SGW-47538
Revision 0

Groundwater Quality Assessment Report for Waste Management Area A-AX: First Determination

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

S

SGW-47538
Revision 0

Groundwater Quality Assessment Report for Waste Management Area A-AX: First Determination

Program/Project: S&GRP

J. W. Lindberg
CH2M HILL Plateau Remediation Company

Date Published
August 2010

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington

LE Bratton 9/8/2010
Release Approval Date

Approved for Public Release;
Further Dissemination Unlimited

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

Contents

1 Introduction and Background 1

2 Results 3

3 Statistical Comparison 6

4 Conclusions 13

5 References 13

Figures

Figure 1. Locations of Wells in WMA A-AX 2

Figure 2. Comparison of Filtered Nickel Concentrations 6

Figure 3. Box-and-Whisker Plots of Nickel at Wells 299-E24-33 and 299-E25-40 8

Figure 4. Frequency Histogram of Nickel at Wells 299-E24-33 and 299-E25-40 9

Tables

Table 1. Summary of Results for Site-Specific COPCs (October 2005 to July 2010) 3

Table 2. Summary of Results for Supporting Constituents (October 2005 to July 2010) 4

Table 3. Nickel Measurements at Wells 299-E24-33 and 299-E25-40 7

Table 4. Summary Statistics of Nickel Measurements at Wells 299-E24-33 and 299-E25-40 8

Table 5. Results of the t-Test on the Nickel Measurements at Wells 299-E24-33 and 299-E25-40 10

Table 6. Nickel Data for Wells 299-E24-33 and 299-E25-40 as Data Pairs 10

Table 7. Results of the Paired t-Test, Sign Test, and Signed Rank Test on the Nickel Measurements 11

Terms

CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
RCRA	*Resource Conservation and Recovery Act of 1976*
TOC	total organic carbon
WAC	*Washington Administrative Code*
WMA	waste management area

1 Introduction and Background

Prior to 2006, Waste Management Area (WMA) A-AX was monitored under the *Resource, Conservation, and Recovery Act of 1976* (RCRA), in interim status under a groundwater indicator parameters evaluation program in accordance with *Washington Administrative Code* (WAC) 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards" (and by reference, 40 *Code of Federal Regulations* [CFR] 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis"). The results from the interim status RCRA semiannual sampling in June 2005 at one downgradient well, 299-E25-93 (Figure 1), showed an average concentration of 536 µS/cm/L for the indicator parameter specific conductance. This exceeded the 522 µS/cm critical mean for this parameter. The results from verification sampling confirmed that specific conductance was above the critical mean with a value of 538 µS/cm. Thus, monitoring at WMA A-AX was elevated to a groundwater assessment program under 40 CFR 265.93(d), "Preparation, Evaluation, and Response."

A first determination, as allowed under 40 CFR 265.93(d)(5), provides the owner/operator of a facility the opportunity to determine whether dangerous or dangerous waste constituents from the regulated unit have compromised groundwater quality. A first determination plan (PNNL-15315, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*) was written and implemented in March 2006. The plan called for monitoring three upgradient wells (299-E24-33, 299-E24-22, and 299-E24-20) and five downgradient wells (299-E25-40, 299-E25-41, 299-E25-2, 299-E25-93, and 299-E25-94). (Note: Well 299-E25-2 is an older well that is not compliant with the standards of WAC 173-160, *Minimum Standards for Construction and Maintenance of Wells*. Data from this well were to be used for information purposes only and not for RCRA-compliance decisions.) The plan (PNNL-15315) required quarterly sampling of these wells and for groundwater samples from these well to be analyzed for the site-specific constituents nitrate, sodium, sulfate, total organic carbon (TOC), chromium, and lead, as well as supporting constituents specific conductance, temperature, turbidity, alkalinity, technetium-99, and the remainder of the analytes indicated in U.S. Environmental Protection Agency (EPA) Method 6010 for metals (18 analytes) and Method 300.0 for anions (5 analytes).

As part of the first determination data quality objectives (DQO) process, a series of four questions were posed concerning the monitoring well network, the groundwater data acquired, and any conclusions about potential significant groundwater contamination:

1. Is the monitoring network adequate?
2. Are observed contaminants consistent with WMA A-AX single-shell tank waste?
3. Is contamination only downgradient from WMA A-AX? (Or is concentration in downgradient wells higher than upgradient wells?)
4. Given the results and the decisions of the previous three questions (above), can it be reasonably concluded that dangerous waste or dangerous waste constituents from WMA A-AX have contaminated groundwater?

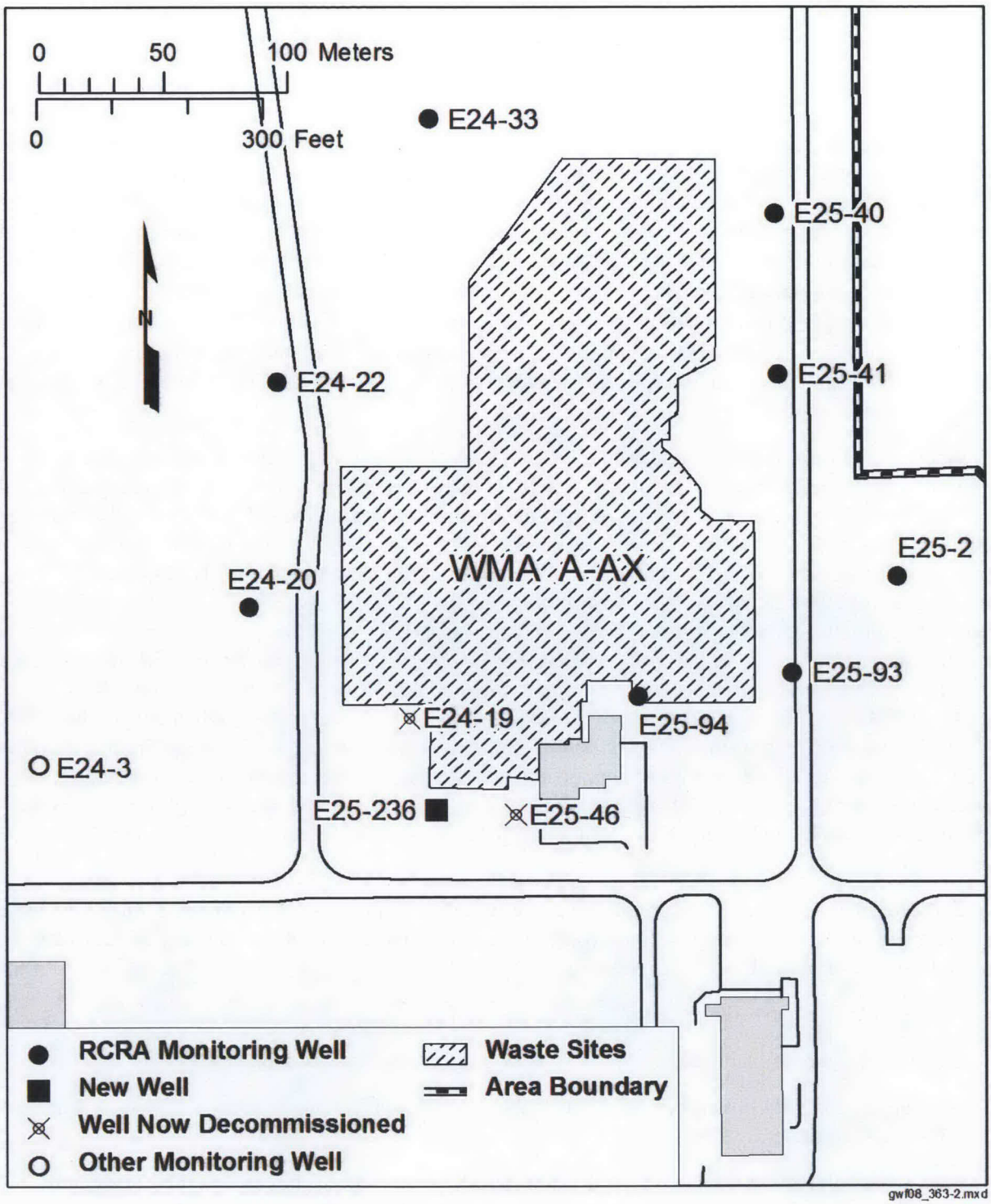


Figure 1. Locations of Wells in WMA A-AX

The first question concerning adequacy of the groundwater monitoring network was addressed by the groundwater monitoring plan (PNNL-15315) when it required that at least one more well be added to the network's south side to replace the two wells lost due to corrosion (299-E24-19 and 299-E25-46). Due to the limited budget for installing groundwater monitoring and the high demand for wells at the Hanford Site, the additional groundwater monitoring well was not installed until 2008. Between the time that the groundwater assessment groundwater monitoring plan was implemented (in 2006) and the time that the new well was added to the well network (in 2008), groundwater monitoring proceeded as required by the new plan. However, it was only after new well 299-E25-236 was installed that the well network was considered complete and adequate to meet the needs of the groundwater monitoring plan (PNNL-15315). In addition, four quarters of data from the new well were collected (along with routine sampling of the existing wells) before sufficient data were available to address the DQO questions.

The second and third DQO questions are discussed in the results presented in Chapter 2. The fourth DQO question is discussed in the conclusions presented in Chapter 3.

2 Results

Of the groundwater analytical results received from monitoring the WMA A-AX well system from October 2005 to July 2010, a total of 21 groundwater constituents were detected. Table 1 summarizes the results of detected site-specific contaminants of potential concern (COPCs), and Table 2 summarizes the results for detected supporting constituents.

Table 1. Summary of Results for Site-Specific COPCs (October 2005 to July 2010)

Groundwater Constituent	Well with Maximum Value	Maximum Value Detected (µg/L)	Laboratory Qualifier	Number of Wells Where Detected	Background at 95th Percentile (Wells Exceeding) (µg/L)	MCL (Number of Wells Where Exceeding) (µg/L)
Chromium* (filtered)	299-E25-40	14.3	B	7	3.17 (7)	100 (0)
Lead* (filtered)	299-E24-20	1.7	B	4	1.3 (1)	15 (0)
Nitrate	299-E25-93	59,300	D	9	41,723 (2)	45,000 (2)
Sodium (filtered)	299-E24-22	22,900	--	9	32,919 (0)	--
Sulfate	299-E25-93	17,000	D	9	54,950 (9)	250,000 (0)
TOC (average of four replicates)	299-E25-41	2,150 (average of four replicates)	--	9	3,336 (0)	--

* Dangerous waste constituent (Appendix IX of 40 CFR 264 ["Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring List") and Appendix 5 of Ecology Publication 97-407 [*Chemical Testing Methods for Designating Dangerous Waste: WAC 173-303-090 & -100*] and referenced in WAC 173-303-080 ["Dangerous Waste Regulations," "Dangerous Waste Lists"] and WAC 173-303-100 ["Dangerous Waste Criteria"]).

B = analyte detected at a value less than the contract-required detection limit, but greater than or equal to the method (instrument) detection limit

D = analyte identified in an analysis at a secondary dilution factor (i.e., dilution factor different than 1.0)

CFR = *Code of Federal Regulations*

Table 1. Summary of Results for Site-Specific COPCs (October 2005 to July 2010)

Groundwater Constituent	Well with Maximum Value	Maximum Value Detected (µg/L)	Laboratory Qualifier	Number of Wells Where Detected	Background at 95th Percentile (Wells Exceeding) (µg/L)	MCL (Number of Wells Where Exceeding) (µg/L)

Ecology = Washington State Department of Ecology
MCL = maximum contaminant level
TOC = total organic carbon
WAC = *Washington Administrative Code*

Table 2. Summary of Results for Supporting Constituents (October 2005 to July 2010)

Groundwater Constituent	Well with Maximum Value	Maximum Value Detected (µg/L)	Laboratory Qualifier	Number of Wells Detected	Background at 95th Percentile (Wells Exceeding) (µg/L)	MCL (Number of Wells Exceeding) (µg/L)
Filtered Metals (µg/L)						
Antimony*	--	Not detected	U	--	--	--
Barium*	299-E25-93	60.1	--	9	149 (0)	2,000 (0)
Beryllium*	--	Not detected	U	--	--	--
Cadmium*	--	Not detected	U	--	1.29 (0)	5 (0)
Calcium	299-E25-93	81,200	--	9	58,381 (6)	--
Cobalt*	299-E25-93	9.7	C	4	1.29 (4)	--
Copper*	299-E25-2	21.3	B	7	1.04 (7)	1,300 (0)
Iron	299-E25-2	104	--	9	1,104 (0)	300 (0)
Magnesium	299-E25-93	23,200	--	9	31,051 (0)	--
Manganese	299-E25-93	60.8	--	9	86.4 (0)	50 (1)
Nickel*	299-E25-93	178	--	8	1.98 (8)	--
Potassium	299-E24-33	10,700	C	9	11,089 (0)	--
Silver*	299-E25-93	10.5	C	8	5.98 (6)	100 (0)
Strontium	299-E25-93	468	--	9	398 (2)	--

Table 2. Summary of Results for Supporting Constituents (October 2005 to July 2010)

Groundwater Constituent	Well with Maximum Value	Maximum Value Detected (µg/L)	Laboratory Qualifier	Number of Wells Detected	Background at 95th Percentile (Wells Exceeding) (µg/L)	MCL (Number of Wells Exceeding) (µg/L)
Anions (µg/L)						
Chloride	299-E25-93	27,400	D	9	19,580 (6)	250,000 (0)
Fluoride	299-E25-40	320	N	9	1,298 (0)	4,000 (0)
Nitrite	299-E25-93	2,990	D, N	8	130 (8)	3,300 (0)
Other (pCi/L)						
Technetium-99	299-E25-93	8,000 pCi/L	--	9	0.988 pCi/L (9)	900 pCi/L (2)

* Dangerous waste constituent (Appendix IX of 40 CFR 264 ["Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring List") and Appendix 5 of Ecology Publication 97-407 [*Chemical Testing Methods for Designating Dangerous Waste: WAC 173-303-090 & -100*] and referenced in WAC 173-303-080 ["Dangerous Waste Regulations," "Dangerous Waste Lists"] and WAC 173-303-100 ["Dangerous Waste Criteria"]).

B = analyte detected at a value less than the contract-required detection limit, but greater than or equal to the method (instrument) detection limit

C = analyte detected in both the sample and the associated quality control blank, and the sample concentration was less than or equal to five times the blank concentration

D = analyte identified in an analysis at a secondary dilution factor (i.e., dilution factor different than 1.0)

N = spike sample recovery is outside control limits

CFR = *Code of Federal Regulations*

Ecology = Washington State Department of Ecology

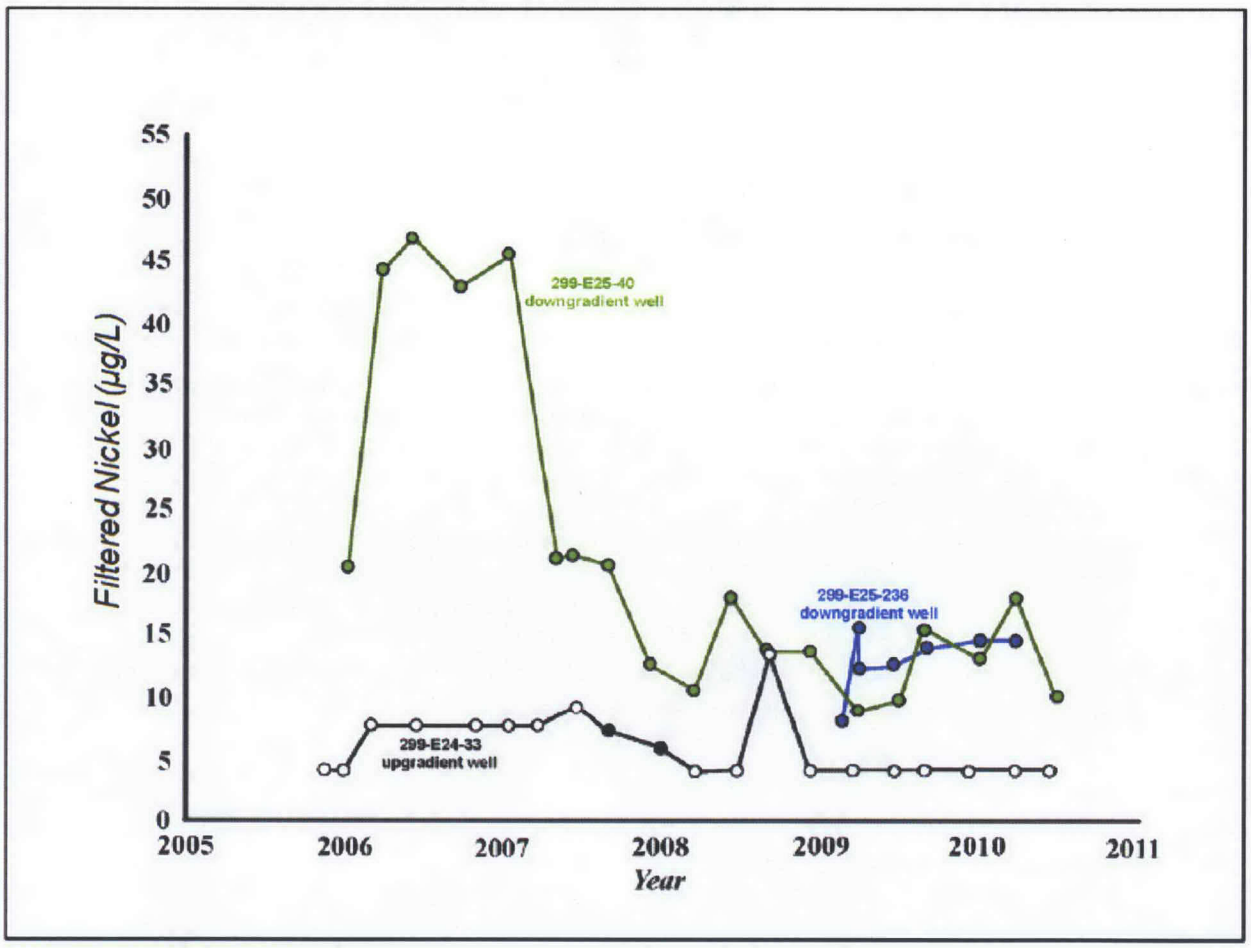
MCL = maximum contaminant level

WAC = *Washington Administrative Code*

All five of the site-specific COPCs, and the indicator parameter TOC, were detected in groundwater samples, although filtered lead and chromium were at such low concentrations that the laboratory flagged them with "B," indicating that the results were less than the contract-required detection limit. The sodium and TOC results were all less than site background at the 95th percentile. Supporting constituents detected included barium, calcium, copper, cobalt, iron, magnesium, manganese, nickel, potassium, silver, strontium, chloride, fluoride, nitrite, and technetium-99 (metals filtered). The results of barium, magnesium, manganese, potassium, and fluoride were all lower in concentration than site background concentrations at the 95th percentile. Detected COPCs and supporting constituents that were detected in concentrations above the 95th percentile of site background concentrations, in concentrations above the laboratory's contract-required detection limit and are listed in Appendix 5 (Ecology Publication 97-407, *Chemical Testing Methods for Designating Dangerous Waste: WAC 173-303-090 & -100*, which references 40 CFR 264, Appendix IX, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring List"), were filtered cobalt, copper, nickel, and silver. All four of these metals are also on the primary non-radiological constituent

list provided in RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*, which indicates that they are potential tank waste constituents.

Concentrations of the four filtered metals (cobalt, copper, nickel, and silver) at downgradient wells were compared with concentrations in the upgradient wells; only nickel appeared to have higher concentrations in downgradient wells. The wells where filtered nickel appeared in higher concentrations downgradient are 299-E25-40 and 299-E25-236 (Figure 2).



Note: Comparison of filtered nickel concentrations at the upgradient well 299-E24-33 (open circles and black) and downgradient wells 299-E25-40 (green) and 299-E25-236 (blue) for the period of October 1, 2005, to July 31, 2010.

Figure 2. Comparison of Filtered Nickel Concentrations

3 Statistical Comparison

The graphical appearance that nickel concentrations are higher at downgradient wells was confirmed by statistical comparison of data from well 299-E25-40 (downgradient) to well 299-E24-33 (upgradient) using four statistical tests including the Student's t-test of the means, paired comparison t-test, sign test, and signed rank test.

The data for wells 299-E25-40 and 299-E24-33 shown in Figure 2 are provided in Table 3.

Table 3. Nickel Measurements at Wells 299-E24-33 and 299-E25-40

Well 299-E24-33	Dates for 299-E24-33	Well 299-E25-40	Dates for 299-E25-40
4	11/15/2005	20.4	1/5/2006
4	12/27/2005	44	3/27/2006
7.5	3/3/2006	46.6	6/8/2006
7.5	6/14/2006	42.8	9/27/2006
7.5	11/1/2006	45.2	1/18/2007
7.5	1/16/2007	21	5/9/2007
7.5	3/26/2007	21.2	6/16/2007
9.1	6/23/2007	20.5	9/4/2007
7.1	9/4/2007	12.5	12/10/2007
5.8	1/2/2008	10.5	3/24/2008
4	3/24/2008	17.9	6/10/2008
4	6/26/2008	13.7	9/2/2008
13.3	9/8/2008	13.6	12/10/2008
4	12/10/2008	8.9	3/30/2009
4	3/19/2009	9.7	7/1/2009
4	6/22/2009	15.2	9/1/2009
4	9/1/2009	13.1	1/6/2010
4	12/9/2009	17.9	3/26/2010
4	3/28/2010	10	6/29/2010
4	6/13/2010		

The Box-and-Whisker plot shown in Figure 3 shows the relative distributions of the nickel values for the two wells. The gray rectangles represent 50 percent of the measurements for each well. The lack of overlap of the rectangles indicates significant differences in nickel concentrations at the two wells.

Table 4 shows summary statistics for the nickel measurements at wells 299-E24-33 and 299-E25-40. The skewness and kurtosis indicate the data is non-normal, potentially invalidating statistical tests relying on the standard deviations of the data, such as the t-test. Figure 4 shows the frequency distribution of the data suggesting non-normality.

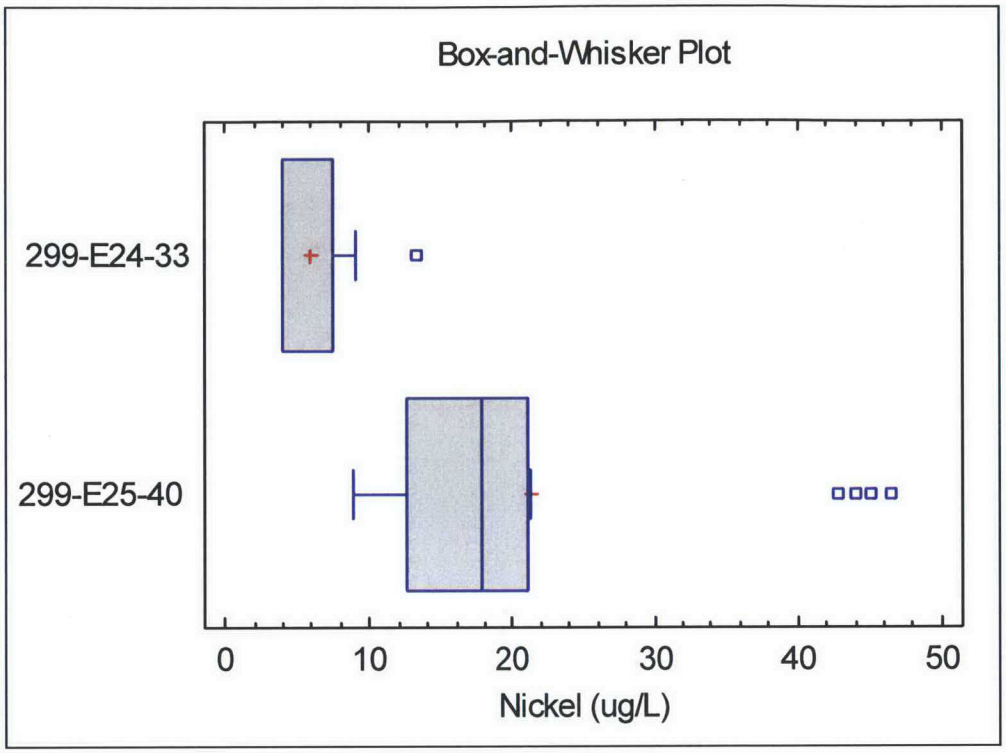
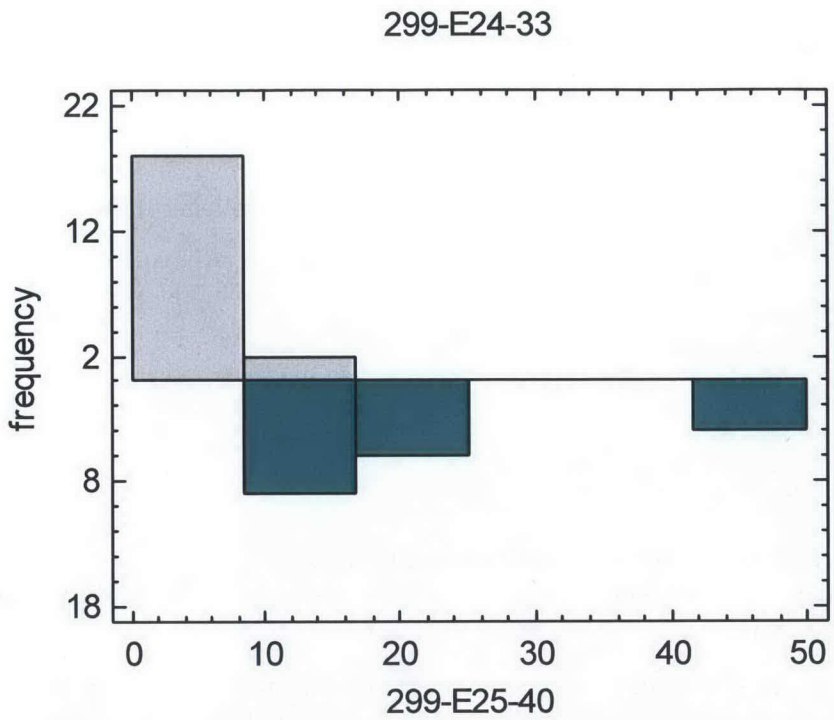


Figure 3. Box-and-Whisker Plots of Nickel at Wells 299-E24-33 and 299-E25-40

Table 4. Summary Statistics of Nickel Measurements at Wells 299-E24-33 and 299-E25-40

	Well 299-E24-33	Well 299-E25-40
Count	20	19
Average	5.84	21.3
Standard Deviation	2.50145	13.0066
Coefficient of Variation	42.8331%	61.064%
Minimum	4.0	8.9
Maximum	13.3	46.6
Range	9.3	37.7
Standard Skewness	2.7705	2.15307
Standard Kurtosis	2.45633	-0.028508



Note: Gray rectangles represent measurement frequencies for well 299-E24-33; green rectangles represent the frequency of measurements for well 299-E25-40.

Figure 4. Frequency Histogram of Nickel at Wells 299-E24-33 and 299-E25-40

The gray rectangles shown above the horizontal line in Figure 4 are measurement frequencies for well 299-E24-33, and the green rectangles represent the frequency of measurements for well 299-E25-40. The large gray rectangle shows that 18 nickel measurements for well 299-E24-33 were between 0 and 8 μg/L.

The important characteristic to note is the rather non-normality of the data. This is due to the non-detect nature of the data for well 299-E24-33, in which many of the measurements were at the same detection level (4 or 7.5). For well 299-E25-40, apparently a plume migrated through the area in 2006, resulting in four significantly elevated measurements relative to the others. Both of these effects make the data rather non-normal.

The t-test, however, is a robust test and would still seem to give meaningful results considering the distribution of the data, as plotted in Figure 2. A comparison of the difference in means relative to the variability in the data should still be useful. Therefore, a t-test was conducted and the results are shown in Table 5.

Table 5. Results of the t-Test on the Nickel Measurements at Wells 299-E24-33 and 299-E25-40

Comparison of Means:

95.0% confidence interval for mean of well 299-E24-33: 5.84 (±1.17072) [4.66928, 7.01072]

95.0% confidence interval for mean of well 299-E25-40: 21.3 (±6.269) [15.031, 27.569]

95.0% confidence interval for the difference between the means, assuming equal variances:
-15.46 (±6.00259) [-21.4626, -9.45741]

t-Test to Compare Means:

Null hypothesis: mean1 = mean2

Alternate hypothesis: mean1 NE mean2, assuming equal variances: t = -5.21858

P-value = 0.00000747096

Reject the null hypothesis for alpha = 0.05

The confidence interval for the difference between the means extends from -21.4626 to -9.45741. Since the interval does not contain the value of zero, there is a statistically significant difference between the means of the two samples at the 95.0 percent confidence level.

The probability of having this amount of difference between the means, assuming nickel concentrations at both wells are actually equal, is approximately 7E-06. Thus, there is a statistically significant difference between the means of the nickel measurements at the upgradient and downgradient wells.

Since the t-test on the means is somewhat compromised by the distributions of the data, paired tests were conducted. The paired tests compare measurements at the two wells pair-wise. Samples taken at approximately the same time were used as pairs. The tests determine if measurements at one well are consistently higher than measurements at the other well. The data for the paired tests are shown in Table 6.

Table 6. Nickel Data for Wells 299-E24-33 and 299-E25-40 as Data Pairs

Well 299-E24-33	Dates for 299-E24-33	Well 299-E25-40	Dates for 299-E25-40
4	12/27/2005	20.4	1/5/2006
7.5	3/3/2006	44	3/27/2006
7.5	6/14/2006	46.6	6/8/2006
7.5	11/1/2006	42.8	9/27/2006
7.5	1/16/2007	45.2	1/18/2007
7.5	3/26/2007	21	5/9/2007
9.1	6/23/2007	21.2	6/16/2007
7.1	9/4/2007	20.5	9/4/2007
5.8	1/2/2008	12.5	12/10/2007
4	3/24/2008	10.5	3/24/2008
4	6/26/2008	17.9	6/10/2008
13.3	9/8/2008	13.7	9/2/2008

Table 6. Nickel Data for Wells 299-E24-33 and 299-E25-40 as Data Pairs

Well 299-E24-33	Dates for 299-E24-33	Well 299-E25-40	Dates for 299-E25-40
4	12/10/2008	13.6	12/10/2008
4	3/19/2009	8.9	3/30/2009
4	6/22/2009	9.7	7/1/2009
4	9/1/2009	15.2	9/1/2009
4	12/9/2009	13.1	1/6/2010
4	3/28/2010	17.9	3/26/2010
4	6/13/2010	10	6/29/2010

The results of the paired tests are shown in Table 7.

Table 7. Results of the Paired t-Test, Sign Test, and Signed Rank Test on the Nickel Measurements

Hypothesis tests for well 299-E24-33 minus well 299-E25-40:

Sample mean = -15.3632
Sample median = -12.1
Sample standard deviation = 12.2196

t-Test:
Null hypothesis: mean = 0.0
Alternative: not equal

Computed t statistic = -5.48024
P-value = 0.0000332354
Reject the null hypothesis for alpha = 0.05

Sign Test
Null hypothesis: median = 0.0
Alternative: not equal

Number of values below hypothesized median: 19
Number of values above hypothesized median: 0

Large sample test statistic = 4.12948 (continuity correction applied)
P-value = 0.0000363785
Reject the null hypothesis for alpha = 0.05

Table 7. Results of the Paired t-Test, Sign Test, and Signed Rank Test on the Nickel Measurements

Signed Rank Test:
Null hypothesis: median = 0.0
Alternative: not equal

Average rank of values below hypothesized median: 10.0
Average rank of values above hypothesized median: 0.0

Large sample test statistic = 3.80327 (continuity correction applied)
P-value = 0.000142846
Reject the null hypothesis for alpha = 0.05

Each measurement at well 299-E25-40 is subtracted from its corresponding measurement at well 299-E24-33. If the measurements all came from the same population (i.e., there is no statistical difference between the measurements at well 299-E24-33 and those at well 299-E25-40) then the pair-wise differences should average approximately zero. The amount by which they differ from zero is the statistical significance of a difference between the measurements at the two wells.

All three tests indicated statistically significant differences in the nickel measurements at the two wells. The t-test compares the mean difference in the pairs from zero relative to the standard deviation of the differences. The probability of equal nickel concentrations at the two wells is approximately 3E-05 according to the paired t-test.

The coefficient of variation in the differences is -80 percent, the standard skewness -2.04, and the standard kurtosis -0.03. The magnitudes of the coefficient of variation and skewness are slightly high, indicating that the non-normality of the differences may compromise the paired t-test. Therefore, the sign test and signed-rank tests, which are nonparametric and therefore do not rely on the normality of the data, were also performed.

The sign test counts the number of times that the nickel measurement at well 299-E25-40 exceeds that at well 299-E24-33. If there is no difference in nickel concentrations at the two wells, this number should be approximately 9 or 10 (i.e., half of the number of pairs). The value of 19 has a probability of 3.6E-05 of occurring if nickel concentrations at the two wells are equal.

The signed-rank test ranks the absolute value of the differences, assigning one to the smallest difference, two to the next smallest difference, and so on. The signs of the differences are then restored to the ranks, and the sum of the negative ranks are compared to the sum of the positive ranks. The amount by which they differ is a measure of the statistical difference between the members of the pairs. The results of the signed-rank test indicate a 1.4E-04 probability that nickel concentrations at wells 299-E24-33 and 299-E25-40 are equal.

Results of the t-test of the means, paired comparison t-test, sign test, and signed rank tests all indicate a statistically significant difference in nickel measurements at wells 299-E24-33 and 299-E25-40. Although the data are somewhat non-normal, the nonparametric tests (the sign and signed rank tests) yielded similar results to the t-tests, confirming the difference in nickel concentrations between the two wells.

4 Conclusions

Although it is likely that WMA A-AX is responsible for groundwater contamination such as nitrate and technetium-99 (DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009*, Volume 1, Sections 5.2.3, 5.2.5, and 5.4.3.3), these constituents are not regulated under RCRA. However, nickel, a dangerous waste constituent (listed in Appendix 5 of Ecology Publication 97-407), is detected in groundwater at two WMA A-AX downgradient wells (299-E25-40 and 299-E25-236) in concentrations higher than concentrations found in upgradient wells. Therefore, it is concluded that WMA A-AX may have contaminated the unconfined aquifer with a dangerous waste constituent, and monitoring should proceed to groundwater quality assessment in accordance with 40 CFR 265.93(d)(7).

5 References

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix IX, "Ground-Water Monitoring List," *Code of Federal Regulations*. Available at: http://edocket.access.gpo.gov/cfr_2009/julqtr/40cfr264AppIX.htm.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_09/40cfr265_09.html.

40 CFR 265.92, "Sampling and Analysis."

40 CFR 265.93, "Preparation, Evaluation, and Response."

DOE/RL-2010-11, 2010, *Hanford Site Groundwater Monitoring and Performance Report for 2009,* Rev. 0, Volumes 1 & 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/rl/uploadfiles/GWRep09/start.htm.

Ecology Publication 97-407, 2009, *Chemical Testing Methods for Designating Dangerous Waste: WAC 173-303-090 & -100*, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/pubs/97407.pdf.

PNNL-15315, 2006, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area A-AX at the Hanford Site*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-15315.pdf.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www4.law.cornell.edu/uscode/42/6901.html.

RPP-23403, 2006, *Single-Shell Tank Component Closure Data Quality Objectives*, Rev. 3, CH2M HILL Hanford Group, Inc., Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

WAC 173-303-080, "Dangerous Waste Lists."

WAC 173-303-100, "Dangerous Waste Criteria."

WAC 173-303-400, "Interim Status Facility Standards."

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160.

Distribution

	MS	Quantity
U.S. Department of Energy, Richland Operations Office		
D.R. Hildebrand	A6-38	1
DOE Public Reading Room	H2-53	1
CH2M HILL Plateau Remediation Company		
J.W. Lindberg	R3-50	10
S.P. Luttrell	R3-50	1
Administrative Record	H6-08	1
Document Clearance	H6-08	1