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Sampling and Analysis Plan Update for Groundwater Monitoring – 1100-EM-1 Operable Unit

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DISCLAIMER

Summary

This document updates the sampling and analysis plan (Department of Energy/Richland Operations - 95-50) to reflect current groundwater monitoring at the 1100-EM-1 Operable Unit. Items requiring updating included sampling and analysis protocol, quality assurance and quality control, groundwater level measurement procedure, and data management. The plan covers groundwater monitoring, as specified in the 1993 Record of Decision, during the 5-year review period from 1995 through 1999. Following the 5-year review period, groundwater-monitoring data will be reviewed by Environmental Protection Agency to evaluate the progress of natural attenuation of trichloroethylene. Monitored natural attenuation and institutional controls for groundwater use at the inactive Horn Rapids Landfill was the selected remedy specified in the Record of Decision.

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1.0 Introduction

The September 1993 Record of Decision for the former 1100 Area required continued monitoring of the trichloroethylene plume downgradient from the inactive Horn Rapids Landfill (Record of Decision 1993). Additionally, the Record of Decision required establishment of a point of compliance to determine if remedial action objectives were being attained or if further action was necessary. The remedial action objectives were identified as follows:

- Attain the Safe Drinking Water Act Maximum Contaminant Level of 5 µg/L for trichloroethylene at the designated point of compliance

- Protect environmental receptors in surface water by reducing groundwater contaminant concentrations in the plume to levels safe for biological and human receptors that may be affected at the groundwater discharge point to the Columbia River.

The point of compliance was the George Washington Way diagonal line. This line is defined by a straight line that begins at the intersection of George Washington Way and Horn Rapids Road and runs in a northwestern direction along George Washington Way beyond a point where it turns due west (Figure 1). This line is approximately parallel to the water table contours and perpendicular to the prevailing groundwater flow direction (and the path of contaminant plumes) in this area. The diagonal line was selected as the point of compliance because modeling results from the Remedial Investigation/ Feasibility Study between 1989 and 1992 (Department of Energy/Richland Operations -92-67) predicted that trichloroethylene concentrations above the 5-µg/L maximum contaminant level would not migrate across this line before attenuating to levels below the maximum. Also, this line is conveniently oriented, easily identifiable, and is within Department of Energy property boundaries.

Modeling results indicated the outer edge of the trichloroethylene plume, as defined by the maximum contaminant level, was approximately 600 m upgradient of the point of compliance (see Figure 1). The 300 Area is approximately 300 m downgradient of the point of compliance at its nearest point, providing a buffer zone between the two areas. Modeling results estimated the leading edge of the trichloroethylene plume was migrating in a northeastern direction at approximately 30 m (100 ft) per year. This movement allows available time to reconsider remedial action objectives if trichloroethylene was detected at or above the maximum contaminant level at the point of compliance. Figure 2, which shows the trichloroethylene plumes in 1990 and 1998, indicates the maximum contaminant level was exceeded at the point of compliance.

The selected remedy identified in the Record of Decision for meeting the remedial action objectives included monitored natural attenuation for groundwater exceeding the maximum contaminant level and continuation of institutional controls for groundwater use at the Horn Rapids Landfill. Following the 1993 Record Decision, continued groundwater monitoring was needed to verify modeled predictions of the attenuation of trichloroethylene concentrations and to evaluate the need for additional remedial response action.

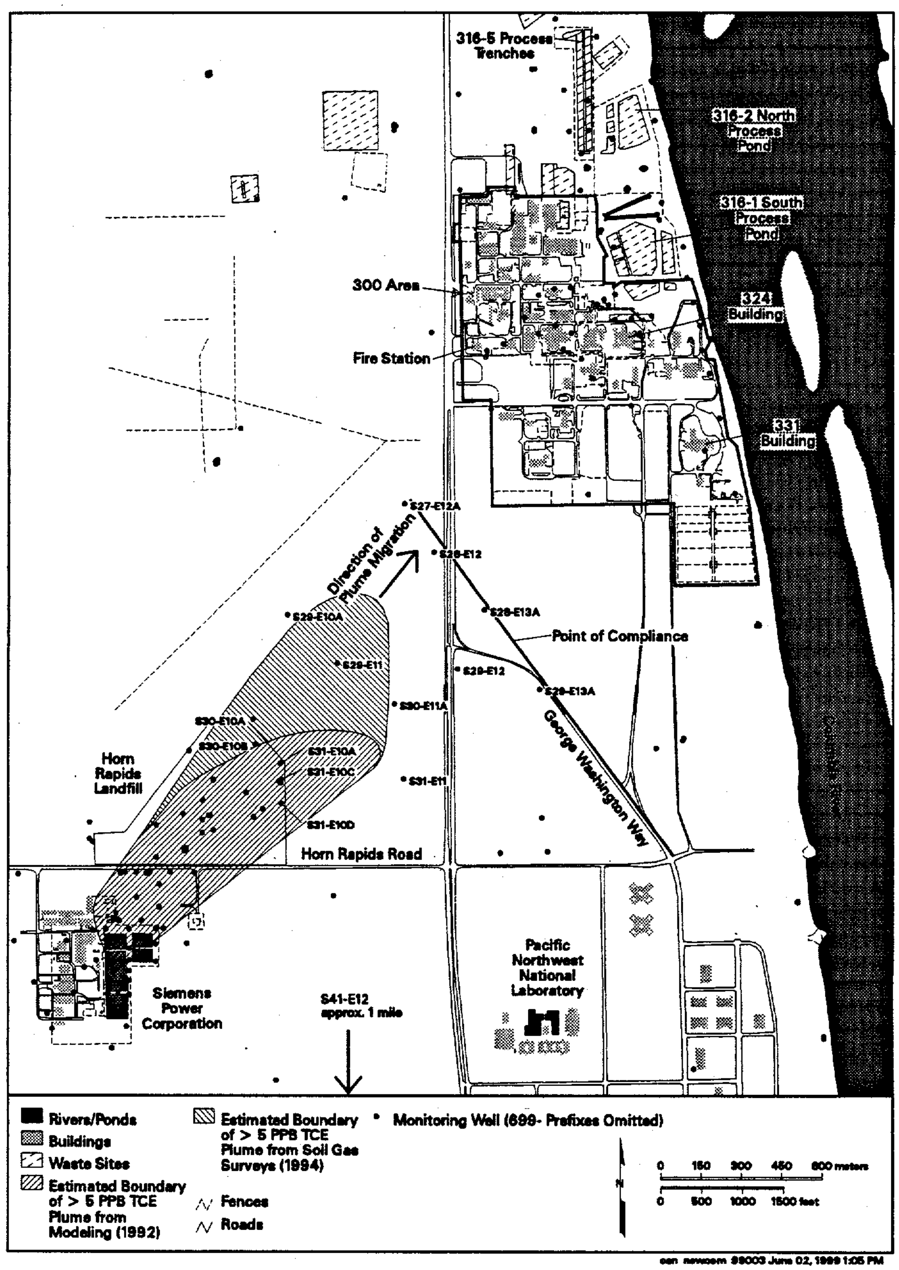

Figure 1. Map of Horn Rapids Landfill

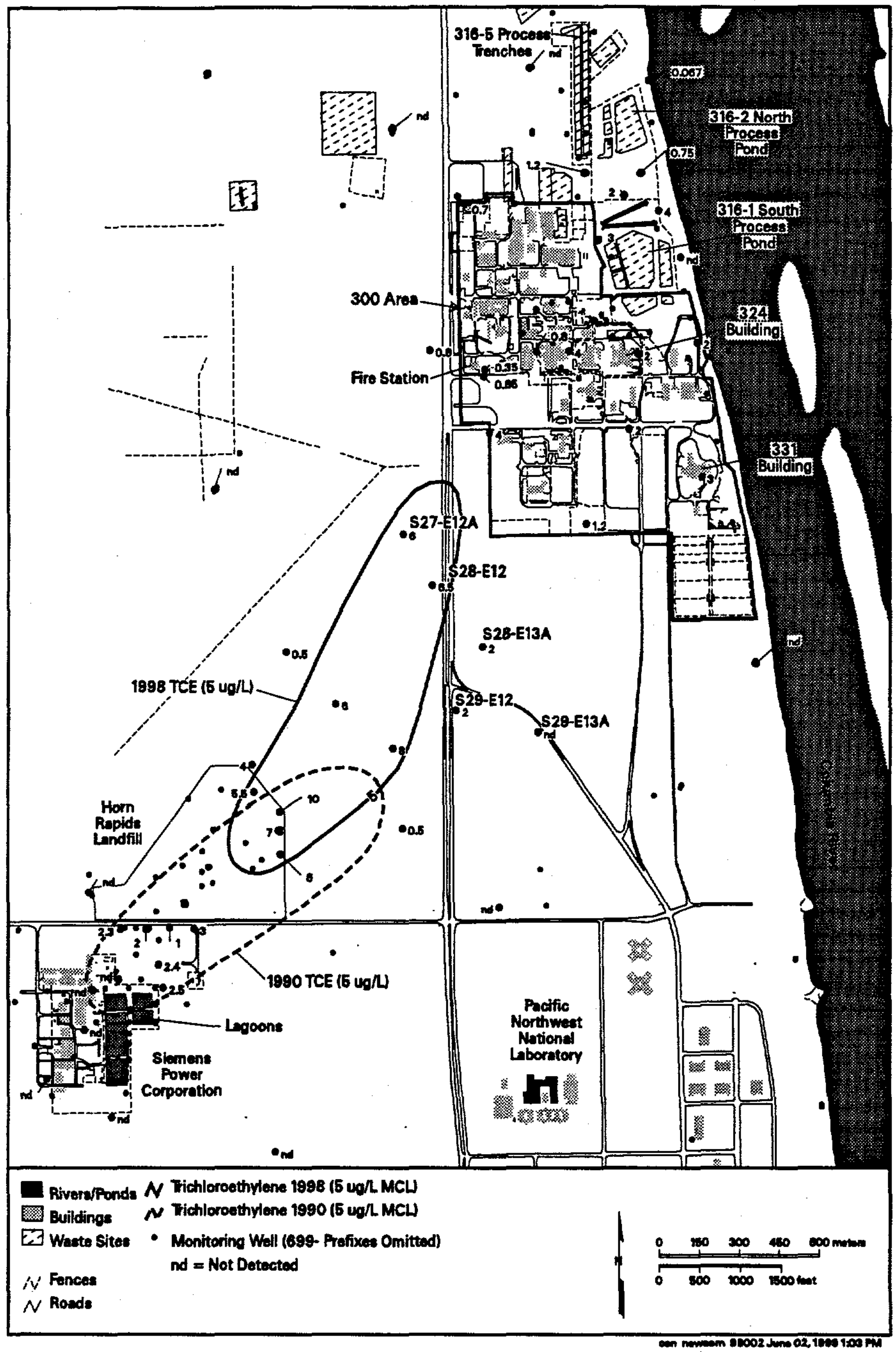

Figure 2. Trichloroethylene Plumes in 1990 and 1998 (after PNNL 1998a)

1.1 Objectives and Scope

The objective of this document is to update the existing sampling plan for the 1100-EM-1 Operable Unit in the former 1100 Area. Sampling and analysis protocol, quality assurance and quality control, groundwater level measurement, and data management sections were updated to reflect current monitoring. However, the data quality objectives of the sampling and analysis are still the same. Beginning in 1997, Pacific Northwest National Laboratory was responsible for groundwater monitoring at the 1100-EM-1 Operable Unit.

The existing sampling plan, contained in *Additional Monitoring Well Installation and Field Sampling Plan for Continued Groundwater Monitoring at the Horn Rapids Landfill* (Department of Energy/ Richland Operations -95-50), recommended continued monitoring of wells downgradient of the Horn Rapids Landfill during a review period of 5 years from 1995 through 1999. The monitoring was to include annual sampling for trichloroethylene, its breakdown products (vinyl chloride, 1,1-dichloroethene), and nitrate that are specified in the 1993 Record of Decision. Although not specified in the Record of Decision, monitoring was to continue for chromium in one well downgradient of the 1171 Building. Following the 5-year review period, groundwater-monitoring data will be reviewed by Environmental Protection Agency to evaluate the progress of natural attenuation of trichloroethylene (Department of Energy/Richland Operations -95-80).

2.0 Sampling and Analysis

2.1 Monitoring Well Network

Table 1 lists the well numbers and locations of the wells to be monitored. The list of 15 wells is the same as that shown in Department of Energy/Richland Operations -95-50. A map of the monitoring wells, the Horn Rapids Landfill, and the point of compliance is shown in Figure 1.

Five new 1100-EM-1 monitoring wells were installed in 1995 in a pattern that met the conditions of the selected remedy defined in the 1993 Record of Decision. Logs of the five wells, 699-S27-E12A, 699-S28-E13A, 699-S29-E10A, 699-S29-E13A, and 699-S30-E11A, are contained in Department of Energy/ Richland Operations -95-81. The purpose of the wells is first to monitor for trichloroethylene to ensure the 5-µg/L maximum contaminant level is not exceeded at the point of compliance that runs along, and extends from, the George Washington Way diagonal. The second purpose for these wells is to monitor for expected attenuation of trichloroethylene concentration levels at the site.

Three of the five wells (699-S27-E12A, 699-S28-E13A, and 699-S29-E13A) were constructed on the immediate upgradient side of the point of compliance line. Well 699-S28-E12 was already located on this point of compliance line before it was established and Well 699-S29-E12 already was approximately 100 m upgradient from the line. Thus, a total of five wells were located on, or near, the point of compliance line. These wells were spaced approximately equidistant from each other and were placed so that, if the trichloroethylene plume migrated to the point of compliance, the plume would be intercepted by the monitoring wells.

Table 1. Well Numbers and Locations

Well ID	Previous Well Name	Location
699-S27-E12A	COE-3	Northwest Point of Compliance Well
699-S28-E12	MW-8A	Between Northwest & Center Point of Compliance Wells
699-S28-E13A	COE-2	Center Point of Compliance Well
699-S29-E10A	COE-5	Upgradient of Point of Compliance
699-S29-E11	MW-20	Downgradient of Horn Rapids Landfill
699-S29-E12	50-15	Upgradient of Point of Compliance
699-S29-E13A	COE-1	Southeast Point of Compliance Well
699-S30-E10A	MW-10	Downgradient of Horn Rapids Landfill
699-S30-E10B	MW-11	Downgradient of Horn Rapids Landfill
699-S30-E11A	COE-4	Upgradient of Point of Compliance
699-S31-E10A	MW-12	Downgradient of Horn Rapids Landfill
699-S31-E10C	MW-14	Downgradient of Horn Rapids Landfill
699-S31-E10D	MW-15	Downgradient of Horn Rapids Landfill
699-S31-E11	MW-22	Downgradient of Horn Rapids Landfill
699-S41-E12	MW-3	Downgradient of 1171 Building

Based on observed contaminant data, observed water table gradients, and computer modeling results during the Remedial Investigation/Feasibility Study, the plume center was predicted to move toward the middle of the five well locations (Figure 1). However, soil gas sampling results in 1994[1] indicated the trichloroethylene plume was migrating slightly more to the north than predicted by modeling (Figure 1). Thus Wells 699-S27-E12A and 699-S28-E13A were located so as to intercept the plume should it continue to migrate, as indicated by the soil gas survey results. The 1998 plume map (see Figure 2) shows the trichloroethylene plume migrated slightly more to the north than predicted and thus corroborated the soil gas sampling results.

In addition to the three wells installed along the point of compliance line, two wells (699-S28-E10A and 699-S30-E11A) were installed upgradient to serve as early warning indicators, to better define the existing trichloroethylene plume, and to provide more complete documentation of changes in contaminant levels. The two wells were installed at locations so that, together with existing Well 699-S29-E11, the three wells represented a line approximately parallel to, and located approximately 500 m (1500 ft) upgradient of, the compliance line. During the time when the wells were installed, the upgradient line was located near the contaminant plume front.

Well 699-S41-E12 is located downgradient of the 1171 Building. Monitoring for chromium continues in this well because of highly variable readings and exceeding the chromium maximum contaminant level of 100 μg/L.

The remaining seven wells listed in Table 1 are located downgradient of the Horn Rapids Landfill. The 1993 Record of Decision for the former 1100 Area required continued monitoring for trichloroethylene downgradient of the Horn Rapids Landfill. Five of the downgradient wells (699-S30-E10A,

[1] Presented by P. E. Dresel and J. C. Evans, *Soil-Gas Monitoring of a Ground-Water Trichloroethylene Plume, Hanford, Washington,* 1st Symposium of Hydrogeology of Washington State, Olympia, Washington, August 28-30, 1995.

699-S30-E10B, 699-S31-E10A, 699-S31-E10C, and 699-S31-E10D) are located immediately adjacent to the landfill and two of the wells (699-S29-E11 and 699-S31-E11) are located approximately 400 m (1300 ft) downgradient of the landfill.

Well screens were placed from approximately 1.5 m (5 ft) above to approximately 4.5 m (15 ft) below the water table. This screen interval allowed for continued sampling within the data quality guidelines and accounted for natural fluctuations in the water table.

2.2 Constituent List and Sample Frequency

The sample constituents and frequency are listed in Table 2. Sampling was conducted at a frequency of one event per year beginning in 1995. A review of the quarterly monitoring data for trichloroethylene prior to 1995 indicates that trichloroethylene concentrations in groundwater did not vary significantly over short periods of time. Additionally, modeling performed during the remedial investigation phase, using the most conservative (or worst-case) assumptions for contaminant transport, indicated the leading edge of the trichloroethylene plume was migrating at approximately 30 m (100 ft) per year. Should trichloroethylene be detected at the point of compliance, ample time will be available to reconsider remedial action objectives, prior to the plume reaching the 300 Area.

Table 2. Sample Constituents and Frequency

Constituent	Frequency
Trichloroethylene	Annual
Vinyl Chloride	Annual
1,1-dichloroethene	Annual
Nitrate	Annual
Chromium (filtered and unfiltered)	Annual

2.3 Groundwater Level Measurement Procedures

Procedures for groundwater level measurements are described in the subcontractor procedure manual (Waste Management Northwest 1998), titled *Measurement of Groundwater Levels*. Static water levels are measured in the monitoring well, prior to sampling, and a minimum of two consistent measurements are taken at each sample well to confirm precision of the measurement.

2.4 Sampling and Analysis Protocol

Monitoring for the 1100-EM-1 Operable Unit is part of the Hanford Groundwater Monitoring Project. Procedures for groundwater sampling, documentation, sample preservation, shipment, and chain-of-custody requirements are described in PNNL or subcontractor manuals (currently Waste Management Northwest 1998) and in the quality assurance plan (Pacific Northwest National Laboratory 1998b). Samples generally are collected after three casing volumes of water have been purged from the well or after field parameters (pH, temperature, specific conductance, and turbidity) have stabilized. For routine groundwater samples, preservatives are added to the collection bottles before use in the field. Samples to be analyzed for metals are usually filtered in the field so that results represent dissolved metals.

Procedures for field measurements are specified in the subcontractor or manufacturer manuals. Analytical methods are specified in contracts with laboratories, and most are standard methods from *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (EPA 1986a). Alternative procedures meet the guidelines of SW-846, Chapter 10 of EPA (1986a). Analytical methods are described in Gillespie (1999).

All sampling activities and information will be documented in field logbooks and on a Groundwater Sample Report. Each sample will be clearly labeled with a Hanford Environmental Information System number.

2.5 Quality Assurance and Quality Control

The quality assurance/quality control program of the groundwater-monitoring project is designed to assess and enhance the reliability and validity of groundwater data. The primary quantitative measures or parameters used to assess data quality are accuracy, precision, completeness, and the method detection limit. Qualitative measures include how representative and comparable the data are. The goals for measuring data representativeness for groundwater monitoring projects are addressed qualitatively by the specification of well locations, well construction, sampling intervals, and sampling and analysis techniques in the groundwater-monitoring plan. Comparability is the measure of confidence with which one data set can be compared to another. The quality control parameters are evaluated through laboratory checks (for example, matrix spikes and laboratory blanks), replicate sampling and analysis, analysis of blind standards and blanks, and inter-laboratory comparisons. Acceptance criteria have been established for each of these parameters (Pacific Northwest National Laboratory 1998b), based on guidance from the U.S. Environmental Protection Agency (OSWER-9950.1, EPA 1986a). When a parameter is outside the criteria, corrective actions are taken to prevent a future occurrence and affected data are flagged in the database.

3.0 Data Management

The contract laboratories electronically report analytical results. The results are loaded into the Hanford Environmental Information System database. Field-measured parameters are entered manually or through electronic transfer. Data from the Hanford Environmental Information System may be downloaded to smaller databases, such as the Geosciences Data Analysis Toolkit for data validation, reduction, and trend analysis. Paper data reports and field records are considered the record copies and are stored at Pacific Northwest National Laboratory.

The data undergo a validation/verification process according to a documented procedure, as described in the project QA plan. QC data are evaluated against the criteria listed in the project QA plan and data flags are assigned when appropriate. In addition, data are screened by scientists familiar with the hydrogeology of the unit, compared to historical trends or spatial patterns, and flagged if they are not representative. Other checks on data may include comparison of general parameters to their specific counterparts (such as, conductivity to ions), calculation of charge balances, and comparison of calculated versus measured conductivity. If necessary, the laboratory may be asked to check calculations or reanalyze the sample, or the well may be sampled again.

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