PNNL-16492

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Results of Groundwater Monitoring for the 300 Area Process Trenches

Reporting Period: July - December 2006

J. W. Lindberg

March 2007

Prepared for Fluor Hanford, Inc. and
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

This report is one of a series of semiannual groundwater monitoring reports on the corrective action program at the 300 Area process trenches. It fulfills requirements of WAC 173-303-645(11)(g) to report on the effectiveness of the corrective action program. This report covers groundwater monitoring data collected during the period from July through December 2006.

The objective of the groundwater monitoring plan is to demonstrate the effectiveness of the corrective action program by examining the trend of the contaminants of interest to confirm that they are attenuating naturally. The overall concentration of uranium in network wells has decreased in recent years but rising water-table conditions during high river stages occasionally mobilize vadose zone uranium and temporarily increase concentrations of uranium in the aquifer. The most recent concentration of cis-1,2-dichloroethene increased in one well (399-1-16B), but the long-term trend is holding steady at levels above the drinking water standard (70 μg/L) and is not affected by river stage.

Contents

Figures

Table

1.0 Introduction

The 300 Area process trenches (316-5) are a *Resource Conservation and Recovery Act* (RCRA) treatment, storage, and/or disposal unit in the Hanford Facility RCRA Permit (Ecology 2007). From 1975 through 1994, the trenches received effluent discharges of dangerous mixed waste from fuel fabrication and research laboratories in the 300 Area. Groundwater monitoring at the 300 Area process trenches is conducted in accordance with Washington Administrative Code (WAC) 173-303-645(11), "Corrective Action Program," and Part VI, Chapter 1 of the Hanford Facility RCRA Permit (Ecology 2004). The modified closure plan (DOE 1995), portions of which are incorporated into the Hanford Facility RCRA Permit, indicates that groundwater remediation is deferred to the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) 300-FF-5 Groundwater Operable Unit.

This report is one of a series of semiannual groundwater monitoring reports on the corrective action program at the 300 Area process trenches. It fulfills requirements of WAC 173-303-645(11)(g) to report on the effectiveness of the corrective action program. This report covers groundwater monitoring data collected during the period from July through December 2006.

2.0 Objective

The objective of groundwater monitoring during the corrective action period is to demonstrate the effectiveness of the corrective action program by examining the trend of the constituents of interest to confirm that they are attenuating naturally, as expected by the CERCLA record of decision for the 300-FF-5 Operable Unit (ROD 1996). The 300 Area process trenches were closed under a modified closure/post-closure plan (DOE 1995) and remain in the groundwater corrective action program because groundwater contamination continues to exceed groundwater quality criteria (federal drinking water standards). Groundwater monitoring will continue for 30 years during the post-closure monitoring period.

3.0 RCRA Groundwater Monitoring Program

The groundwater monitoring network for the 300 Area process trenches (Lindberg et al. 1995) includes four well pairs (see Figure 1). Each of the well pairs has one shallow and one deep well. The shallow wells are screened at the water table, and the deep wells are screened at the bottom of the unconfined aquifer (above the lacustrine and over-bank deposits of the Ringold Formation lower mud unit). One of the pairs is upgradient, and the other three pairs are downgradient. The constituents of

interest are and the volatile organic compounds cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene. Uranium results are provided for information purposes.[1] Sampling frequency is semiannual, but during each semiannual sampling period the wells are sampled four times (monthly intervals). As a result, the wells are sampled during the months of December, January, February, March, and June, July, August, and September. Groundwater samples are analyzed for the contaminants of interest. Well data from wells other than the 300 Area process trenches network (300-FF-5 Operable Unit wells) are used as supplementary information to construct larger-scale water-table and uranium-concentration maps that extend beyond the area of the 300 Area process trenches network.

All 300 Area process trenches network wells were sampled as scheduled during the July to December 2006 semiannual period except for wells 399-1-18A and 399-1-18B (upgradient wells) for the August 2006 sampling event. Wells 399-1-18A and 399-1-18B were missed due to the extreme wildfire danger in August 2006 and the off-road restrictions associated with the fire danger.

4.0 Groundwater Flow Direction

Measurements of depth to groundwater in each 300 Area process trenches network well were collected when the wells were sampled in July, August, September, and December 2006. In addition, depths to water at most of the wells in the 300 Area were measured on December 4, 2006, specifically for the purpose of constructing a water-table map for the 300 Area. Furthermore, depths to water were measured again in many of these wells for the 300-FF-5 Operable Unit during December 2006.

Figure 2 shows the configuration of the water table and uranium concentrations in the upper portion of the unconfined aquifer (e.g., "A" wells) just prior to the reporting period (June 2006). At that time, the water table was elevated (106.7 to 106.8 meters) due to the raised river level during the spring runoff. The peak river level due to spring runoff occurred in early June, and river levels were beginning to subside when water levels were measured June 22 to 27. Consequently the groundwater flow direction in the area of the 300 Area process trenches was returning to its normal southeast flow direction. The water table generally conforms to this configuration throughout most of the year except during periods of high river stage in the spring. Figure 3 shows the configuration of the water table on December 4, 2006, when the water table was 1 to 2 meters lower (than June 2006 levels). The contours in the northern portion of the 300 Area near the process trenches show a southeastward gradient and groundwater flow direction. Groundwater response to river stage is described in detail in previous semiannual reports on the RCRA

[1] Groundwater monitoring objectives of RCRA, CERCLA, and the *Atomic Energy Act* (AEA) often differ slightly and the contaminants monitored are not always the same. For RCRA-regulated units, monitoring focuses on non-radioactive dangerous waste constituents. Radionuclides (source, special nuclear and by-product materials) may be monitored in some RCRA unit wells to support objectives of monitoring under the AEA and/or CERCLA. Please note that pursuant to RCRA, the source, special nuclear and by-product material component of radioactive mixed wastes, are not regulated under RCRA and are regulated by U. S. Department of Energy (DOE) acting pursuant to its AEA authority. Therefore, while this report may be used to satisfy RCRA reporting requirements, the inclusion of information on radionuclides in such a context is for information only and, may not be used to create conditions or other restrictions set forth in any RCRA permit.

300 Area process trenches and in annual reports of the Groundwater Performance Assessment Project (e.g., Hartman et al. 2005, 2006, 2007).

5.0 Groundwater Contaminant Trends

This section discusses concentrations of uranium, cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene (the contaminants of interest) in the well network during the reporting period. Table 1 lists the analytical results for each contaminant of interest in each well of the monitoring network.

Uranium. A persistent uranium plume continued to underlie a large portion of the 300 Area. Figure 2 illustrates uranium distribution in June 2006, just prior to the reporting period, and Figure 3 shows the distribution in December 2006, at the end of the reporting period. The maps include additional uranium data from wells sampled and analyzed for the 300-FF-5 Operable Unit. CERCLA and RCRA sampling and analysis are coordinated to avoid duplication of effort and to provide consistency for data interpretation purposes. The most concentrated portions of the plume in June 2006 (Figure 2) were near the southern end of the process trenches (316-5) and the 316-3 trench. These two facilities are former liquid waste disposal sites and are likely sources of continued uranium groundwater contamination. In December 2006 (Figure 3), the two zones of elevated uranium concentration had moved downgradient in the unconfined aquifer toward the Columbia River.

Uranium was detected in five of the eight network wells during the reporting period (July through December 2006). However, uranium concentrations exceeded the drinking water standard (30 μg/L) only at the three downgradient network wells that are screened at the water table (399-1-10A, 399-1-16A, and 399-1-17A). The highest concentration reported in the network wells was 152 μg/L at well 399-1-17A in a sample collected July 25, 2006. Uranium concentration trends at wells 399-1-10A and 399-1-16A (Figures 4 and 5, respectively), although generally changing little over the last 2 years, show a rise in concentration since June 2006 when uranium concentrations were low at these two wells. Conversely, the uranium concentration at well 399-1-17A (Figure 6) decreased significantly since June 2006 when the uranium concentration was elevated at this well. Response of the water table and uranium concentration in the 300 Area to river stage is described in detail in previous semiannual reports on the RCRA 300 Area process trenches and in annual reports of the Groundwater Performance Assessment Project (e.g., Hartman et al. 2005, 2006, 2007).

Cis-1,2-Dichloroethene. Cis-1,2-dichloroethene was detected at three wells in the 300 Area process trenches network during the reporting period (399-1-16A, 399-1-16B, and 399-1-17B). The B wells are screened in the lower portion of the unconfined aquifer, and the A wells are screened at the water table. Only well 399-1-16B had concentrations of cis-1,2-dichloroethene that exceeded the drinking water standard (70 μg/L). The trend at well 399-1-16B (Figure 7) was relatively stable around 150 to 160 ug/L from July to September 2006, but rose to 270 μg/L in December 2006. The reason for the increase is unknown, but the concentration declined to 190 μg/L in January 2007. At the other three wells where cis-1,2-dichloroethene was detected, the concentration never exceeded 3.2 μg/L during the reporting period.

Trichloroethene. Trichloroethene (drinking water standard 5 μg/L) was detected at three wells in the 300 Area process trenches network during the reporting period (399-1-16A, 399-1-16B, and 399-1-17B). The well with the highest reported concentration during the reporting period was well 399-1-16B with a value of 2.5 μg/L. This well is screened at the base of the unconfined aquifer, and the source was most likely the 300 Area process trenches. The historical trend at this well shows that trichloroethene concentrations decreased since 1997, but have remained relatively stable at levels below the drinking water standard since 2000. The source of trichloroethene at the other wells (399-1-16A and 399-1-17A, screened at the water table) is uncertain, but may be from the 300 Area process trenches or from an offsite source to the southwest (Hartman et al. 2007, Figure 2.12-15).

Tetrachloroethene. In recent years, tetrachloroethene (5-μg/L drinking water standard) has occasionally been detected in the well network downgradient of the 300 Area process trenches. During the reporting period, it was not detected at levels above the method detection limit (0.19 μg/L).

6.0 Conclusions

The objective of groundwater monitoring at the 300 Area process trenches is to demonstrate the effectiveness of the corrective action program by examining the trend of the contaminants of interest to confirm that they are attenuating naturally. Three wells downgradient of the 300 Area process trenches and screened at the water table continued to have uranium concentrations that exceeded the 30-μg/L drinking water standard. Two of these three wells (399-1-16A and 399-1-10A located near the Columbia River) started out the reporting period with very low concentrations of uranium and had increasing uranium concentrations throughout the reporting period. The other well (399-1-17A), located farther away from the river, started out the reporting period with a high concentration of uranium, and showed a decreasing trend thereafter. These variations in uranium concentration are due to seasonal water-table and river-level fluctuations that, in turn, alter groundwater chemistry and affect uranium adsorption in the aquifer. These relationships have been discussed in previous reports. Overall, the uranium concentrations have attenuated, but continue to fluctuate with levels of the river and water table.

The concentration of cis-1,2-dichloroethene continued at levels above the drinking water standard (70 μg/L) in one well (399-1-16B) and is not affected by river stage. The trend of this contaminant at well 399-1-16B has not attenuated as expected, and has generally fluctuated between about 120 and 240 μg/L except for the December 2006 results (250 and 270 μg/L), which were higher than the previous range.

7.0 References

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Table 1. Results of Groundwater Analyses for 300 Area Process Trenches Contaminants of Interest During July to December 2006

Well	Sample Date	cis-1,2-DCE (µg/L)		Tetrachloroethene (µg/L)		Trichloroethene (µg/L)		Uranium (µg/L)	
399-1-10A	7/24/2006	0.19	U	0.19	U	0.2	U	54.2	
399-1-10A	8/10/2006	0.19	U	0.19	U	0.2	U	62.9	
399-1-10A	9/14/2006	0.19	U	0.19	U	0.2	U	70.4	
399-1-10A	12/8/2006	0.19	U	0.19	U	0.2	U	53.4	
399-1-10B	7/24/2006	0.19	U	0.19	U	0.2	U	0.0148	U
399-1-10B	8/10/2006	0.19	U	0.19	U	0.2	U	0.0251	U
399-1-10B	9/14/2006	0.19	U	0.19	U	0.2	U	0.0307	U
399-1-10B	12/8/2006	0.19	U	0.19	U	0.2	U	0.05	U
399-1-16A	7/31/2006	0.55	J	0.19	U	0.41	J	40.8	
399-1-16A	8/10/2006	0.24	J	0.19	U	0.33	J	47.6	
399-1-16A	9/14/2006	0.24	J	0.19	U	0.3	J	71.9	
399-1-16A	12/22/2006	0.20	J	0.19	U	0.68	JN	77.1	
399-1-16B	7/31/2006	150	D	0.19	U	2.4		5.1	
399-1-16B	8/10/2006	160	D	0.19	U	2.4		9.93	
399-1-16B	9/14/2006	150	D	0.19	U	1.8		13.5	
399-1-16B	12/22/2006	260	D	0.19	U	2.5	N	12.4	
399-1-17A	7/25/2006	0.19	U	0.19	U	0.2	U	152	
399-1-17A	8/10/2006	0.19	U	0.19	U	0.2	U	129	
399-1-17A	9/14/2006	0.19	U	0.19	U	0.22	J	101	
399-1-17A	12/8/2006	0.19	U	0.19	U	0.28	J	61	
399-1-17B	7/25/2006	3		0.19	U	0.2	U	0.0254	U
399-1-17B	8/10/2006	3.2		0.19	U	0.2	U	0.00726	U
399-1-17B	9/14/2006	2.9		0.19	U	0.2	U	0.0204	U
399-1-17B	12/8/2006	2.9		0.19	U	0.2	U	0	U
399-1-18A	7/25/2006	0.19	U	0.19	U	0.2	U	5.48	
399-1-18A	9/25/2006	0.19	U	0.19	U	0.2	U	5.63	
399-1-18A	12/14/2006	0.19	U	0.19	U	0.2	U	5.82	
399-1-18B	7/25/2006	0.19	U	0.19	U	0.2	U	0.00982	U
399-1-18B	9/25/2006	0.19	U	0.19	U	0.2	U	0.0194	U
399-1-18B	12/14/2006	0.19	U	0.19	U	0.2	U	0.0409	U

D = Sample diluted for analysis.
J = Value is an estimate (close to detection limit).
N = Presumptive evidence of compound based on mass spectral library search.
U = Undetected.
Replicates are averaged.

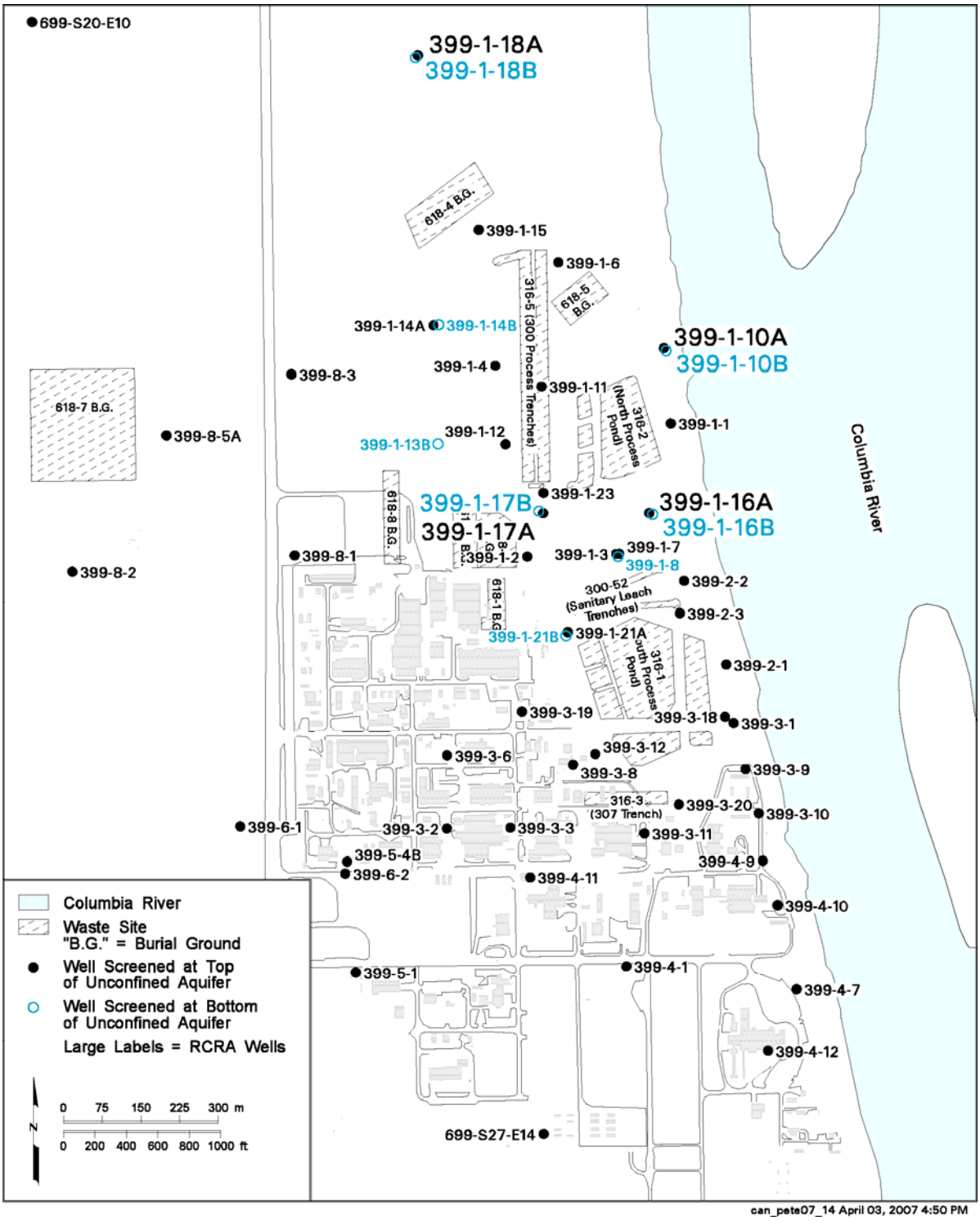

Figure 1. Locations of Wells in the 300 Area Process Trenches Monitoring Networks (after Lindberg et al. 1995). The four well pairs of the 300 Area process trenches network have larger labels.

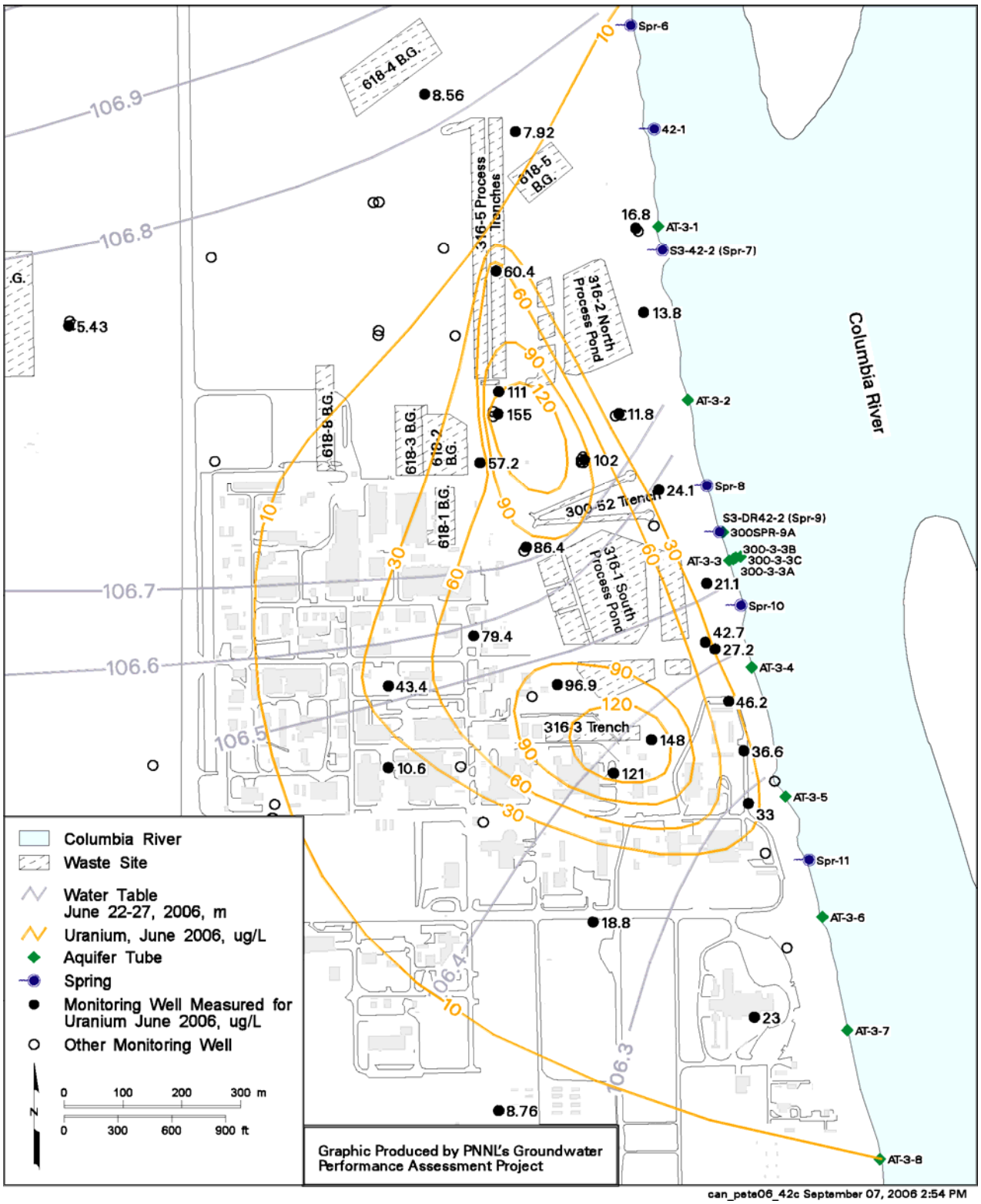

Figure 2. 300 Area Water Table and Uranium Concentrations in the Upper Portion of the Unconfined Aquifer, June 22 to 27, 2006

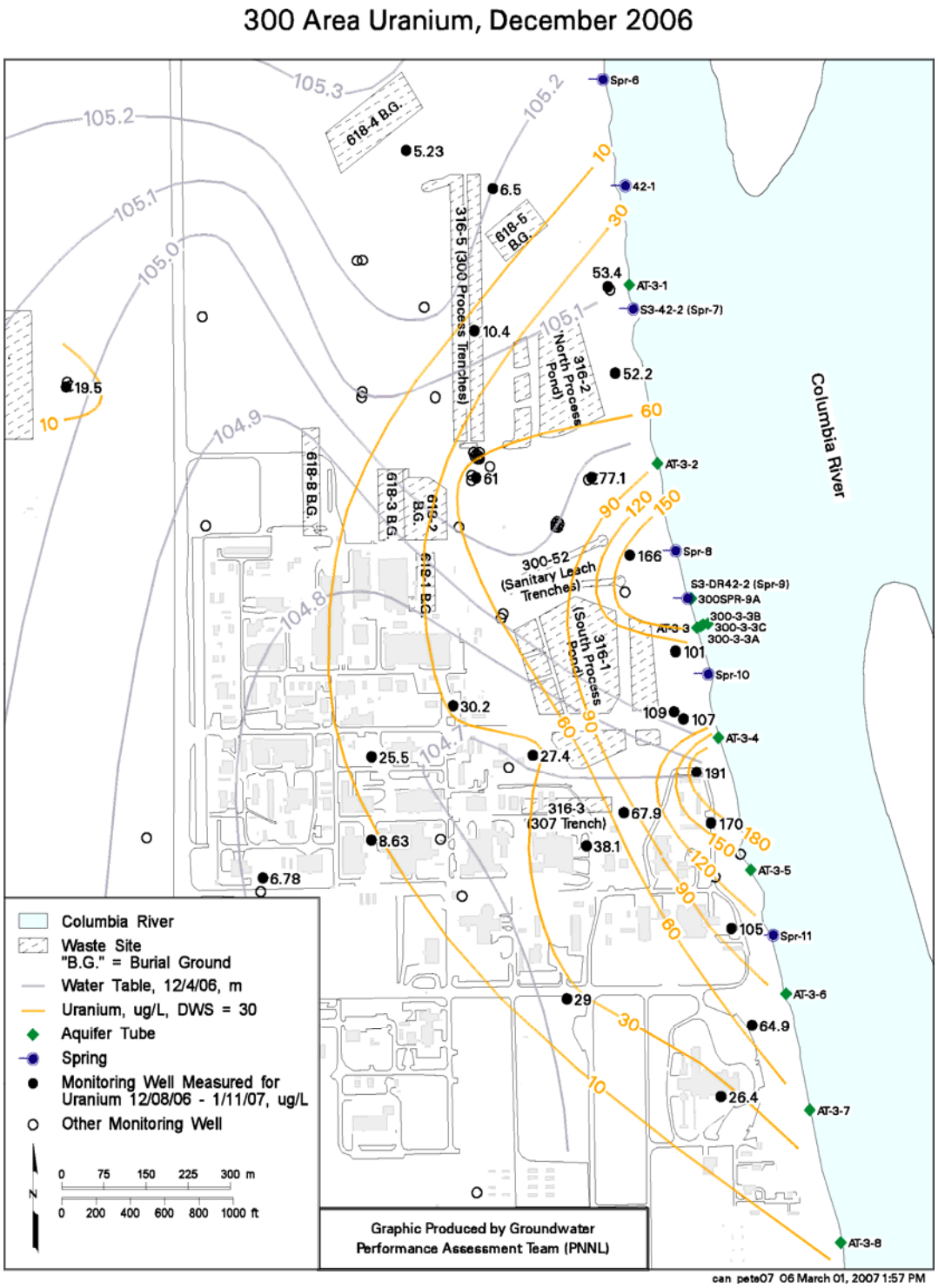

Figure 3 300 Area Water Table and Uranium Concentrations in the Upper Portion of the Unconfined Aquifer, December 2006. Wells 399-1-18A, 399-2-2, 399-3-10, 399-3-12, and 399-8-5A were sampled in early January 2007, and the remainder were sampled in December 2006. Water-table data collected December 4, 2006.

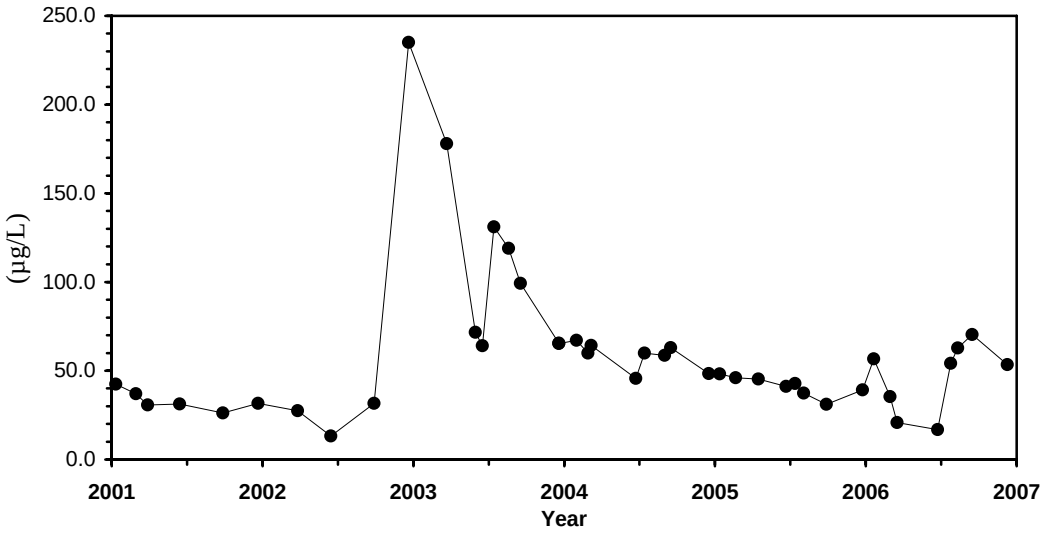

Figure 4. Uranium Concentrations in Well 399-1-10A

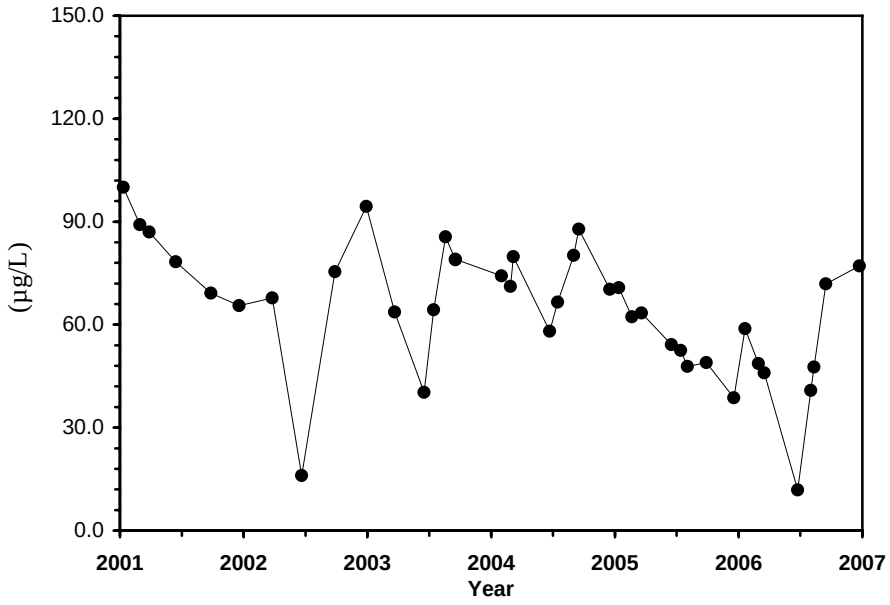

Figure 5. Uranium Concentrations in Well 399-1-16A

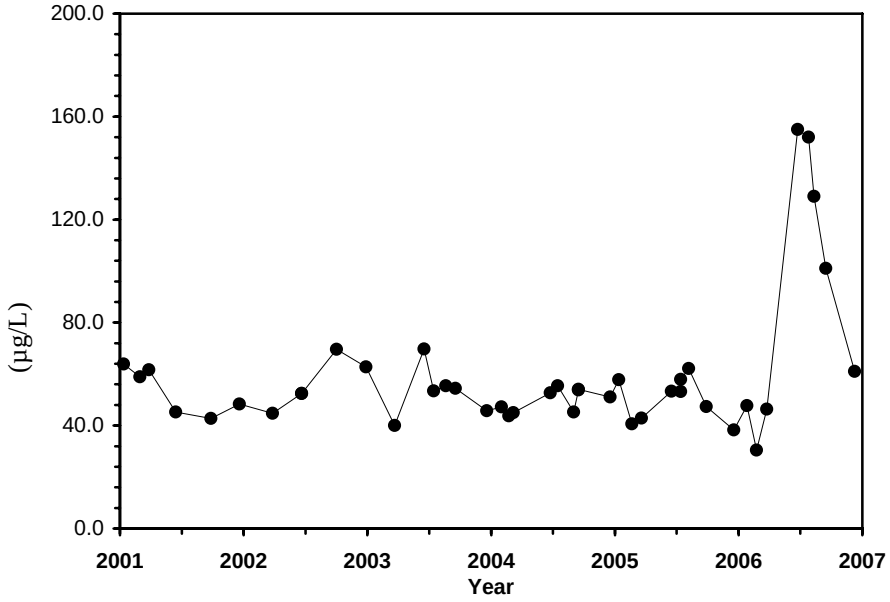

Figure 6. Uranium Concentrations in Well 399-1-17A

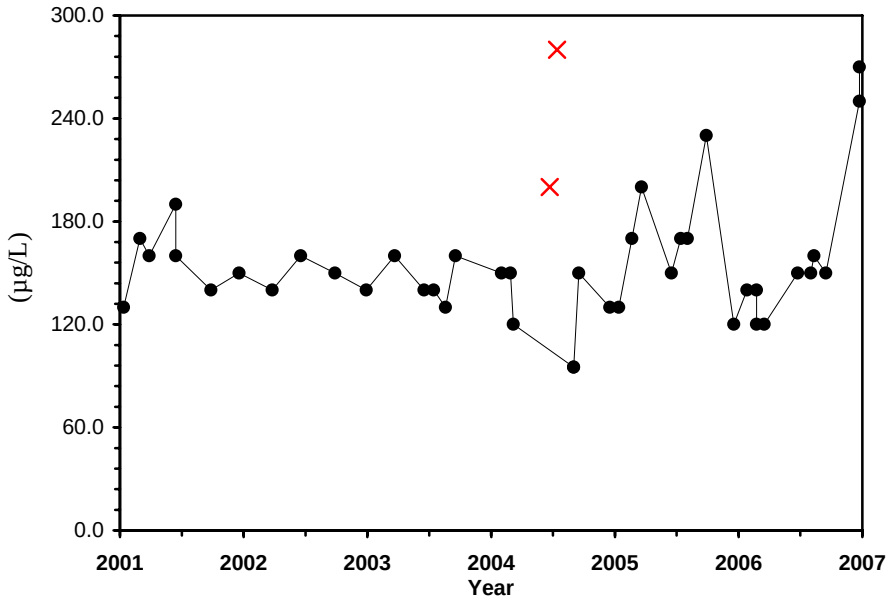

Figure 7. Cis-1,2-Dichloroethene Concentrations in Well 399-1-16B. Potential laboratory errors indicated by "X."

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