiated. Current plans are for additional excavation and backfill operations to start in early fiscal year 2013. There are currently no monitoring wells near the excavation, and few in the near downgradient portion of the aquifer.

While it is likely that the increased Cr(VI) concentrations in the downgradient monitoring well are due to Cr(VI) from the excavation site, there are no data to quantify the overall impact of the excavation site on groundwater. Prior to backfilling, characterization can be conducted to evaluate the flux of Cr(VI) from the excavation site into the groundwater. This investigation can be conducted from the bottom of the excavation where groundwater can be accessed with direct-push drilling technology.

Several types of data are needed to assess the flux of Cr(VI) from the excavation into the groundwater. As described in this plan, these data include 1) temporal Cr(VI) data in the shallow groundwater beneath the pit; 2) hydrologic data to interpret groundwater flow and contaminant transport; 3) hydraulic gradient data; and 4) as a contingency action if necessary, vertical profiling of Cr(VI) concentrations in the shallow aquifer beyond the depth possible with aquifer tubes. A decision for whether or not to proceed with contingency vertical profiling will be made pending review of aquifer tube data with the concurrence of the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA).

2.0 Site Description and Conditions

The 100-C-7 and 100-C-7:1 waste sites were excavated to remove soil contaminated with Cr(VI). These excavations have removed soil down to the water table (Figure 1). No additional excavation is planned for 100-C-7 because verification sampling shows that soil cleanup levels for Cr(VI) have been achieved. Continued excavation in the upper portion of 100-C-7:1 is planned for the future. Additionally, soil Cr(VI) contamination above soil cleanup levels was identified at the bottom of 100-C-7:1; however, deeper excavation cannot continue because the bottom of the waste site has reached the water table.

Relevant available data are provided in the following sections describing the current geologic, hydraulic, and sediment contaminant conditions at the site.



Figure 1. Existing 100-C-7 and 100-C-7:1 Excavations

2.1 Geologic Setting

The 100-C-7 and 100-C-7:1 waste sites are located in the Hanford formation. Borehole data from the area suggests that the water table, locally beneath the waste sites (Figure 2) and for a portion of the distance toward the Columbia River (Figure 3), is also within the Hanford formation. However, contact with the Ringold Formation undulates and may occur within 5 m of the water table.

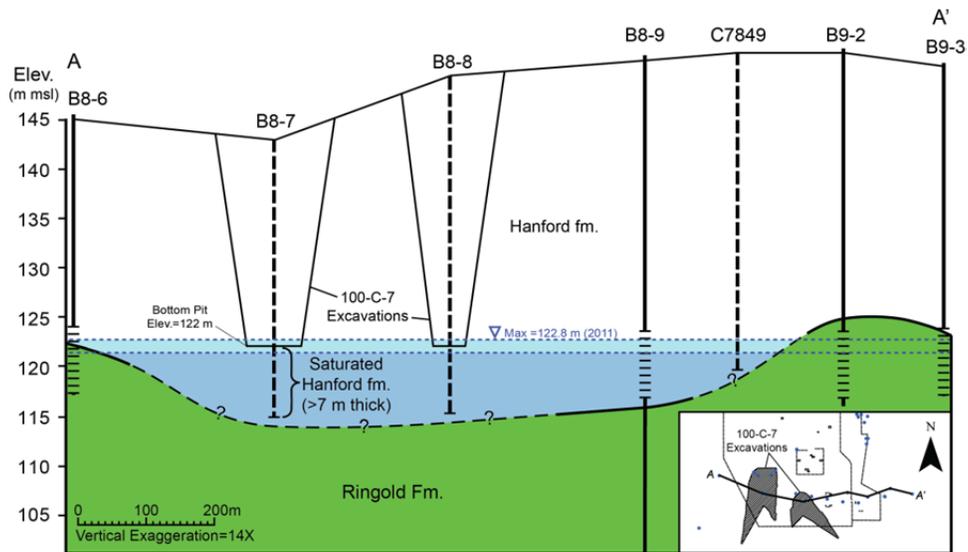


Figure 2. East-West Transect Showing the Water Table and Hanford-Ringold Contact

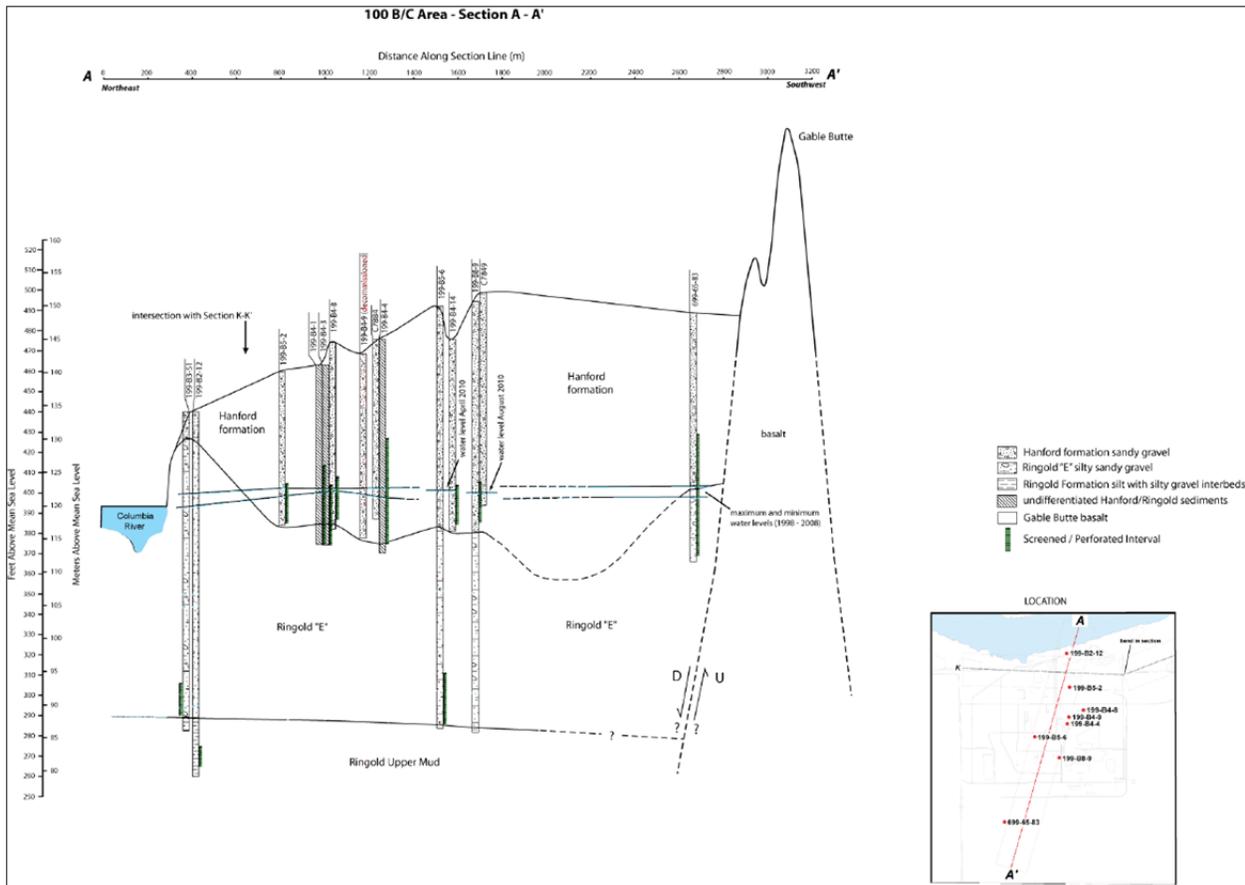


Figure 3. North-South Transect Showing the Water Table and Hanford-Ringold Contact Between the Site and the Columbia River (after Khaleel and Williams 2011)

2.2 Hydrology and Hydraulic Conditions

Local hydraulic conditions are available based on hydraulic head data collected at wells 199-B8-6, 199-B4-14, and 199-B5-8 (Figure 4). A record of high-frequency hydraulic head data is available at these wells dating from April 2011 through December 2011 (Figure 5). Hydraulic gradient magnitude and direction can be interpreted from triangulation of these data (Figure 6 and Figure 7) and show a relative constant flow direction to the north-northeast over time with a shallow gradient varying from $5E-5$ to $2E-4$ (m/m) over the monitored time frame. Using these and the regional hydraulic property information in Khaleel and Williams (2011), the groundwater velocity was estimated to vary over time (Figure 8) with maximum velocities between 1 m/d and 0.1 m/d for hydraulic conductivity estimates of 1000 m/d and 100 m/d, respectively.

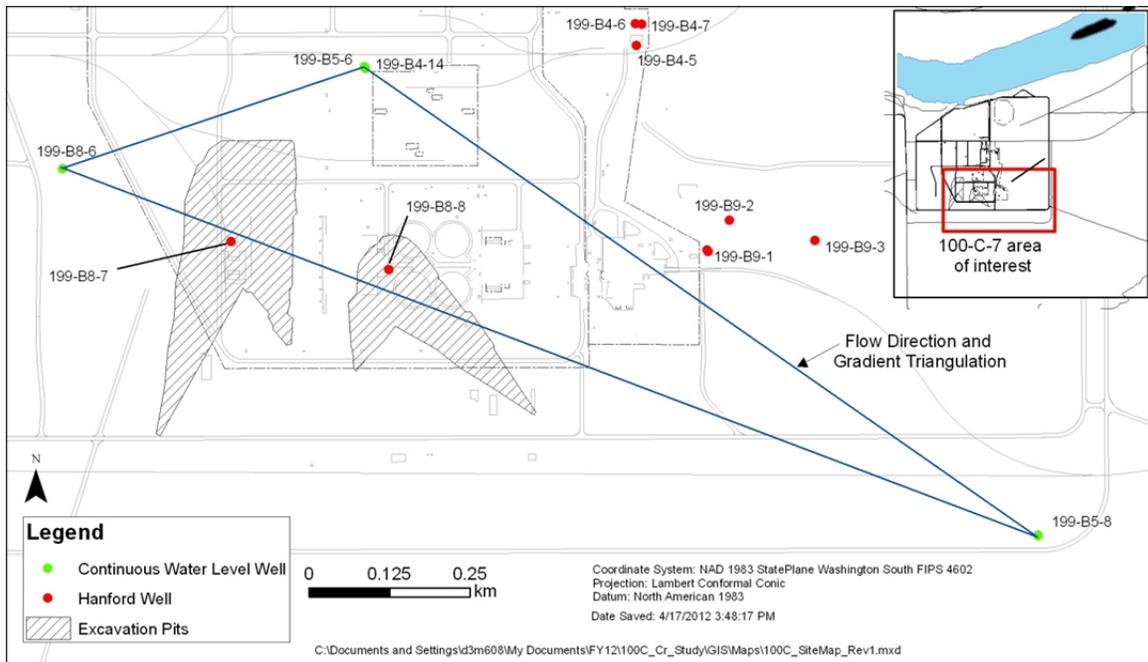


Figure 4. Location of Water-Level Monitoring Wells Relative to 100-C-7 and 100-C-7:1

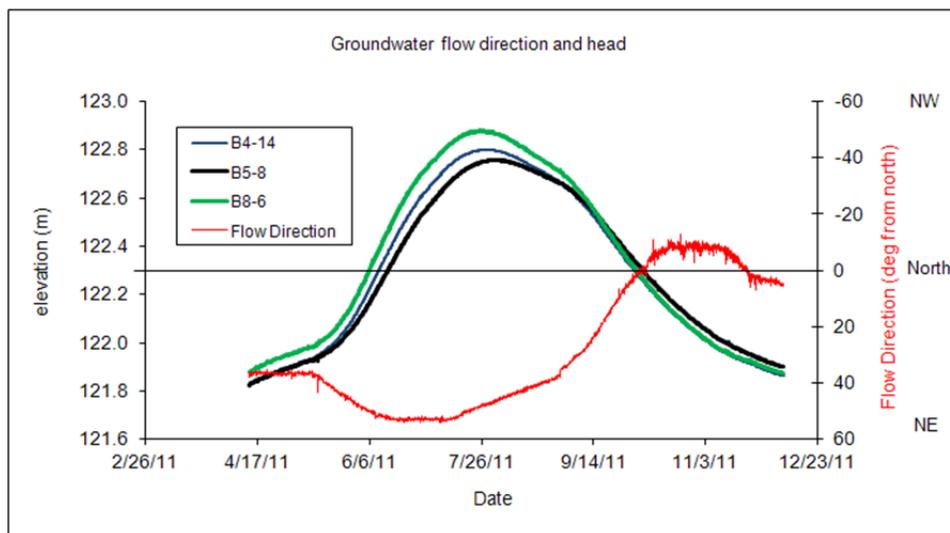


Figure 5. Hydraulic Head and Interpreted Groundwater Flow Direction from Wells 199-B8-6, 199-B4-14, and 199-B5-8

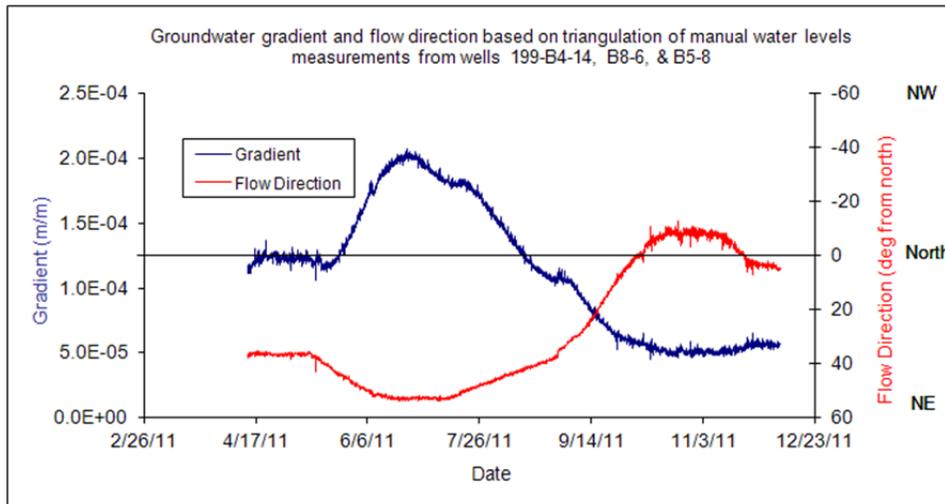


Figure 6. Interpreted Hydraulic Gradient and Groundwater Flow Direction from Wells 199-B8-6, 199-B4-14, and 199-B5-8

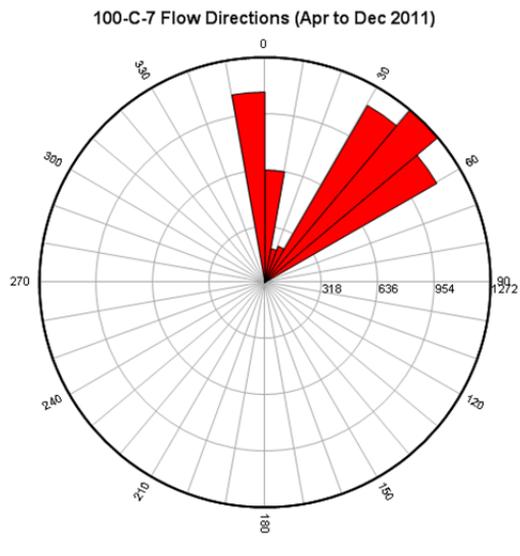


Figure 7. Interpreted Groundwater Flow Direction from Wells 199-B8-6, 199-B4-14, and 199-B5-8

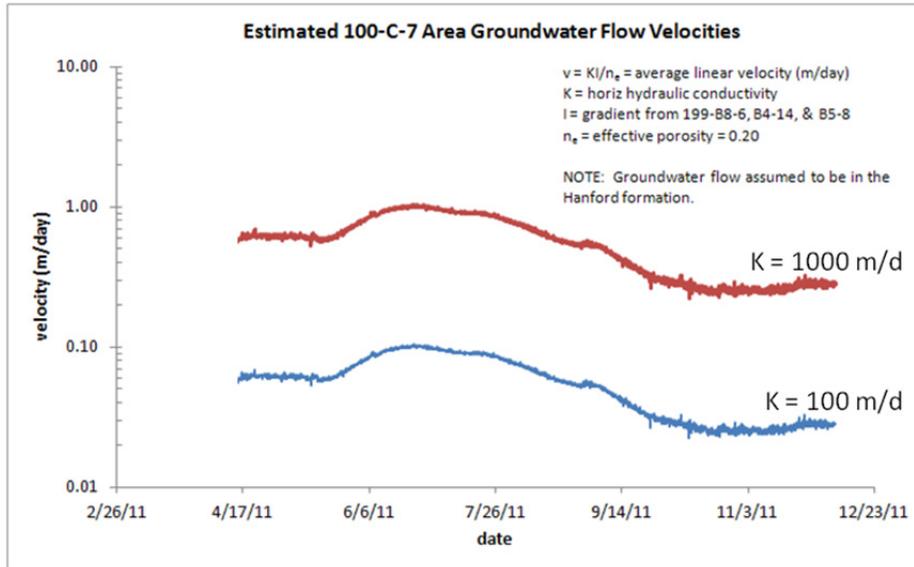


Figure 8. Estimated Range of Groundwater Velocities in the Hanford Formation Beneath 100-C-7 and 100-C-7:1

2.3 Soil Contaminant Conditions

Soil contamination data were collected in March 2012 at the floor of 100-C-7:1 with sample locations J1NLD4, J1NLD5, J1NLD7, J1NLD9, J1NLF0, and J1NLF1 showing concentrations above 10 mg/kg up to a maximum at J1NLD7 of about 40 mg/kg (Figure 9). These samples were collected from approximately 7.5 cm below the excavation floor. Verification sampling for the 100-C-7 site shows that soil cleanup levels for Cr(VI) have been achieved.

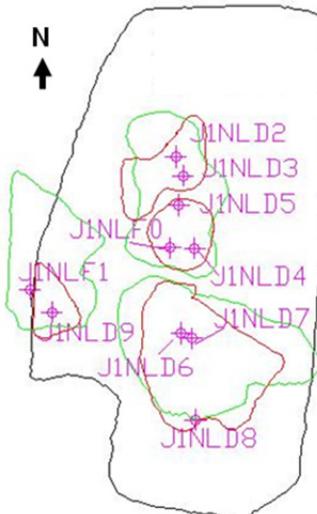


Figure 9. Soil Sample Data at the Floor of 100-C-7:1. The black line is the floor outline. The red lines show interpreted contamination zones from the March 2012 excavation floor sample results. The green lines show interpreted contamination zones from previous higher-elevation sample results. Sample locations are shown for the March sampling of the excavation floor.

3.0 Change Management

This sampling instruction contains descriptions of each element of the planned investigation. However, some test details will be finalized based on data obtained in the field. For instance, the final tracer test operational procedures will be described in a field test instruction that will be distributed for informational purposes, but not require signature. In addition, final emplacement depth intervals and locations for the aquifer tubes and direct push sampling locations are contingent on the ability to push these probes in the field. Final installations will be reported, but not require modification to this sampling instruction.

Significant changes—such as the inability to conduct a specific element of the effort or discovery of unexpected waste forms—will be communicated with the DOE Richland Operations Office (RL) and EPA so that a determination of the need to revise the sampling instruction can be made. If the sampling instruction document is revised, the revision will be signed by the same parties as for the original document.

4.0 Site Assumptions and or Constraints

The following items are assumptions and constraints for the project.

- Cr(VI) is the only contaminant of concern in the groundwater. Low concentrations of tritium or other contaminants will not be a health and safety, waste disposal, or operational concern.
- Vehicle and mobile laboratory access to the bottom of the entrance ramp for installing the tracer network, conducting tracer tests, and sampling the aquifer tubes, with trailer(s) remaining on site for the duration of testing and sampling.
- Ability to maintain access to the waste site and entrance ramp for the duration of testing including periods with 24-hour access that may be required for the tracer test operations.
- Base elements assume the ability to install aquifer tubes and conduct vertical profiling with the aquifer tubes to a depth of 2–3 m.
- For the tracer test effort conducted on the entrance ramp, the direct push rig is assumed to be able to obtain a penetration to 115 m above mean sea level (AMSL) for investigating the Hanford and Ringold Formations contact and be able to install temporary 2-in. piezometers to a depth of 119 m AMSL.
- If the contingency element 4 is enacted, the entrance ramp will be modified sufficiently for the track-mounted rig to access the pit floor.
- Contingency element 4 can be conducted in fiscal year 2013 after the groundwater recedes to below the pit floor and in parallel with continued excavation activities in the west pit.
- Temporary piezometers will be decommissioned by the drilling contractor to meet *Washington Administrative Code* (WAC) 173-160 requirements. Because these temporary piezometer installations do not extend to native ground surface elevation and the excavation will be backfilled in 2013, WAC requirements for wellhead protection do not strictly apply. However, the general

requirements of the code will still be followed. For planning purposes, it is assumed piezometer decommissioning will include backfilling the 2-in. screen and polyvinyl chloride (PVC) casing with bentonite and either unthreading and removing the surface joint of 2-in. PVC casing, or cutting the 2-in. PVC casing flush to the ground. No permanent markings will be required because the excavation pit will be backfilled to original ground surface. Aquifer tubes will be left in place to be covered during backfill operations.

5.0 Sampling Plan

There are three elements to the sampling plan and a contingency element.

Element 1. Temporal Cr(VI) data in the shallow (top 1–2 m) groundwater will be collected using aquifer tubes. In addition to spatial and temporal Cr(VI) data in the shallow aquifer, aquifer tubes will also be used to collect a vertical profile of Cr(VI) concentrations to approximately 3 m depth with the goal of minimizing or negating the need for additional profiling using a direct push rig (see contingency element 4 below).

Element 2. Localized hydraulic information will be collected with a network of direct push installed temporary piezometers at the bottom of the entrance ramp (above high water level). Resulting data include direct push information, limited hydraulic testing, and a tracer test to characterize the following:

- Hanford and Ringold Formations contact relative to the excavation floor
- effective porosity
- groundwater velocity under known gradient condition
- localized hydraulic properties.

Element 3. The currently operating water-level monitoring network in the vicinity of the excavation (199-B8-6, 199-B4-14, and 199-B5-8; see Section 2.2) will be maintained and used to monitor hydraulic heads throughout the life of the project. These data are needed to determine the hydraulic gradient and groundwater flow direction that will be used in conjunction with the localized hydraulic/tracer data and Cr(VI) information to assess the Cr(VI) source flux and potential impacts to the groundwater.

Contingency Element 4. Vertical profiling of Cr(VI) in the top of the aquifer will be conducted, if necessary, to augment the aquifer tube data (element 1) and confirm the Hanford and Ringold Formations contact within the pit area using a track-mounted direct-push rig. The emphasis of these data will be to pair with aquifer tube locations and collect deeper vertical profiling of Cr(VI) concentrations. A decision for whether or not to proceed with contingency vertical profiling will be made pending review of aquifer tube data with the concurrence of DOE and EPA.

Sampling plan elements are discussed in more detail in the following sections.

5.1 Aquifer Tube Installation and Sampling

Aquifer tubes (Figure 10) consist of a perforated screen attached to a well-point on one end and a tube on the other. The screens will be 15-cm long (6-in.) and 1.3-cm diameter (0.5-in.) 80 mesh stainless-steel attached to a stainless-steel point (Geoprobe® Systems, Salina, Kansas). To facilitate sampling over long distances between the aquifer tube and the pump location, 0.95-cm outside diameter (OD) (0.375-in.) polyethylene tubing will be used for the sampling tubing.

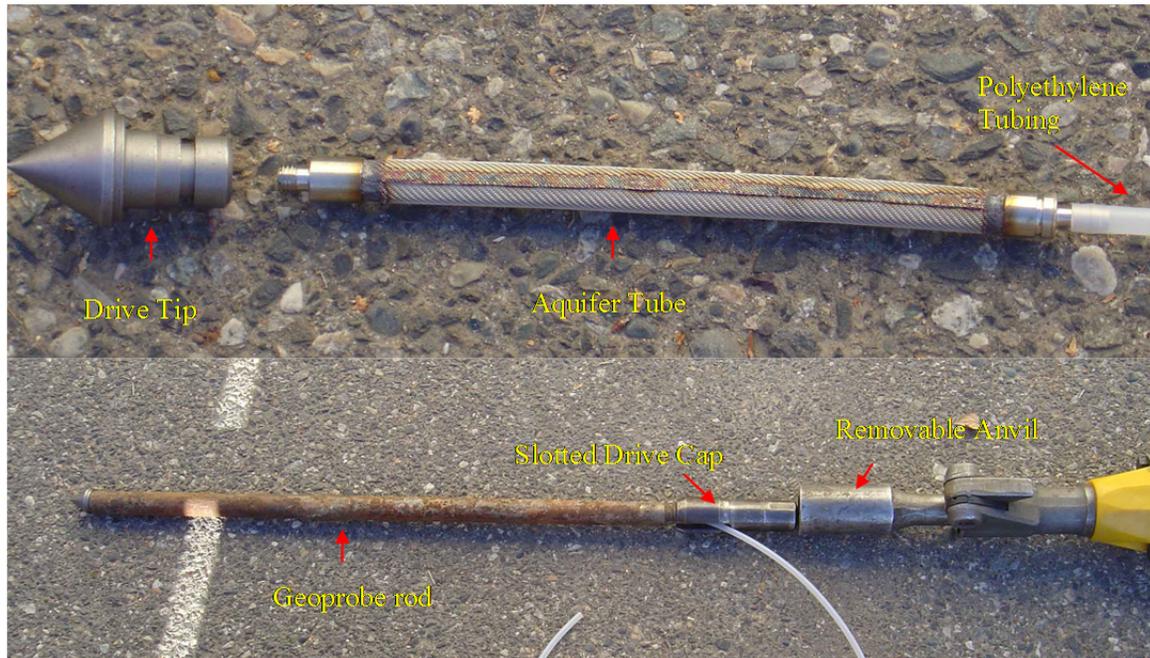


Figure 10. Aquifer Tube Components

The aquifer tubes will be installed by driving a hollow, 2.54-cm (1-in.) OD hardened steel drive rod into the ground with the stainless-steel tip attached to the end and the screen and tubing inside of the drive rod (Geoprobe® Systems). A slotted drive cap that allows the tubing to come out the top of the rod is used so that the tubing is not pinched or damaged during the hammering process. Drive rod sections will be added as needed to reach the desired depth. Driving will be accomplished with a two-cycle jackhammer. After the desired depth is reached, the drive rod will be extracted, leaving the point, screen, and tubing behind. The drive rod will be extracted either with pipe wrenches (for shallow points), with sledgehammers (medium depth points) pounded against a custom fabricated extraction plate, or using pneumatic jacks to push against the extraction plate (deep installations). As the drive rod is extracted, the tip, screen, and tubing are left behind in the ground. These methods of aquifer tube installation are based on the implant method developed by Geoprobe® Systems. Reused equipment will be decontaminated with a distilled water rinse between uses. Alternatively, 1.25-in. diameter well-point piezometers may be driven and left in place. This alternative method provides some benefits, including improved annular seal characteristics, access for water-level measurements, and the ability to change out sampling tubing if required.

After installation, aquifer tubes will be subjected to developmental pumping to remove silt-sized materials that accumulate in the screen during installation. All tubes/piezometers will be pumped until

turbidity levels stabilize prior to sampling. The tubing will be extended up to a location on the pit entrance ramp or first bench of the excavation to allow access for sampling while the pit is flooded. A peristaltic pump will be attached to the tubing to withdraw samples.

Vertical profiling of Cr(VI) concentration will be conducted during installation of the first two aquifer tubes: one within an expected high concentration area (e.g., near soil sampling point JINLD7; Figure 9) and one at a downgradient monitoring location. For vertical profiling, the aquifer tubes will be incrementally driven and aqueous samples will be collected at 0.5-m (1.5-ft) intervals as the drive point is advanced to total depth (targeted at 3 m [10 ft]). Field parameters (pH, specific conductance, dissolved oxygen, oxidation reduction potential and temperature) will be measured and evaluated for stability prior to collection of aqueous samples, and final field parameter measurements will be recorded manually on field data sheets along with other sample collection records. After an aqueous sample has been collected and analyzed for Cr(VI) by the spectrophotometric method, the drive point will be advanced to the next sampling depth and the sampling process repeated. Aquifer tube advancement will continue until refusal or until a depth of 3 m (10 ft) is reached.

Results from this vertical Cr(VI) profiling with the aquifer tubes will be used to determine sampling depths for subsequent aquifer tube installations. It is anticipated that aquifer tubes will be installed at seven locations around the excavation floor (Figure 11), each location comprised of two sampling depths within the contaminated interval. These tubes will remain in place throughout the life of the project and will be sampled on a routine basis to assess the spatial and temporal variability in Cr(VI) concentrations. One or more piezometers installed under work element 2 (see Section 5.2) may also be included in this monitoring network. In addition to real-time Cr(VI) analysis by the spectrophotometric method, archive samples will be collected and a subset submitted for verification analysis by inductively coupled plasma-mass spectrometry (ICP-MS) for total chromium. Both filtered and unfiltered archive samples will be collected for ICP-MS analysis of total chromium. The set of filtered samples selected for analysis will be run first. Subsequent analysis of unfiltered samples will be conducted pending review of data with concurrence by DOE and EPA. Groundwater sample collection and analytical requirements are provided in Table 1 and Table 2, respectively.

All field measurements and field parameter probe calibration data will be recorded manually on data sheets. The record copy data sheets will scanned copies of the originals that will be transferred to the project manager for storage as a project record. The original data sheets will be maintained by PNNL staff until project completion. All samples submitted to PNNL analytical laboratories will be delivered in a government vehicle by project staff with an appropriate chain-of-custody form accompanying the samples.

Pending review of data with concurrence by DOE and EPA, one or two aquifer tubes may be installed in the 100-C-7 excavation floor. Vertical profiling will be conducted as described above for the initial 100-C-7:1 aquifer tubes with in-field analysis of Cr(VI) and collection of filtered and unfiltered archive samples for potential ICP-MS analysis pending review of data with concurrence by DOE and EPA.

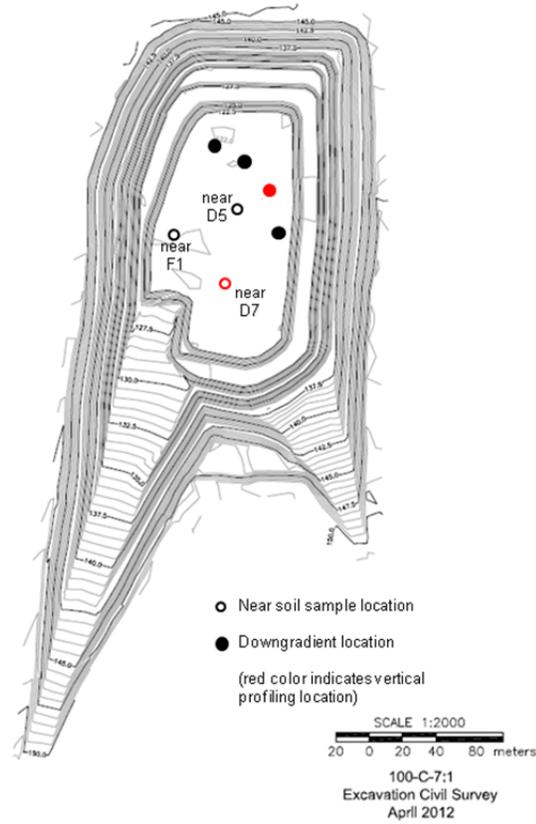


Figure 11. Approximate Aquifer Tube Sampling Locations. Open circles indicate areas of elevated Cr(VI) concentration from soil samples. Filled circles are downgradient monitoring locations.

Table 1. Aqueous Sampling Requirements

Parameter ^(a)	Media/Matrix	Sampling Frequency ^(b)	Volume/Container	Preservation
RCRA/Trace Metals: Cr, Cu, As, Se, Mo, Ag, Cd, Pb, U	Water	4 samples per sampling event; all samples archived to facilitate verification sample selection	25 ml plastic vial (acid washed)	Filtered and unfiltered, HNO ₃ to pH <2 Hold time: 60 days
Cr(VI)	Water	10 sampling events, weekly first month then biweekly	Field measurement	Filtered
pH	Water	Measure for all samples collected	Field measurement	None
Electrical conductivity	Water	Measure for all samples collected	Field measurement	None
Dissolved oxygen (DO)	Water	Measure for all samples collected	Field measurement	None
Oxidation reduction potential (ORP)	Water	Measure for all samples collected	Field measurement	None
Temperature	Water	Measure for all samples collected	Field measurement	None
(a) Priority analytes highlighted.				
(b) Sampling frequency for temporal monitoring, not profiling.				

Table 2. Aqueous Sample Analytical Requirements

Parameter	Analysis Method	Detection Limit	Typical Precision/Accuracy	QC Requirements
RCRA/Trace Metals: Cr, Cu, As, Se, Mo, Ag, Cd, Pb, U	ICP-MS, PNNL-AGG-415 (similar to EPA Method 6020)	1 µg/L for trace elements	±10%	Daily calibration; blanks and duplicates and matrix spikes at 10% level
Cr(VI)	Hach DR-2000 w/ Accuvac Ampules	10 µg/L	±10 µg/L	Blanks, duplicates at 10% level
pH	pH electrode	Not applicable	±0.1 pH unit	User calibrate with pH buffer solutions
Electrical conductivity	Electrode	1 µS/cm	±10%	User calibrate, blanks
Dissolved oxygen (DO)	Membrane electrode	0.1 ppm	±15%	User calibrate, blanks
Oxidation reduction potential (ORP)	Electrode	Not applicable	±10%	For indication only
Temperature	Thermocouple	Not applicable	±1°C	Factory calibration

5.2 Localized Hydrology Data

A piezometer network will be installed near the bottom of the entrance ramp (above high water level) to support hydraulic testing and tracer injection and drift testing. These temporary piezometers will be installed using direct push drilling technology. A conceptual diagram of the piezometer network is provided in Figure 12. The nominal design includes a central piezometer through which a majority of injection testing will be conducted, two near-field piezometers for characterizing the injection pore volume (~3 m [10 ft] radial extent) and monitoring hydraulic response, and a single downgradient monitoring location. At one location, the temporary drill casing will be advanced to an elevation of ~115 m (~12–14 m bgs), or until the Hanford and Ringold Formations contact is encountered. All piezometers will be nominally screened over the top 3 m (10 ft screen length) of the aquifer, although this specification may be changed based on results from the aquifer tube contaminant profiling effort. If direct push drilling costs allow, one or more additional piezometers may be installed. Based on the relatively consistent groundwater flow direction indicated by the available historical record, a complete tracer arrival and elution response is expected for the downgradient monitoring location. However, installation of additional downgradient monitoring locations would increase the likelihood of capturing this full tracer drift response.

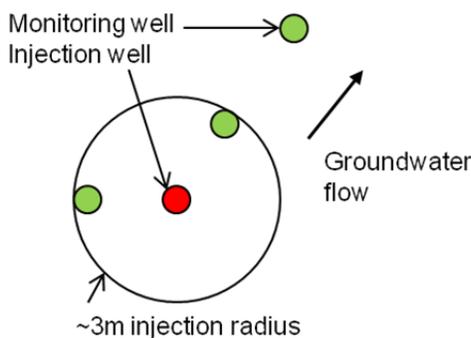


Figure 12. Conceptual Piezometer Network Layout

Hydraulic testing will be conducted in the central piezometer, as required, to determine the hydraulic properties of the aquifer and the specific capacity of the injection point. Hydraulic testing will include a step injection test to determine the specific capacity of the injection well and either slug interference testing or a short duration constant-rate injection test to provide a semi-quantitative estimate of hydraulic properties, pending results of the step injection test. Pressure recovery data from the tracer injection test will also be analyzed to provide an additional estimate of hydraulic properties pending results of the step injection test. Hydrologic test data will be analyzed using standardized analytical or numerical methods that are applicable to the given test conditions.

A tracer injection and drift test will be conducted to provide direct estimates of effective porosity, dispersivity, and groundwater flow velocity. A solution containing the conservative tracer, potassium or sodium bromide (~100 ppm Br⁻), will be prepared and injected into the central piezometer shown in Figure 12. A tracer volume will be used that assures arrival at the two near-field monitoring points. Tracer solution will be prepared using extracted groundwater stored in an onsite tank or using an onsite raw water supply. The injection volume is estimated to be approximately 5000 gallons, which at an injection rate of 10 gpm, would require approximately 8 hours to inject. Bromide concentrations will be

measured in the surrounding monitoring wells and breakthrough curves (time versus concentration) will be prepared for each well. Bromide concentrations will be monitored using downhole ion-selective electrodes and/or specific conductance electrodes. Aqueous samples will also be collected at sufficient frequency to fully characterize the tracer arrival and elution responses and analyzed for verification by ion chromatography. Groundwater sample collection and analytical requirements for the tracer injection test are provided in Table 3 and Table 4, respectively.

If injection of the tracer solutions cannot be conducted as described above, the tracer testing approach may be modified to include as a series of single well point dilutions tests at multiple locations.

Table 3. Tracer Test Sampling Requirements

Parameter ^(a)	Media/Matrix	Sampling Frequency	Volume/Container	Preservation
Anions: Cl ⁻ , Br ⁻ , SO ₄ ²⁻ , SO ₃ ²⁻ , PO ₄ ³⁻ , NO ₂ ⁻ , NO ₃ ⁻	Water	As required to define arrival and elution curves at all locations	25 ml plastic vial	None Hold Time: 45 days
Br ⁻	Water	Continuous, downhole	Field measurement	None

(a) Priority analytes highlighted.

Table 4. Aqueous Sample Analytical Requirements for Tracer Monitoring

Parameter	Analysis Method	Detection Limit	Typical Precision/Accuracy	Quality Control Requirements
Anions: F ⁻ , Cl ⁻ , Br ⁻ , SO ₄ ²⁻ , SO ₃ ²⁻ , PO ₄ ³⁻ , NO ₂ ⁻ , NO ₃ ⁻	Ion Chromatography (EPA Method 300.0) ^(a)	200 µg/L	±15%	Daily calibration; blanks and duplicates at 10% level
Br ⁻	Electrode	Not applicable	±10%	For indication only

(a) EPA (1993).

5.3 Hydraulic Gradient Monitoring

Hydraulic gradient information will be gathered by continuation of current hydraulic head data collection at wells 199-B8-6, 199-B4-14, and 199-B5-8. Data collection will use the existing pressure transducer and data logging equipment with PNNL staff downloading the data directly from the data loggers for the duration of the 100-C-7 investigation. PNNL staff will also collect manual water level data from each well for comparison to the pressure transducer data. In addition, PNNL staff will evaluate the need for collecting supplemental hydraulic data at other wells in the area and may install pressure transducers and well-head data loggers at several other locations.

The hydraulic head data are needed to determine the hydraulic gradient direction and magnitude and will be used in conjunction with the localized hydraulic/tracer data and Cr(VI) information to assess the Cr(VI) source flux and potential groundwater impacts. Standard hydraulic head triangulation will be conducted to determine the hydraulic gradient direction and magnitude over time.

5.4 Contingency Vertical Profiling of Cr(VI) Concentrations in Groundwater

Vertical profiling of Cr(VI) in the upper portion of the aquifer may be conducted to augment the aquifer tube data and confirm the Hanford and Ringold Formations contact within the pit area using a track-mounted direct-push rig (Figure 13). A decision for whether or not to proceed with contingency vertical profiling will be made pending review of aquifer tube data with the concurrence of DOE and EPA. The emphasis of these data will be to pair with aquifer tube locations and collect deeper vertical profiling of the Cr(VI) concentration. This work element will only be conducted if the aquifer tube contaminant profiling described in Section 5.1 cannot reach deep enough to identify the vertical extent of contamination. The direct-push campaign would also augment the Hanford and Ringold Formations contact data from the tracer network installation (localized to the entrance ramp area). This work element is expected to have a limited duration of 1 month or less and would likely need to be conducted in October or November 2012 in parallel with focused sidewall excavation of the large pit. If required, selection of sampling locations and depth extent of interrogation would be conducted in coordination with DOE and EPA project leads.

For vertical profiling, the direct-push points will be incrementally driven and aqueous samples will be collected at 0.5-m (~1.5-ft) intervals as the drive point is advanced to total depth. Field parameters (pH, specific conductance, dissolved oxygen, oxidation reduction potential and temperature) will be measured and evaluated for stability prior to collection of aqueous samples, and final field parameter measurements will be recorded manually on field data sheets along with other sample collection records. After an aqueous sample has been collected and analyzed for Cr(VI) by the spectrophotometric method, the drive point will be advanced to the next sampling depth and the sampling process repeated. Advancement will continue until refusal or until Cr(VI) concentration is below 20 µg/L or an alternative concentration as agreed to by DOE and EPA. In addition to this real-time Cr(VI) screening analysis, archive samples will be collected for possible verification analysis by ICP-MS for total chromium.



Figure 13. Example of a Track-Mounted Direct Push Rig

6.0 Data Management

A project-specific database will be developed and maintained to collect, organize, store, verify/validate, and manage analytical laboratory data and/or field measurements for environmental samples. These data will be stored electronically as Microsoft Excel® spreadsheet files and hard copies will be maintained in the project files. A project data custodian will be designated to control and maintain the data. The following data will be contained, at a minimum, as part of the database:

- Sample identifier
- Sample location
- Sample medium type
- Sampling date
- Analysis date
- Laboratory name
- Analyte name
- Concentration value
- Measurement unit.

Data will be managed in accordance with applicable PNNL *How Do I* (HDI) subject areas and quality assurance protocols. Data will be made available for entry into the Hanford Environmental Information System.

7.0 Health and Safety

Safety and health issues relating to these work elements are addressed in a project-specific health and safety plan (HASP) that identifies industrial safety and health hazards as well as control measures for those hazards. The HASP includes specific training requirements for all site workers as well as visitors. A pre-job safety briefing will be held prior to start of work and a daily tailgate safety meeting will be held to discuss any task-specific safety concerns.

8.0 Quality Assurance

The work will comply with applicable subject areas of the PNNL HDI. HDI is a web-based system for communicating PNNL's management systems and procedures through subject areas. PNNL's Quality Assurance Program is based on the requirements of DOE Order 414.1C, "Quality Assurance," and 10 CFR 830, Subpart A, "Quality Assurance Requirements." Additional specific quality assurance requirements are provided in sampling and analysis tables in Section 5.0.

9.0 Waste Management

All investigation-derived waste (IDW) will be handled in accordance with PNNL waste management procedures and applicable Hanford Site requirements. Expected waste streams may include the following:

- Miscellaneous solid waste such as filters, wipes, gloves and other personal protective equipment, sampling and measuring equipment, pumps, pipe, wire, or plastic sheeting
- Purge water generated during groundwater sampling and hydraulic testing
- Decontamination solutions.

Miscellaneous solid waste that has contacted potentially contaminated groundwater will be segregated from other materials and will be transported to PNNL facilities for disposal based on a waste designation per internal PNNL waste management procedures. Waste will be designated in accordance with WAC 173-303 using a combination of process knowledge, historical analytical data, and analyses of samples collected from the site.

Based on available soil contamination data collected during excavation, the hazardous waste designation for hexavalent chromium—which is the only constituent identified likely to trigger a hazardous waste designation—is likely to be exceeded and thus, all investigation derived sampling waste will be disposed of in accordance with PNNL procedures for disposal of such waste. All purge water and decontamination water generated during routine sampling will be handled in accordance with Hanford Site requirements. During the initial aquifer tube contaminant profiling in the bottom of the pit, collected purge water, which is not expected to be of higher concentration than is already present at the pit surface, will be discharged back to the pit at a distance sufficient to assure that the depth discrete sampling is not impacted. In this case, the safety concerns associated with manually hauling the purge water out of the pit outweigh the benefits of containing this purge water.

10.0 References

10 CFR 830, Subpart A. 2012. “Quality Assurance Requirements.” *Code of Federal Regulations*, U.S. Environmental Protection Agency.

DOE Order 414.1C. 2005. “Quality Assurance.” U.S. Department of Energy, Washington, D.C.

EPA. 1993. *Method 300.0 – Determination of Inorganic Anions by Ion Chromatography*. EPA Method 300.0, U.S. Environmental Protection Agency, Cincinnati, Ohio.

Khaleel R and BA Williams. 2011. *Geohydrologic Data Package in Support of 100-BC-5 Modeling*. SGW-44022, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

WAC 173-303. 2009. “Dangerous Waste Regulations.” *Washington Administrative Code*, Olympia, Washington.



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