Figure 46

Groundwater Flow Map: Roubidoux Formation, June 2007

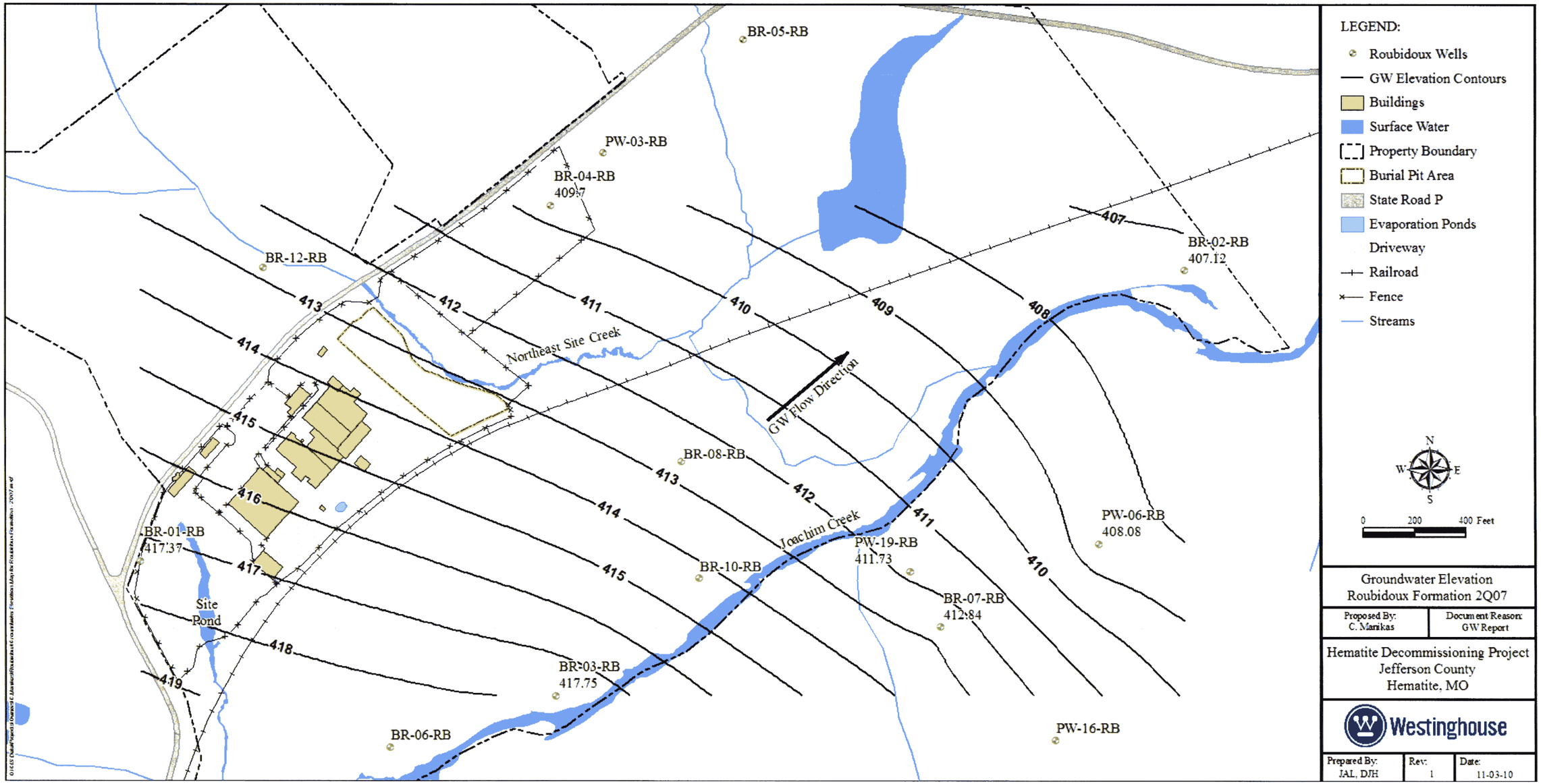


Figure 47

Groundwater Flow Map: Roubidoux Formation, September 2007

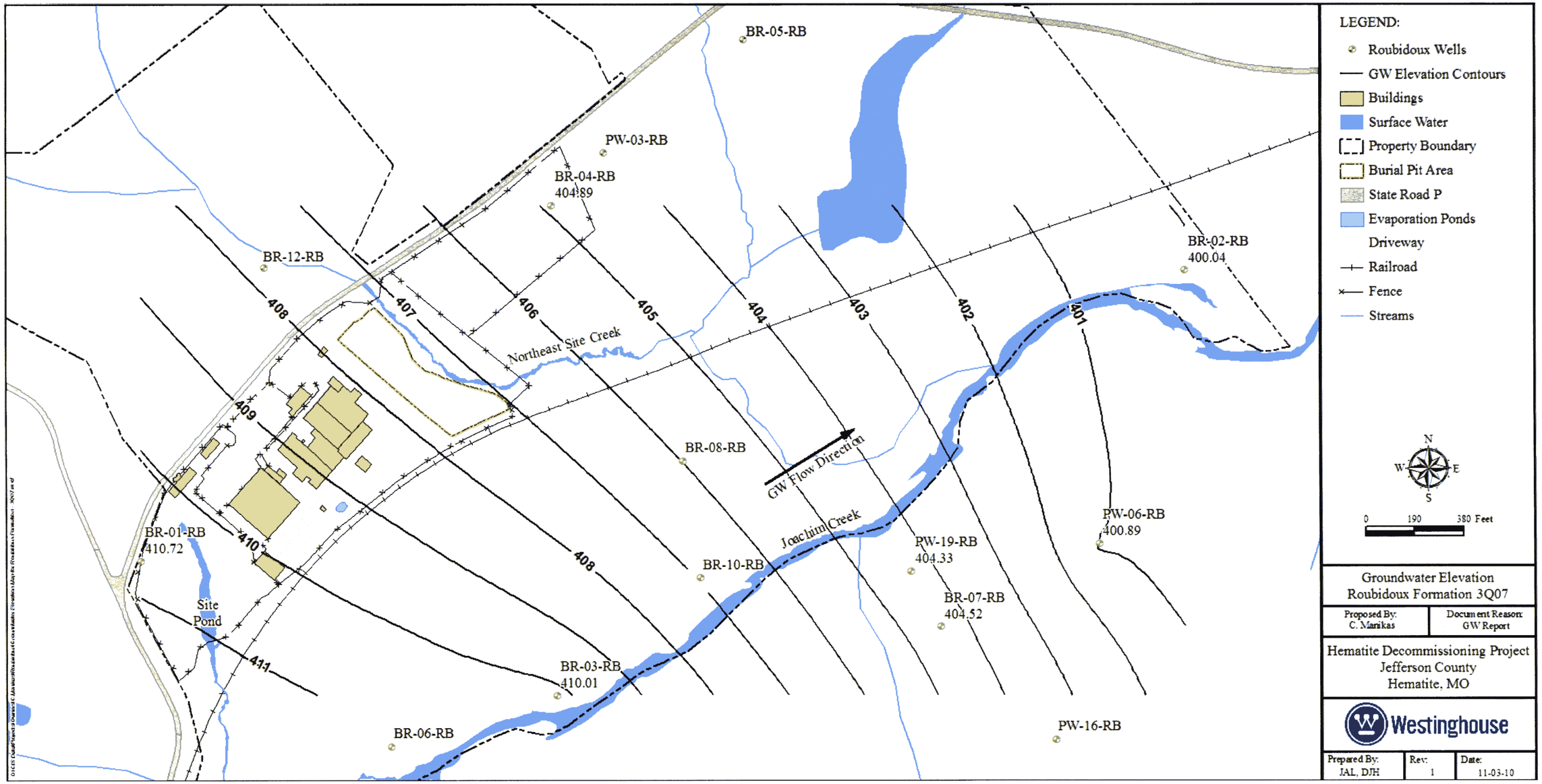


Figure 48

Groundwater Flow Map: Roubidoux Formation, December 2007

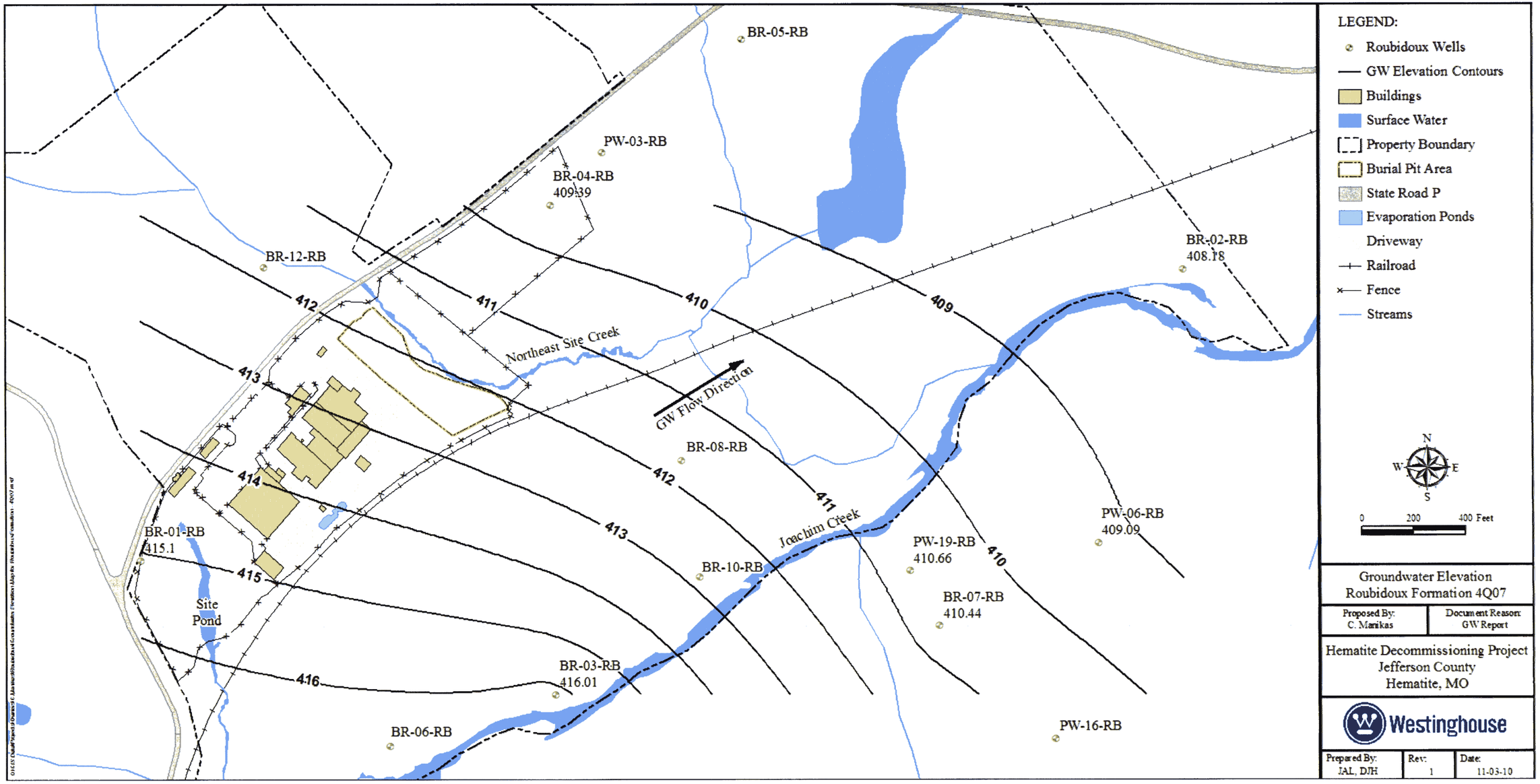


Figure 49

Groundwater Flow Map: Roubidoux Formation, March 2008

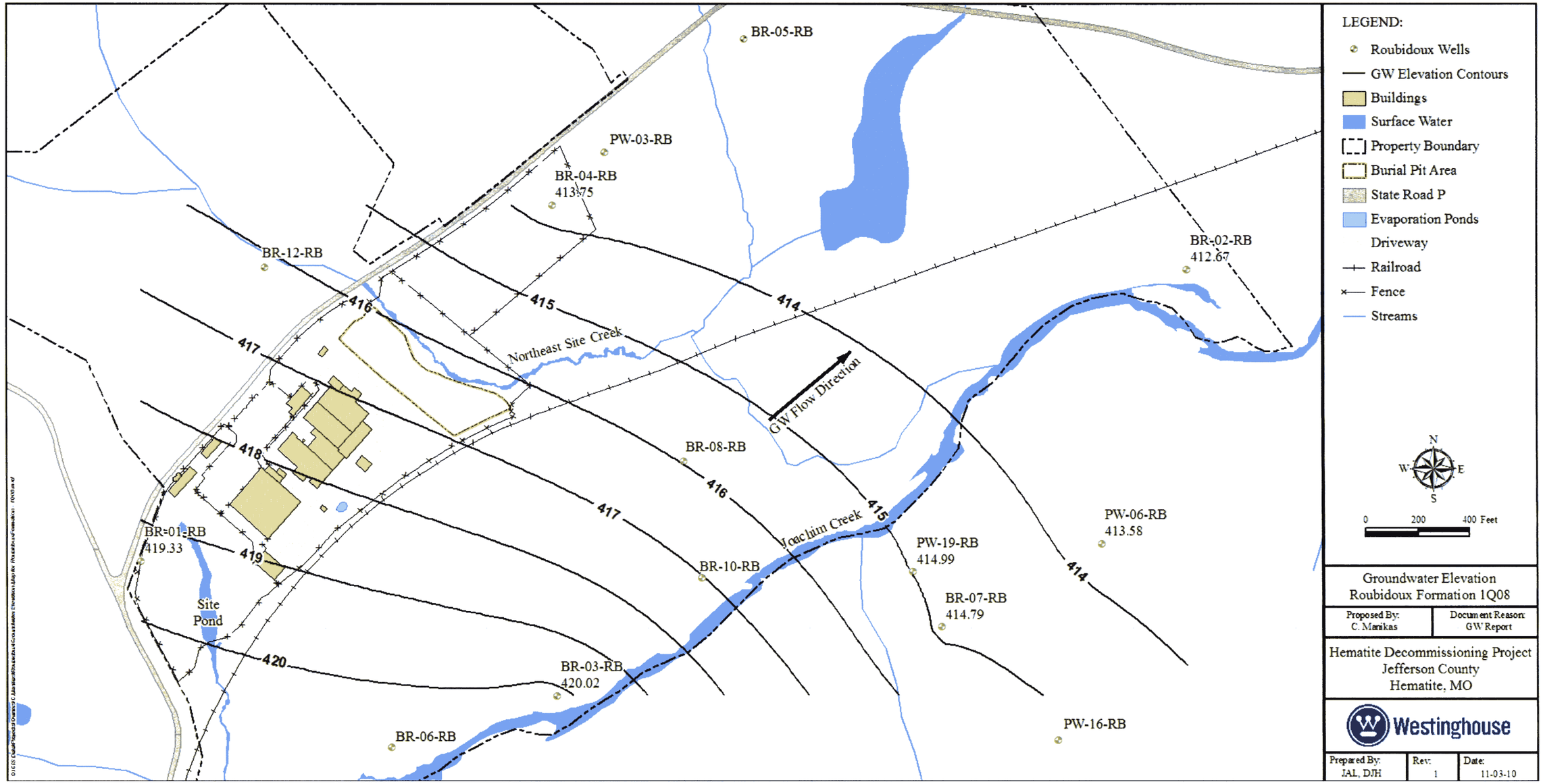


Figure 50

Groundwater Flow Map: Roubidoux Formation, June 2008

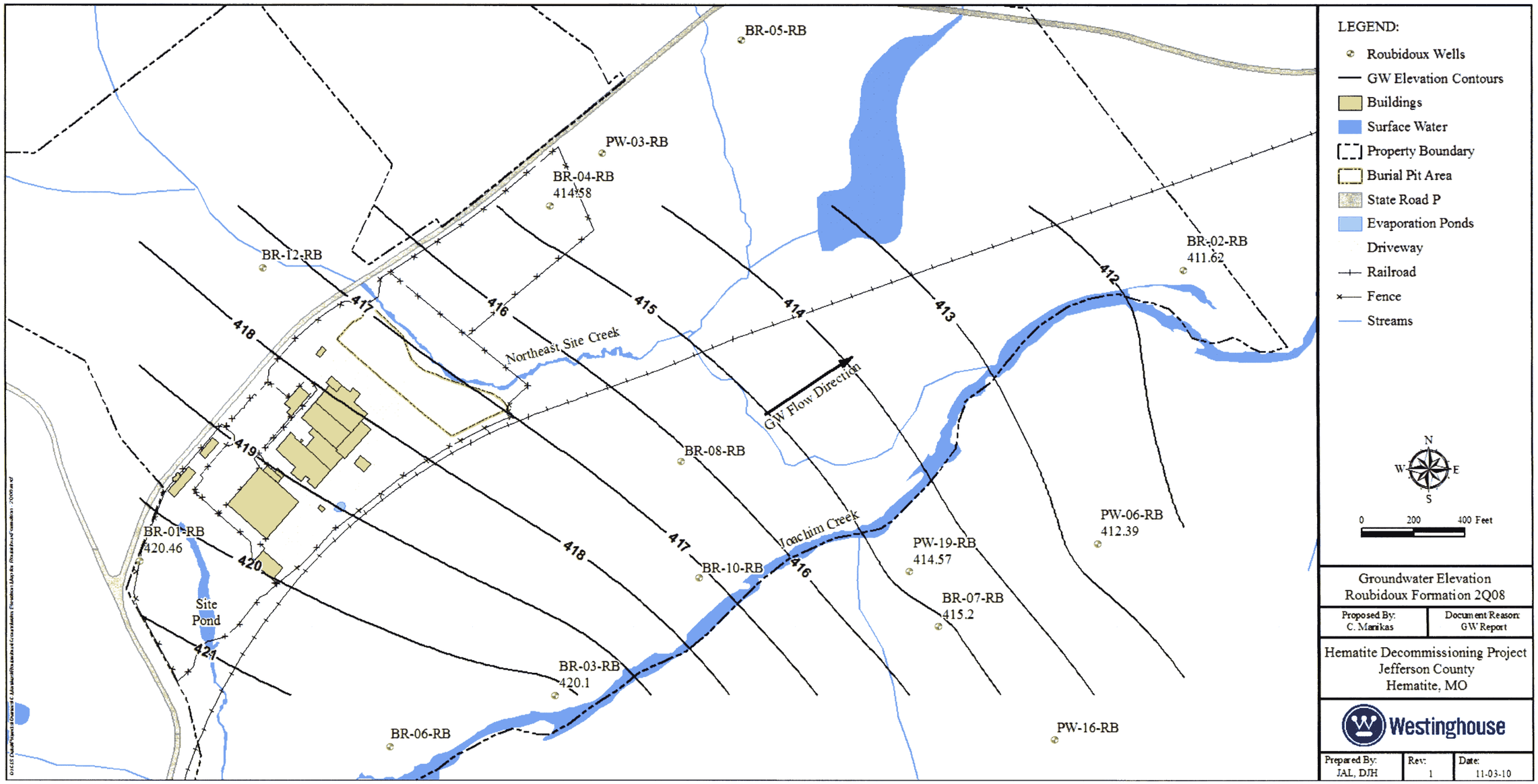


Figure 51

Groundwater Flow Map: Roubidoux Formation, September 2008

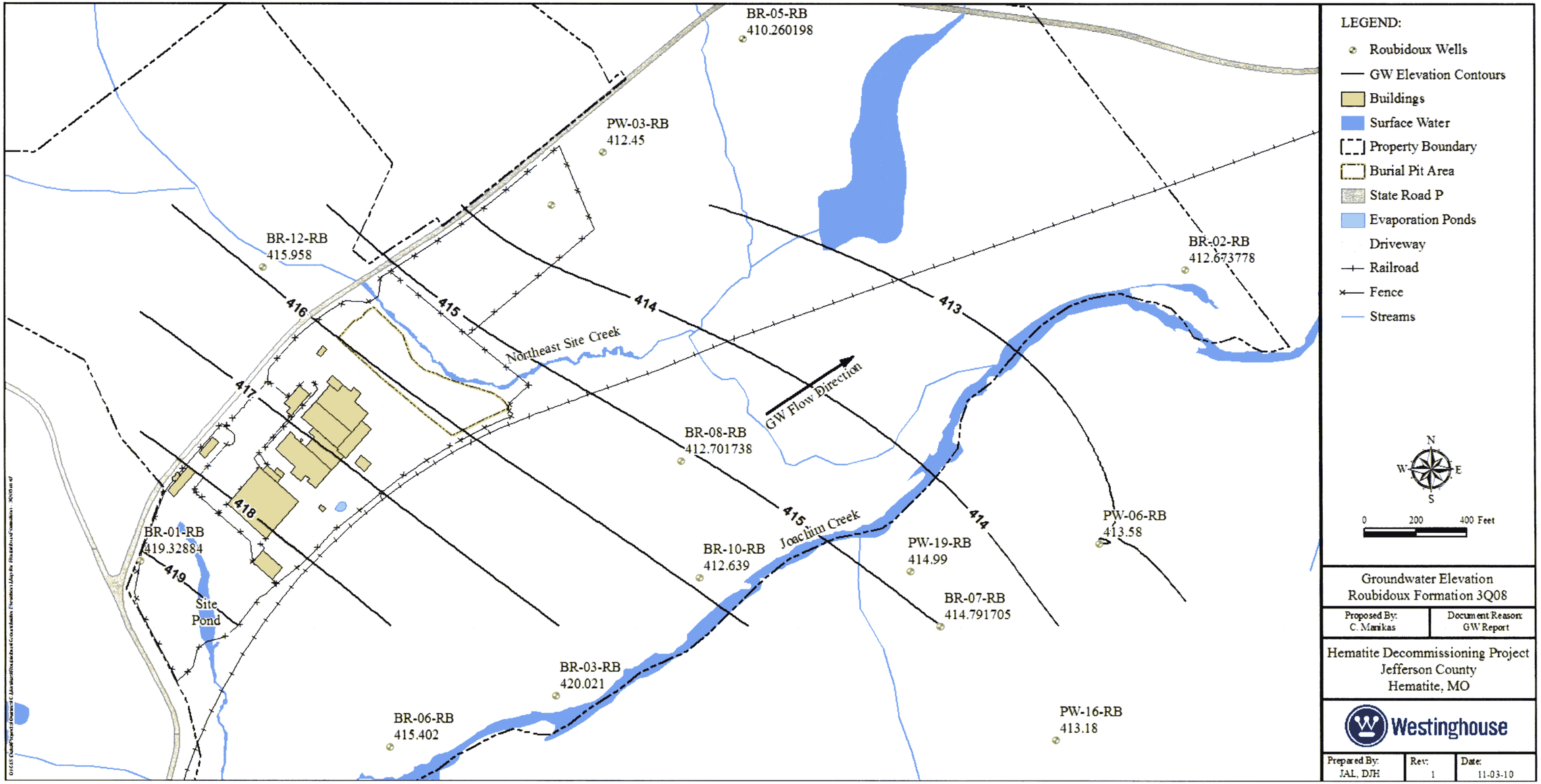


Figure 52

Groundwater Flow Map: Roubidoux Formation, December 2008

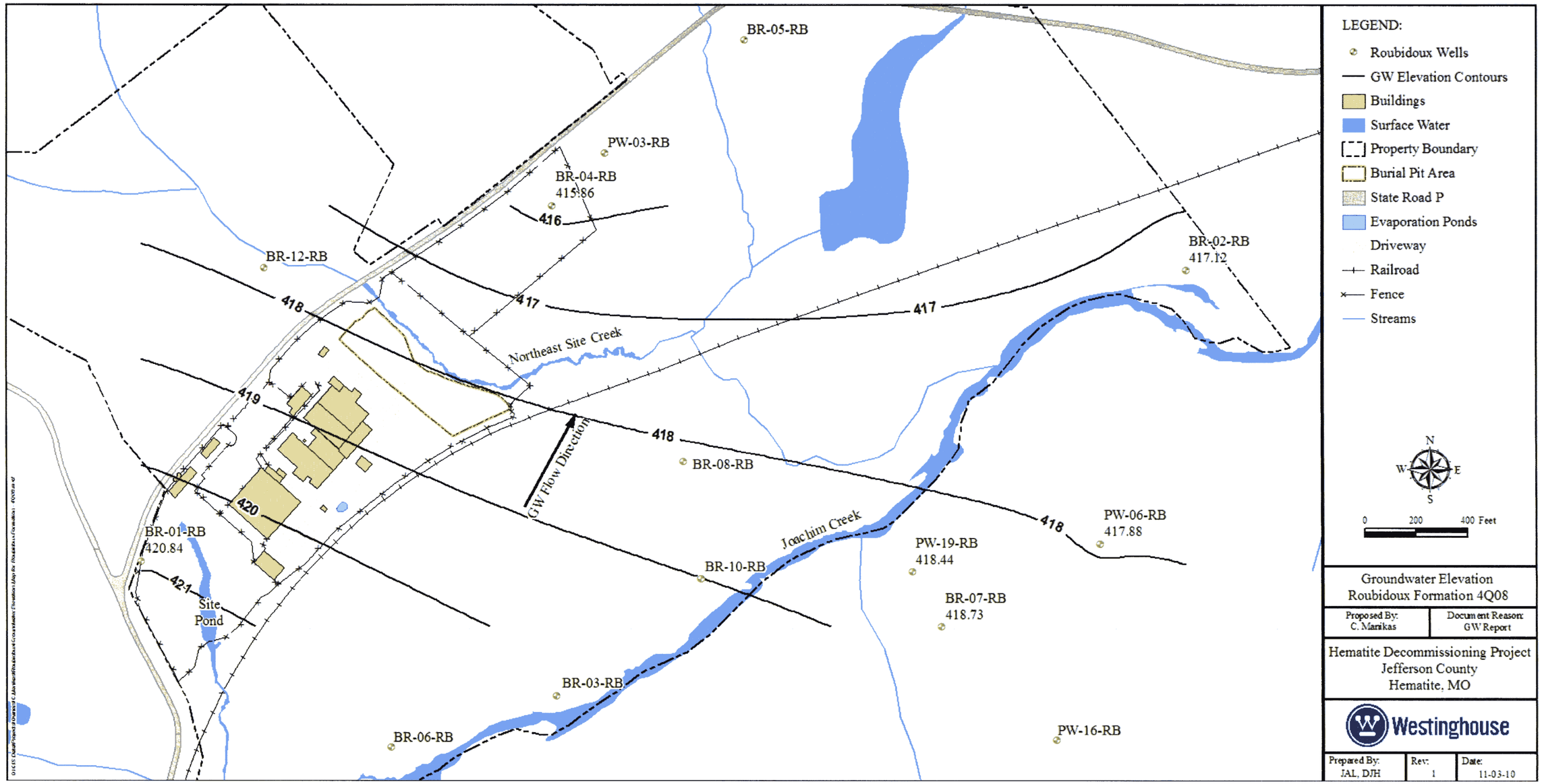


Figure 53

Groundwater Flow Map: Roubidoux Formation, March 2009

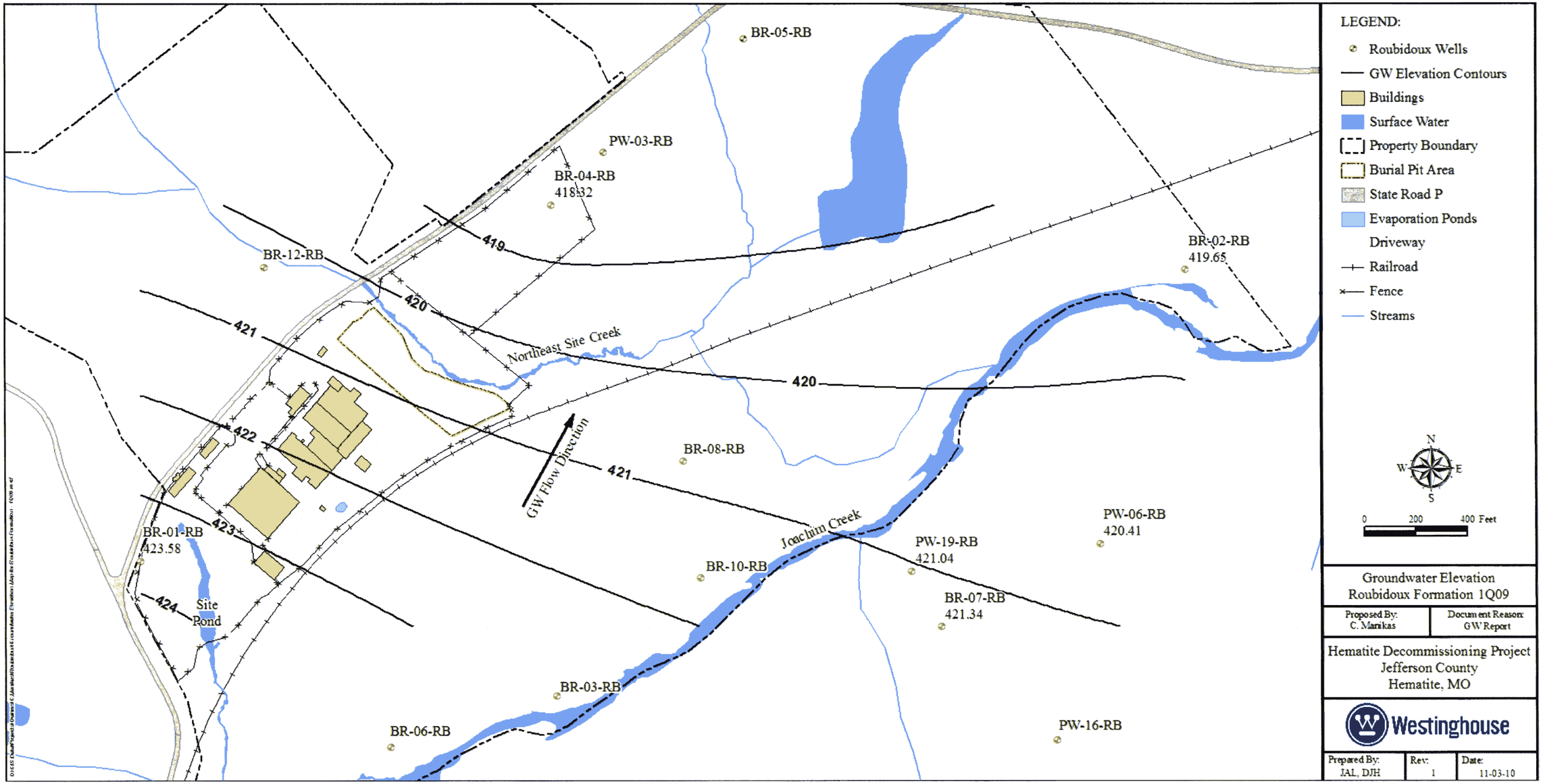


Figure 54

Groundwater Flow Map: Roubidoux Formation, June 2009

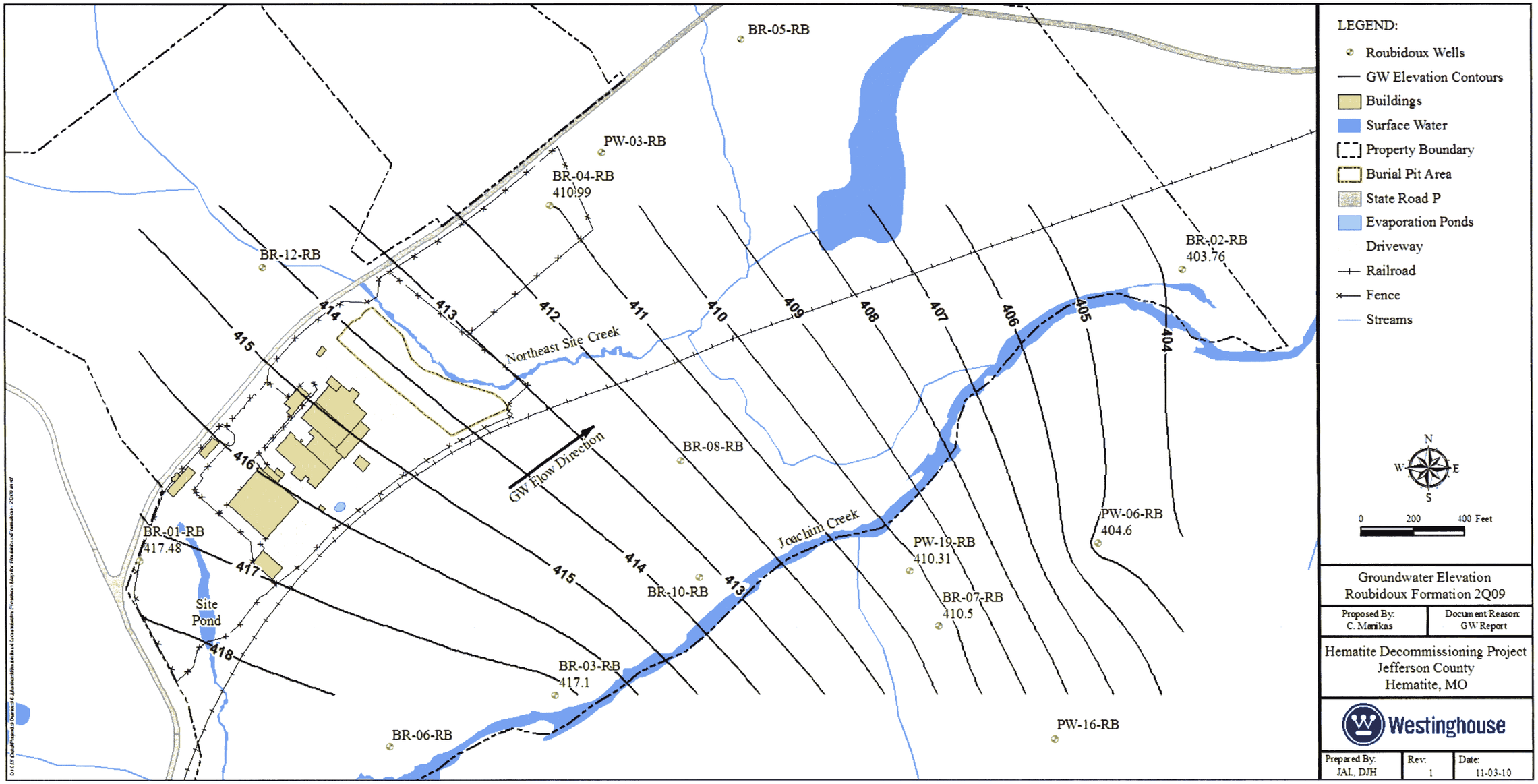


Figure 55

Groundwater Flow Map: Roubidoux Formation, September 2009

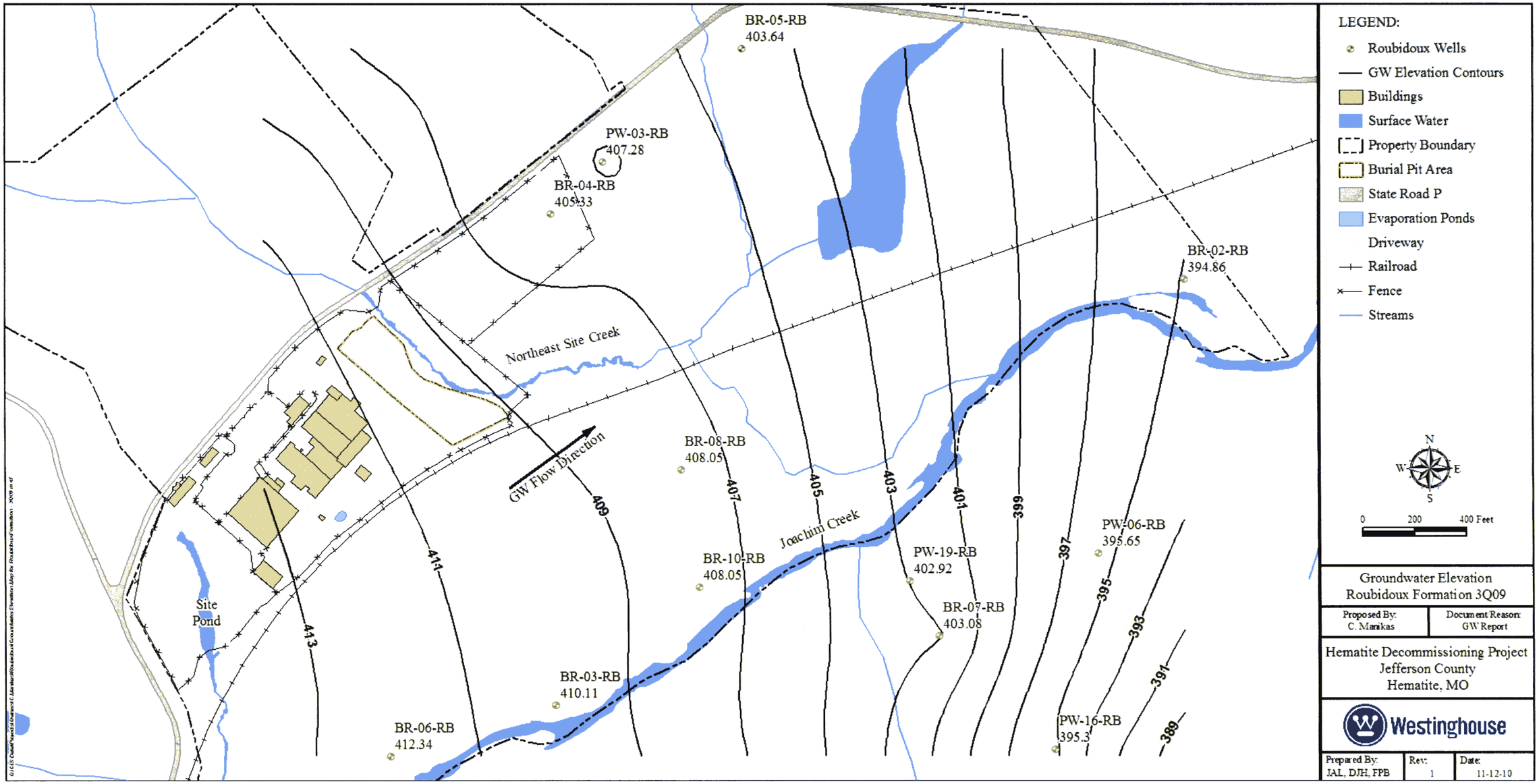


Figure 56

Groundwater Flow Map: Roubidoux Formation, December 2009

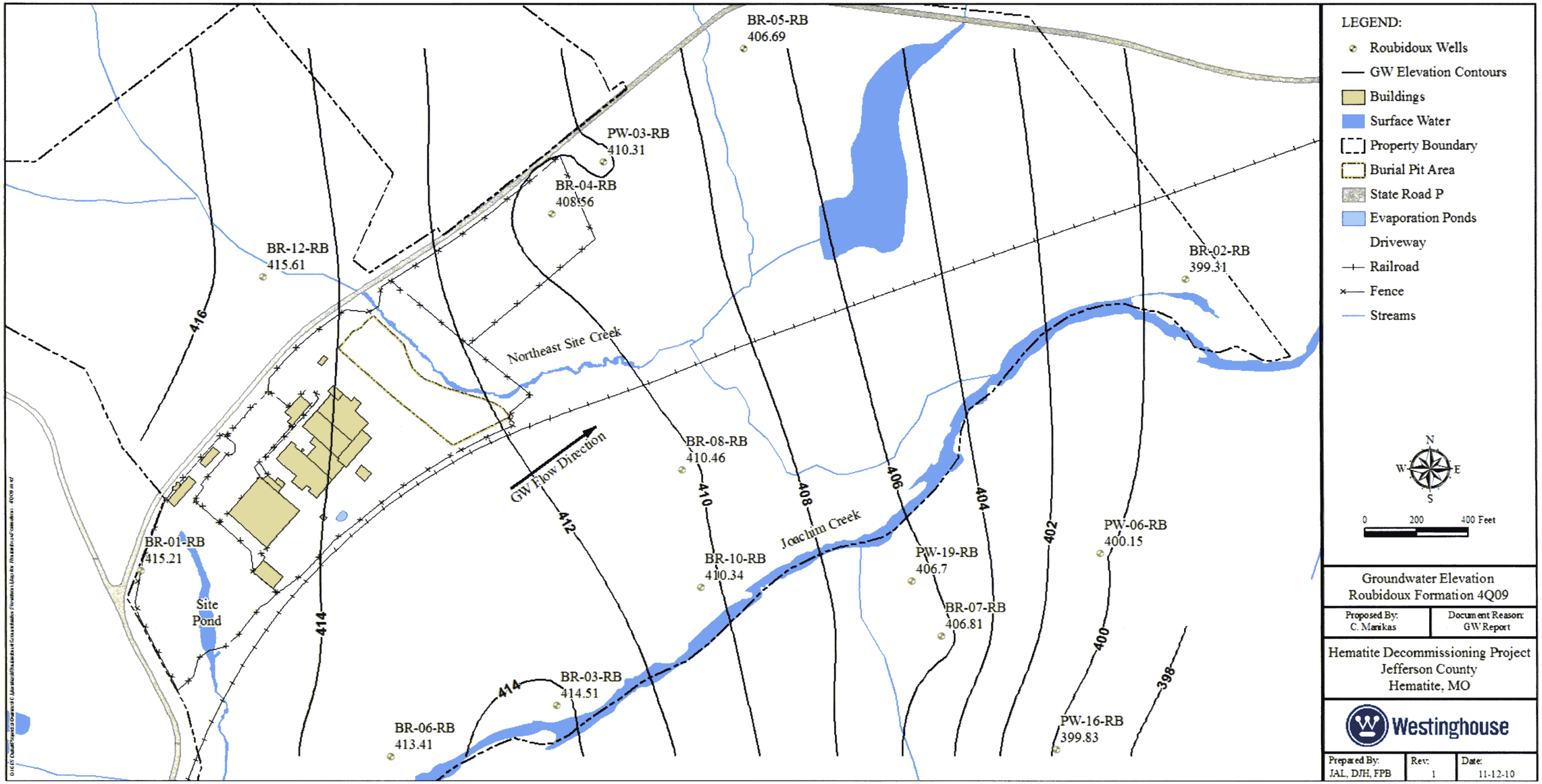


Figure 57

Groundwater Flow Map: Roubidoux Formation, March 2010

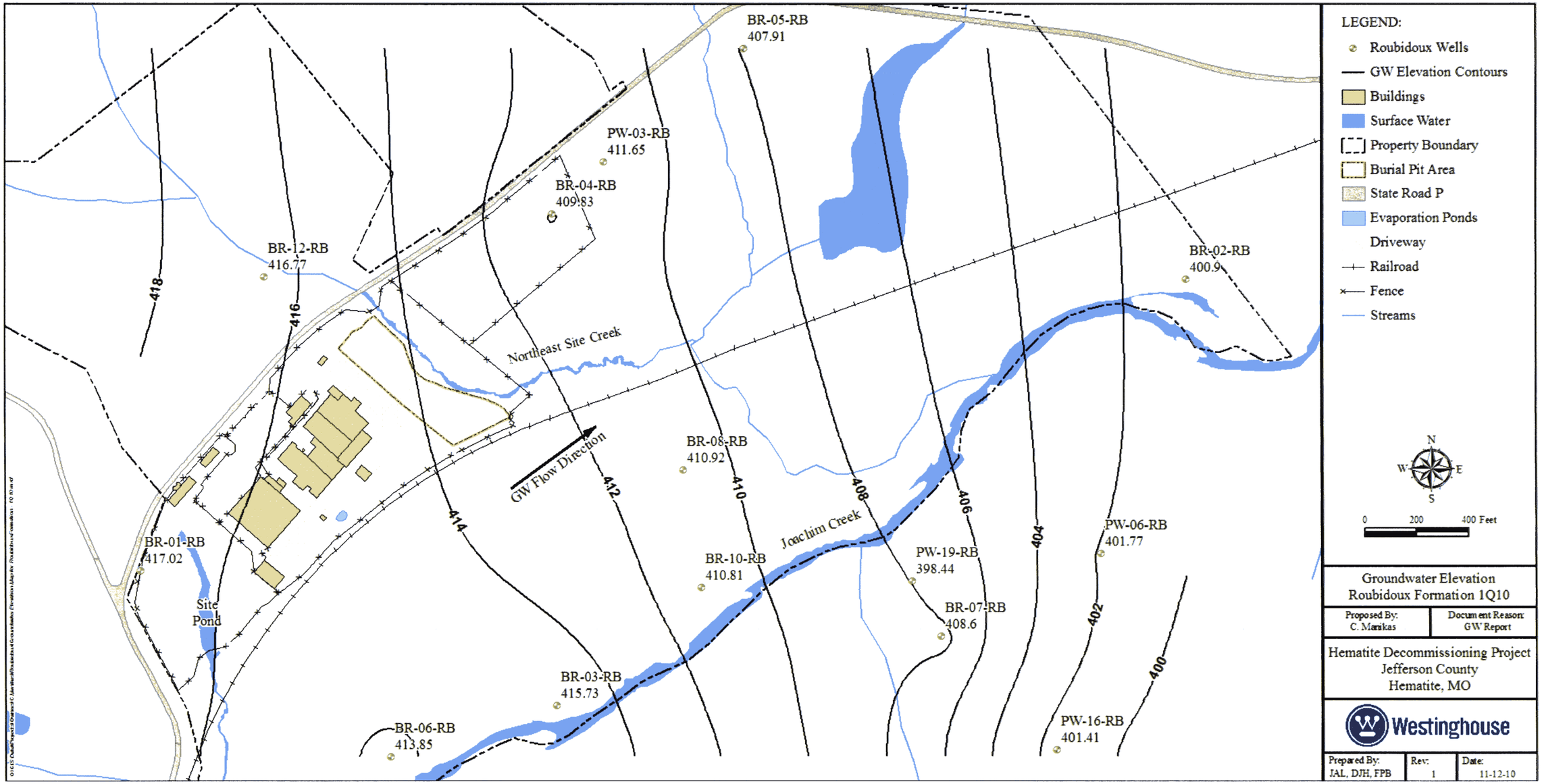


Figure 58

Groundwater Flow Map: Roubidoux Formation, June 2010

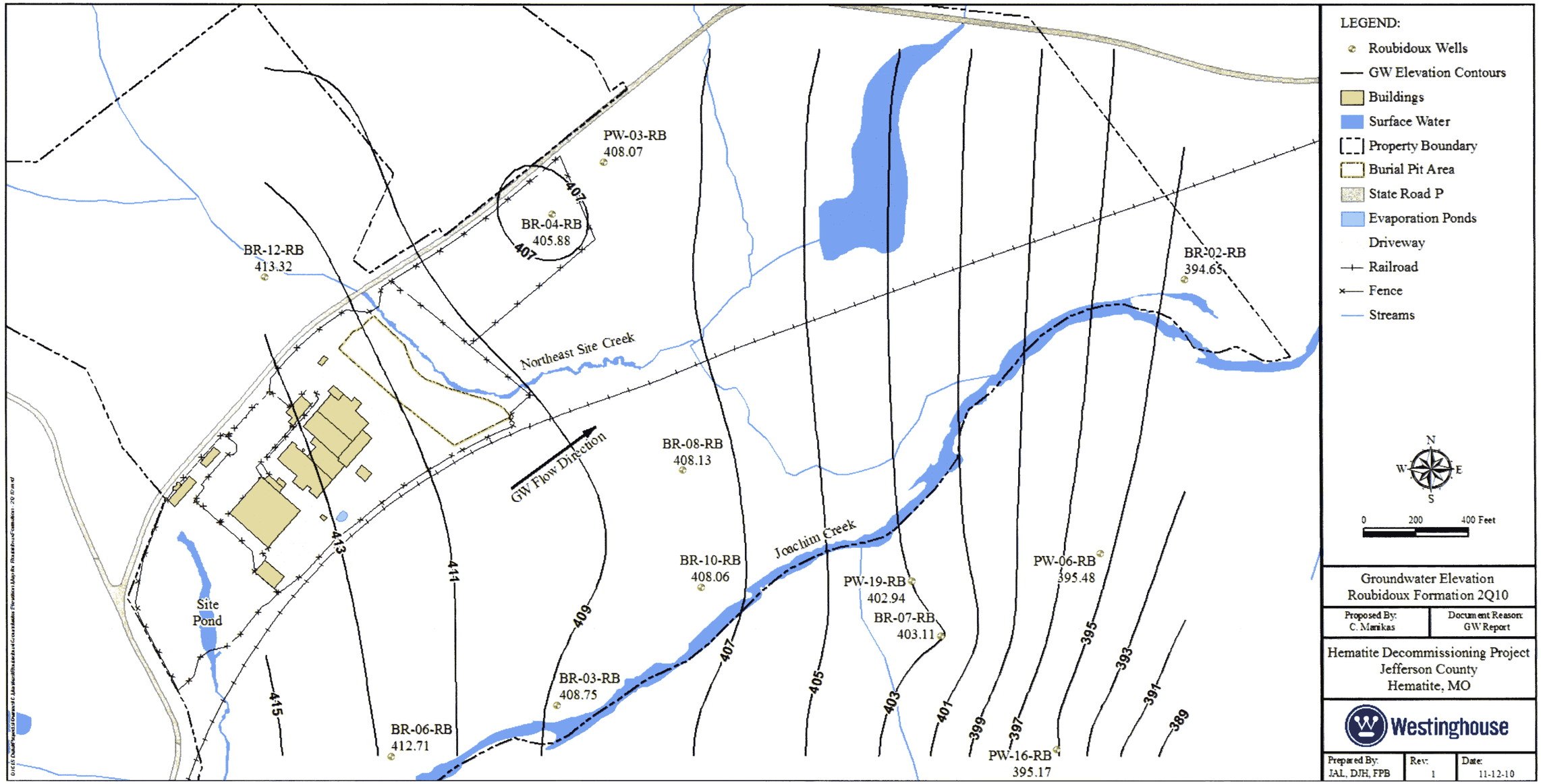
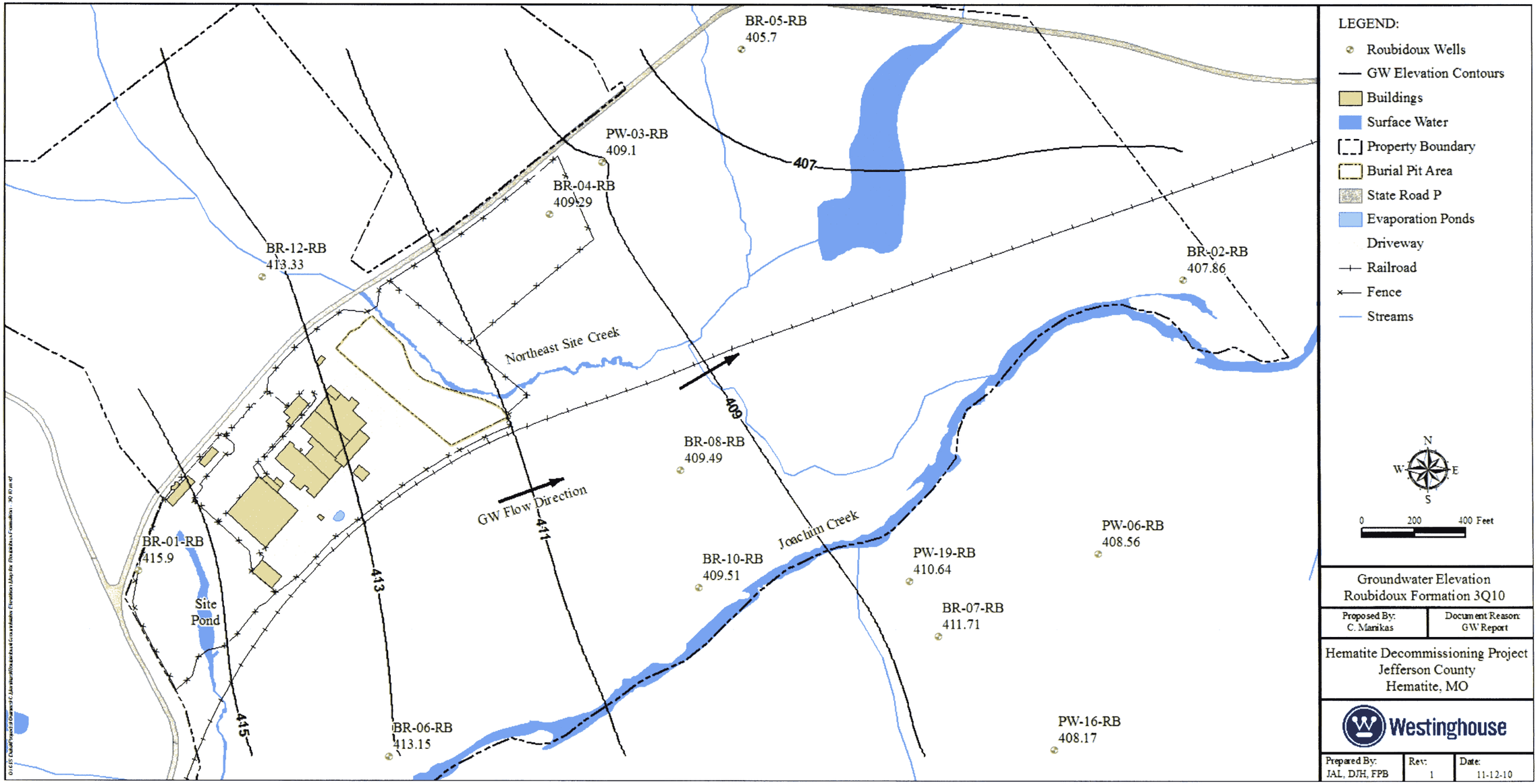


Figure 59

Groundwater Flow Map: Roubidoux Formation, September 2010



14. (HDP-4-Q14) Comment: The background statistical data for bedrock wells BR12RB and BR12JC are not provided in Table 4-1 of the Hematite Radiological Characterization Report.

    Basis: The background statistical data for bedrock wells BR12RB and BR12JC is necessary to establish a better understanding of the methodology used for the background statistical evaluation.

    Path Forward: Provide the background statistical data for bedrock wells BR12RB and BR12JC. Also provide a discussion that should include the statistical method used to determine background conditions, number of samples used in the analysis and a table to further summarize the results.

Westinghouse Response:

Summary

HRCR Table 4-1 contained the data for wells BR12RB and BR12JC, however the summary statistics were not reported independently for the two wells. Additionally, DP Section 4.5.2 discussed summary statistics for groundwater background data, however it did not discuss how the statistics would be used in establishing a background threshold value (BTV). The Hematite Radiological Characterization Report will be revised to: (1) Add Table 4-1a to provide the summary statistics for BR12RB and BR12JC sample data (as provided below); and (2) Revise the last paragraph of HRCR Section 4.1.1 to include a discussion of the statistical method used to determine groundwater BTV. Additionally, DP Section 4.5.2 will be revised to reflect the updated groundwater background statistics, BTV, and to include the new HRCR Table 4-1a.

Discussion and DP/HRCR Changes

HRCR Table 4-1a will include the data from HRCR Table 4-1 for wells BR12RB and BR12JC for gross alpha, gross beta, Tc-99, U-234, U-235, U-238, and total uranium radioactivity. Also, HCRC Table 4-1a provides summary statistics for that data. It should be noted that the statistical values shown in section 4.5.2 were calculated by substituting the MDC value for gross alpha [only] in place of the result when the result is less than the MDC. This is the reason for the difference in the mean and standard deviation values shown in the Table 4-1a and those shown in Section 4.5.2 of the DP. DP Section 4.5.2 will be revised to reflect the gross alpha data in HRCR Table 4-1a. HRCR Table 4-1a is included in this response, and follows the changes to the text in the HRCR and DP.

Subsequent to submittal of the DP, additional groundwater data has been collected from wells BR12RB and BR12JC. This more recent data and summary statistics for BR12RB and BR12JC are provided herein in Table 8 below. The range of data for this more recent dataset is within the range of the dataset in HRCR Table 4-1a.

The statistics used in establishing background levels are based on ProUCL, which is software developed by the EPA for sample statistics, including establishing background threshold values. This use of ProUCL is consistent with the methodology used in DP Section 4.3.5 and HRCR Appendix A for assessment of background data for soils. Groundwater BTV are only

developed for total uranium since this is a naturally occurring radionuclide of concern. All data used to determine the BTV are based on isotopic analysis since gross alpha and gross beta radioactivity are treated as semi-quantitative measures.

The last paragraph of HRCR Section 4.1.1 will be revised to background levels as follows:

"Ground water monitoring wells indicative of background are based on their location relative to the central tract of the Site (Reference 4-5). In the Jefferson City and Roubidoux formations, the flow is to the northeast/southeast and northeast, respectively. The BR-12 series monitoring wells were installed during the RI to assess up gradient ground water conditions.

Table 4-1 contains the background sample results from the BR12 series wells. The Uranium enrichment for this data appears to be slightly enriched; however, due to the low activity concentrations of U-235 as reported by alpha spectroscopy, the calculated enrichment in within the margin of error and indistinguishable from background. Selected analytes for the BR12 series wells are reproduced in Table 4-1a to provide summary statistics.

For the purpose of the statistical evaluation to determine the background threshold value, total uranium values (the sum of U-234, U-235, and U-238) were considered non-detect if either the U-234 or U-238 component was less than the associated MDC value. Due to the relatively low U-235 activity expected in the samples, the U-235 activity was not used to flag total uranium values as non-detect for this evaluation. For instances where the U-235 result was less than the MDC and a positive integer, the reported value was used. Results for U-235 that were less than or equal to zero were not used in the calculation.

EPA software package ProUCL (Version 4.00.005) was used to perform the statistical analysis for the background threshold value. ProUCL identified one total uranium value as an outlier (13.7 pCi/L for sample GW-BR12RB-120804), so this sample was not used in the background threshold value calculation. The ProUCL output identified the refined data met the Shapiro-Wilk test for a lognormal distribution at a 5 percent significance level. The lognormal result for the 95 percent upper tolerance limit (UTL) with 90 percent coverage was 8.6 pCi/L. Accordingly, 8.6 pCi/L is the background threshold value."

DP Section 4.5.2 will be revised as follows:

"While no groundwater monitoring wells were specifically constructed for the purpose of obtaining samples that are representative of the background radioactivity concentration, bedrock wells BR12JC and BR12RB were installed to assess groundwater conditions up gradient of the impacted areas. Therefore, the data obtained at these locations are considered to be representative of the background concentration. The summary statistics of the data obtained from these wells, including the results that were less than the MDC, are reported in HRCR Table 4-1a.

In addition, HRCR Section 4.1.1 contains an evaluation of the data to determine groundwater background threshold value for total uranium. The resulting groundwater background threshold value is 8.6 pCi/L for total uranium. The background threshold value will be used to identify samples that require additional evaluation."

HRCR Table 4-1a

Groundwater Background Statistical Data

Sample ID	Gross Alpha (pCi/L)			Gross Beta (pCi/L)			Tc-99 (pCi/L)			U-234 (pCi/L)			U-235 (pCi/L)			U-238 (pCi/L)			Total Uranium (pCi/L)	
	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	With Outlier	Without Outlier
Ground Water – Background – BR12JC and BR12RB – Statistical Data Analyses																				
No. of Detects	12			18			0			11			4			11			4	3
No. of Non-Detects	6			0			11			0			7			0			7	7
Detection Freq.	66.7%			100.0%			0.0%			100.0%			36.4%			100.0%			36.4%	30%
Max Conc.	13.1			10.9			4.6			12.4			0.10			1.2			13.7	5.7
Min Conc.	1.6			2.5			-8.2			0.61			-0.01			0.19			0.98	0.98
Mean Conc.	6.2			6.8			-1.06			3.60			0.04			0.48			4.1	3.1
Std. Deviation	3.0			2.2			3.89			3.09			0.04			0.36			3.4	1.2
Ground Water – Background – BR12JC – Analytical Data Results																				
GW-BR12JC-120804	10.4	2.4	1.5	9.7	2.3	2.8	**4.6**	4.6	7.5	4.5	0.79	0.02	0.07	0.05	0.02	1.2	0.27	0.02	5.7	5.7
GW-BR12JC-062707	3.5	2.6	1.8	7.6	2.7	3.4	**-1.9**	3.9	6.5	2.6	0.44	0.12	**0.02**	0.06	0.07	0.39	0.16	0.10	**3.0**	**3.0**
GW-BR12JC-091907	7.2	5.6	6.3	7.1	3.0	4.0	**2.5**	3.4	5.5	3.1	0.39	0.09	**0.01**	0.02	0.03	0.36	0.13	0.09	**3.4**	**3.4**
GW-BR12JC-120307	**3.3**	3.9	5.1	7.2	2.9	3.8	**-5.8**	3.5	5.9	2.6	0.80	0.30	**0.00**	0.00	0.09	0.39	0.30	0.23	**3.0**	**3.0**
GW-BR12JC-030308	6.1	4.5	5.0	5.4	3.0	4.3	**-1.9**	3.0	5.0	0.61	0.19	0.08	**0.02**	0.03	0.02	0.35	0.14	0.06	**0.98**	**0.98**
GW-BR12JC-062508	**5.4**	5.2	6.2	10.9	3.2	3.8	**-4.8**	3.6	6.0	2.7	0.40	0.05	0.07	0.07	0.04	0.29	0.12	0.05	3.0	3.0
GW-BR12JC-091508	6.1	1.4	1.3	7.4	1.4	1.7	**1.3**	2.2	3.5	2.6	0.37	0.06	**0.01**	0.02	0.03	0.24	0.09	0.05	**2.9**	**2.9**
GW-BR12JC-120808	7.4	2.6	2.2	4.9	1.2	1.4	**0.28**	0.84	1.4	2.4	0.44	0.09	**0.04**	0.05	0.05	0.33	0.15	0.04	**2.8**	**2.8**
GW-BR12JC-032409	7.3	2.5	2.1	4.0	1.5	1.9	**1.5**	7.3	13.0	2.0	0.40	0.14	0.10	0.09	0.09	0.19	0.12	0.09	2.3	2.3
Ground Water – Background – BR12RB – Analytical Data Results																				
GW-BR12RB-120804	13.1	2.8	1.4	10.2	2.3	2.5	**0.81**	4.1	7.0	12.4	2.0	0.04	0.06	0.04	0.02	1.2	0.26	0.05	13.7	–
GW-BR12RB-062707	3.6	2.7	1.9	6.1	2.6	3.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-091907	**4.3**	5.1	6.5	8.3	3.1	4.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-120307	**1.6**	3.4	5.0	8.6	3.0	3.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-030308	**2.7**	3.8	5.1	5.2	3.0	4.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-062508	**4.6**	4.9	6.0	6.8	2.9	3.8	**-8.2**	3.6	6.1	4.1	0.55	0.07	**-0.01**	0.01	0.05	0.35	0.15	0.08	**4.4**	**4.4**
GW-BR12RB-091508	6.6	1.3	1.0	5.9	1.0	1.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-120808	10.6	2.8	2.0	4.6	1.0	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-032409	8.3	2.5	2.8	2.5	1.5	2.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 8

Groundwater Data and Statistics from the 2nd Quarter 2009 to 3rd Quarter 2010

Sample ID	Gross Alpha (pCi/L)			Gross Beta (pCi/L)			Tc-99 (pCi/L)			U-234 (pCi/L)			U-235 (pCi/L)			U-238 (pCi/L)			Total Uranium (pCi/L)
	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	Conc.	±2σ	MDC	
Ground Water – Background – BR12JC and BR12RB – Statistical Data Analyses																			
No. of Detects	9			10			0			7			0			0			0
No. of Non-Detects	1			0			7			0			7			7			7
Detection Freq.	10.0%			0.0%			100.0%			0.0%			100.0%			100.0%			100.0%
Max Conc.	7.60			10.20			0.61			3.29			0.05			0.26			3.49
Min Conc.	2.80			2.70			-0.90			2.19			-0.01			0.14			2.33
Mean Conc.	5.72			4.99			-0.09			2.63			0.00			0.21			2.85
Std. Deviation	1.44			2.24			0.50			0.37			0.02			0.04			0.38
Ground Water – Background – BR12JC – Analytical Data Results																			
GW-BR12JC-07069	5.90	3.20	4.10	3.20	2.00	2.90	**-0.60**	1.30	2.30	2.58	0.49	0.17	**-0.01**	0.05	0.17	**0.20**	0.14	0.17	**2.78**
GW-BR12JC-100109	5.80	2.40	2.70	3.90	1.00	1.20	**0.02**	1.10	1.90	2.21	0.43	0.18	**-0.01**	0.05	0.14	**0.26**	0.14	0.10	**2.47**
GW-BR12JC-121009	7.20	2.50	2.30	5.40	1.50	1.70	**0.10**	1.10	1.90	2.73	0.40	0.08	**-0.01**	0.01	0.07	**0.26**	0.10	0.06	**2.99**
GW-BR12JC-032210	**2.80**	2.20	3.00	5.00	1.30	1.40	**-0.90**	1.10	2.00	2.72	0.39	0.07	**0.02**	0.03	0.06	**0.23**	0.10	0.05	**2.97**
GW-BR12JC-062210	5.60	2.90	3.60	10.20	3.00	4.00	**0.14**	0.97	1.60	2.69	0.40	0.08	**0.05**	0.05	0.07	**0.18**	0.09	0.06	**2.92**
GW-BR12JC-092010	–	–	–	–	–	–	**0.02**	0.87	1.50	2.19	0.44	0.10	**-0.01**	0.01	0.10	**0.14**	0.10	0.05	**2.33**
Ground Water – Background – BR12RB – Analytical Data Results																			
GW-BR12RB-07069	6.30	2.80	2.90	2.70	1.60	2.30	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-100109	4.60	2.00	2.10	3.51	0.97	1.10	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-121009	7.60	2.60	2.30	6.20	1.60	1.90	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-032210	6.90	2.80	2.90	3.40	1.20	1.50	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-062210	4.50	2.60	3.40	6.40	2.60	3.80	–	–	–	–	–	–	–	–	–	–	–	–	–
GW-BR12RB-092010	–	–	–	–	–	–	**0.61**	0.93	1.50	3.29	0.57	0.10	**0.00**	0.02	0.06	**0.20**	0.12	0.08	**3.49**

15. (HDP-4-Q15) Comment: Table 4-28 shows that the maximum concentrations of gross alpha and gross beta exceed background levels established for the bedrock aquifers and EPA drinking water standards.

    Basis: Gross alpha and gross beta measurements provide indications whether drinking water aquifers were impacted due to activities performed by the licensee.

    Path Forward: Evaluate the nature and extent of gross alpha and gross beta in the bedrock aquifers at the Hematite site and any relationship to total uranium concentrations in these aquifers.

Westinghouse Response:

Summary

Based on data from bedrock wells, the nature and extent of gross alpha and gross beta radioactivity in the Jefferson City aquifer and the Roubidoux aquifer is evaluated herein through Tables 9 and 10, Figures 60 through 63, and the following discussion. The tables show mean values of total uranium, Tc-99, gross alpha radioactivity, and gross beta radioactivity for each well through the third quarter of 2010. The full data set and figures showing bedrock well locations are provided with the response to RAI HDP-4-Q9.

The gross alpha and gross beta radioactivity results for the bedrock wells suggest that the radioactivity is naturally occurring. Though outliers exist in the 438 data points, the outliers are not supported by associated data (e.g., a reported elevated gross radioactivity data, but the absence of the radionuclide of concern based on isotopic data). These outliers are considered anomalous, and individually discussed below. In addition, a concise and consistent correlation has not been observed between the gross alpha or gross beta radioactivity results and the total uranium results.

Discussion

Initially, the evaluation of the sample results from bedrock wells were reviewed for outliers. As discussed in the response to HDP-4-Q14, the Background Threshold Value (BTV) for total uranium is defined by 8.6 pCi/L, and therefore this value was used to identify outliers for total uranium. For Tc-99, gross alpha, and gross beta radioactivity, the outliers were identified by a review of associated analytical data of the same sample and by engineering judgment.

Of the 438 bedrock aquifer samples taken from 2004 through the third quarter of 2010, the following number of outliers were identified, which is about 2.3% of the total number of samples. These outliers are individually addressed later in this response:

- 1 outlier for total uranium
- 1 outlier for Tc-99
- 3 outliers for gross alpha radioactivity
- 5 outliers for gross beta radioactivity

The bedrock dataset was refined by removing the outlier results after conducting an evaluation of the data. One part of this evaluation consisted of a comparison of mean values for gross alpha and gross beta radioactivity to the mean values of total uranium and Tc-99 for the same wells. Table 9 (Jefferson City) and Table 10 (Roubidoux) herein make this comparison. Where there are elevated gross alpha and gross beta means, the corresponding isotopic results for radionuclides of concern were not elevated. This would indicate that elevated gross alpha and gross beta results are due to naturally occurring alpha and beta emitters, and that drinking water aquifers have not been impacted by activities performed at the Hematite Site.

Another part of this evaluation was evaluating the data for correlation between the total uranium results to both gross alpha and gross beta radioactivity results. The Pearson's Correlation Coefficient was calculated for both datasets and it failed to identify a strong correlation between the two variables. A Pearson's Correlation Coefficient of 1 indicates full correlation and 0 indicates no correlation. While there was no strong correlation, the accompanying p-Values indicate that, at an α less than the p-Value, the null hypothesis (that there is no relationship at all) cannot be rejected.

Correlation of Total Uranium with Gross Alpha/Beta

Compared Datasets	Pearson's Correlation Coefficient	p-Value
Gross Alpha vs. Total Uranium	0.274	0.158
Gross Beta vs. Total Uranium	0.227	0.204

Table 9

Jefferson City Bedrock Aquifer Wells Refined Dataset Summary

Well	Means				3rd Quarter 2010 Data		
	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tc-99[a] (pCi/L)	Total U (pCi/L)	Sample ID	Tc-99 (pCi/L)	Total U (pCi/L)
BR-01-JC	9.89	8.72	**0.15**	3.16	GW-BR01JC-092110	**-0.21**	2.29
BR-02-JC	8.67	10.20	**1.39**	1.82	GW-BR02JC-092110	**0.39**	2.19
BR-03-JC	4.41	6.12	**-0.55**	2.81	GW-BR03JC-092310	**0.78**	2.31
BR-04-JC	9.78	9.28	**-1.19**	3.88	GW-BR04JC-092010	**1.23**	3.11
					WS-53/BR-04-JC	**0.39**	3.20
BR-05-JC	6.58**	9.10**	**6.93****	2.43**	N/A		
BR-07-JC	7.01	6.37	**-1.37**	4.76	GW-BR07JC-092310	**-0.51**	4.12
BR-08-JC	4.93	9.26	0.80*	0.73	GW-BR08JC-092210	**-0.10**	0.49
BR-09-JC	5.04	7.55	**0.51**	3.10	GW-BR09JC-092710	**0.90**	2.67
BR-10-JC	6.43	8.09	**-0.12**	3.03	GW-BR10JC-092210	**0.60**	2.62
BR-11-JC	4.73	8.02	**0.10**	1.99	GW-BR11JC-092110	**0.51**	1.94
BR-12-JC	6.00	6.56	**-0.36**	2.90	GW-BR12JC-092010	**0.02**	2.33
PW-03-JC	4.64	13.40	**0.22**	0.96	GW-PW03JC-092010	**0.22**	0.96
PW-06-JC	8.99	7.19	**0.40**	2.80	GW-PW06JC-092710	**0.40**	2.80
PW-16-JC	11.50	12.90	**0.26**	1.58	GW-PW16JC-092710	**0.26**	1.58
PW-19-JC	9.53	7.29	**1.10**	5.29	GW-PW19JC-092310	**1.10**	5.29
PZ-03-JC	4.71	7.35	2.94*	0.26	N/A		
PZ-04-JC	1.66	1.78	**-0.56**	0.31	N/A		
WS-30-JC	9.81	37.14	**9.25**	7.91	N/A		
WS-31-JC	6.92	8.16	0.51*	1.31	GW-WS31-092810	**1.36**	0.98

[a] For Tc-99 entries, bolded entries are less than MDC.
* These samples are specifically discussed in the text of this RAI response.
** Single data point.

Table 10

Roubidoux Bedrock Aquifer Wells Refined Dataset Summary

Well	Means				3rd Quarter 2010 Data		
	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tc-99[a] (pCi/L)	Total U (pCi/L)	Sample ID	Tc-99 (pCi/L)	Total U (pCi/L)
BR01RB	4.91	1.89	**2.27**	4.81	GW-BR01RB-092110	**0.12**	4.35
BR02RB	3.83	2.35	**1.88**	3.72	GW-BR02RB-092110	**0.66**	3.00
BR03RB	6.53	3.86	**0.50**	2.27	GW-BR03RB-092310	**0.70**	2.23
BR04RB	6.57	4.23	**3.11**	3.01	GW-BR04RB-092010	**-0.21**	2.51
BR05RB	5.10	4.73	**2.95**	5.66	GW-BR05RB-092810	**1.02**	4.83
BR06RB	8.54	4.35	**-1.02**	7.91	GW-BR06RB-092710	**0.12**	7.25
BR07RB	19.00*	10.80*	**3.73***	5.65*	N/A		
BR08RB	8.79	4.57	**0.32**	5.38	GW-BR08RB-092210	**0.90**	4.70
BR10RB	9.65	5.29	**1.22**	4.25	GW-BR10RB-092210	**0.26**	3.62
BR12RB	6.09	5.74	**-2.25**	3.95	GW-BR12RB-092010	**0.61**	3.49
PW03RB	6.21	9.36	**0.59**	2.85	GW-PW03RB-092010	**0.59**	2.85
PW06RB	5.49	2.21	**0.49**	4.08	GW-PW06RB-092710	**0.49**	4.08
PW16RB	6.48	2.42	**0.37**	6.09	GW-PW16RB-092410	**0.37**	6.09
PW19RB	10.56	6.43	**0.40**	5.10	GW-PW19RB-092310	**0.40**	5.10

[a] For Tc-99 entries, bolded entries are less than MDC.
*Single data point.

The outlier results are individually addressed below. A potential explanation for the three June 2007 high outlier values is that the wells had not been sampled during the previous three years. If the wells were not adequately purged at the time of sampling in 2007, samples containing settled sediment may have been collected.

- 1 outlier for total uranium
  - *BR-12-RB:* ProUCL identified one total uranium value as an outlier (13.7 pCi/L for sample GW-BR12RB-120804), so this sample was not used in the background threshold value calculation.
- 1 outlier for Tc-99
  - *BR-01-JC:* A sample taken on 06/28/2007 had a Tc-99 result of 48.9 pCi/L. All of the 14 other Tc-99 results for this well were less than MDC.
- 3 outliers for gross alpha radioactivity
  - *BR-01-JC:* A sample taken on 12/04/2007 had a gross alpha radioactivity result of 24.2 pCi/L. The total uranium result for this same sample was 5.6 pCi/L (less than BTV).
  - *BR-04-JC:* A sample taken on 06/27/2007 had a gross alpha radioactivity result of 277 pCi/L. The total uranium result for this same sample was 5.8 pCi/L (less than MDC).
  - PW-16-JC: A sample taken on 03/26/2009 had a gross alpha radioactivity result of 83.0 pCi/L. All of the 12 other gross alpha radioactivity results for this well were less than 19 pCi/L. The sole total uranium result for this well, which is from the third quarter of 2010, was 1.6 pCi/L (with two of the three uranium isotopes less than MDC).
- 5 outliers for gross beta radioactivity
  - *BR-01-JC:* A sample taken on 06/28/2007 had a gross beta result of 51.7 pCi/L. As noted below, one other sample from this well showed elevated gross beta radioactivity. Both of these samples were taken in 2007. All 10 of the samples subsequently taken from this well have been less than 16 pCi/L for gross beta radioactivity. The total uranium result for this sample was 3.4 pCi/L (less than BTV).
  - *BR-01-JC:* A sample taken on 12/04/2007 had a gross beta radioactivity result of 57.7 pCi/L. The Tc-99 result for this same sample was -0.38 pCi/L (non-detect). The total uranium result for this sample was 5.6 pCi/L (less than BTV).
  - *BR-04-JC:* A sample taken on 06/27/2007 had a gross beta radioactivity result of 224 pCi/L. The Tc-99 result for this same sample was -2.3 pCi/L (non-detect). The total uranium result for this sample was 5.8 pCi/L (less than BTV).
  - *PW-03-RB:* A sample taken on 03/06/2008 had a gross beta radioactivity result of 48.7 pCi/l. All 9 of the samples subsequently taken from this well have been less than 24 pCi/L for gross beta radioactivity. In addition, the sole Tc-99 sample

result for this well, which is from the third quarter of 2010, was 0.59 pCi/L (less than MDC). The gross alpha radioactivity of 11.1 pCi/L for this sample was not elevated.

- PW-16-JC: A sample taken on 03/26/2009 had a gross beta radioactivity result of 33.6 pCi/L. All 5 of the samples subsequently taken from this well have been less than 12 pCi/L for gross beta radioactivity. In addition, the sole Tc-99 sample result for this well, which is from the third quarter of 2010, was 0.26 pCi/L (less than MDC). The preceding discussion explains that the gross alpha radioactivity for this sample was an outlier.

In addition to the Tc-99 outlier described above, the following positive results for Tc-99 are also explained:

- *BR-08-JC*: Four samples had Tc-99 results slightly above the MDC. The dates, result, and MDC are shown below. The 8 results preceding the first of these outliers, 2 result in-between these results and a subsequent result were all less than MDC. This data was evaluated in SAIC Report, "Radionuclide Activity in Bedrock Groundwater at Westinghouse Hematite Facility, Hematite, Missouri," Revision 0, July 2009 (submitted to NRC via HEM 09-133, November 10, 2009). This evaluation concluded that the data is oscillatory around zero activity and are not indicative of bedrock groundwater contamination.

BR-08-JC Tc-99 Results

Date of Sample	Tc99 Result	MDC
03/11/2009	2.0	1.2
07/01/2009	1.96	1.5
03/23/2010	2	1.7
06/24/2010	1.7	1.6

- *PZ-03*: Three samples had Tc-99 results slightly above the MDC. The dates, result, and MDC are shown below. The 7 results preceding these outliers were all less than MDC. This data was evaluated in SAIC Report, "Radionuclide Activity in Bedrock Groundwater at Westinghouse Hematite Facility, Hematite, Missouri," Revision 0, July 2009. This evaluation concluded that because well PZ-03 is located in an area of elevated Tc-99 activity in the overburden groundwater, the potential exists for vertical leakage from the overburden or along the well bore to the bedrock. However, the time series plot does not reflect an overall increasing trend in Tc-99 activity at PZ-03 and the observed activity is approximately three orders of magnitude less than the activity observed in the overburden. This well was an interference to the rail spur and was abandoned in 2009.

PZ-03 Tc-99 Results

Date of Sample	Tc-99 Result	MDC
12/08/2008	3.7	1.2
03/19/2009	2.5	1.5
07/06/2009	2.8	2.3

- *WS-31*: A sample taken on 03/29/2010 had Tc-99 results of 1.7 pCi/L, which was slightly above the MDC of 1.6 pCi/L. All other 14 Tc-99 results for this well were less than MDC.

Figure 60

Jefferson City Bedrock Aquifer Mean Total Uranium - 2004 to 3rd Quarter 2010

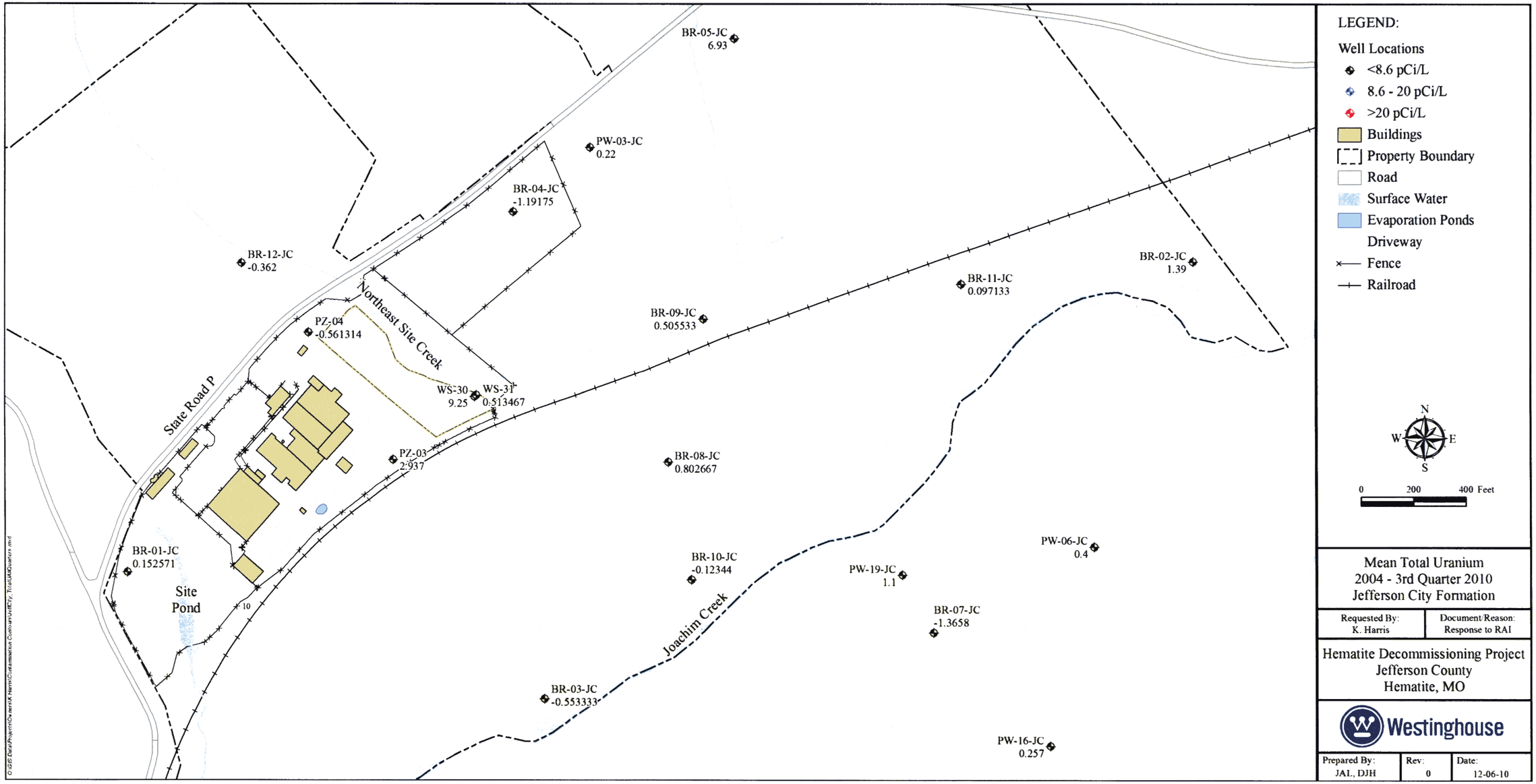


Figure 61

Jefferson City Bedrock Aquifer Tc-99 - 2004 to 3rd Quarter 2010

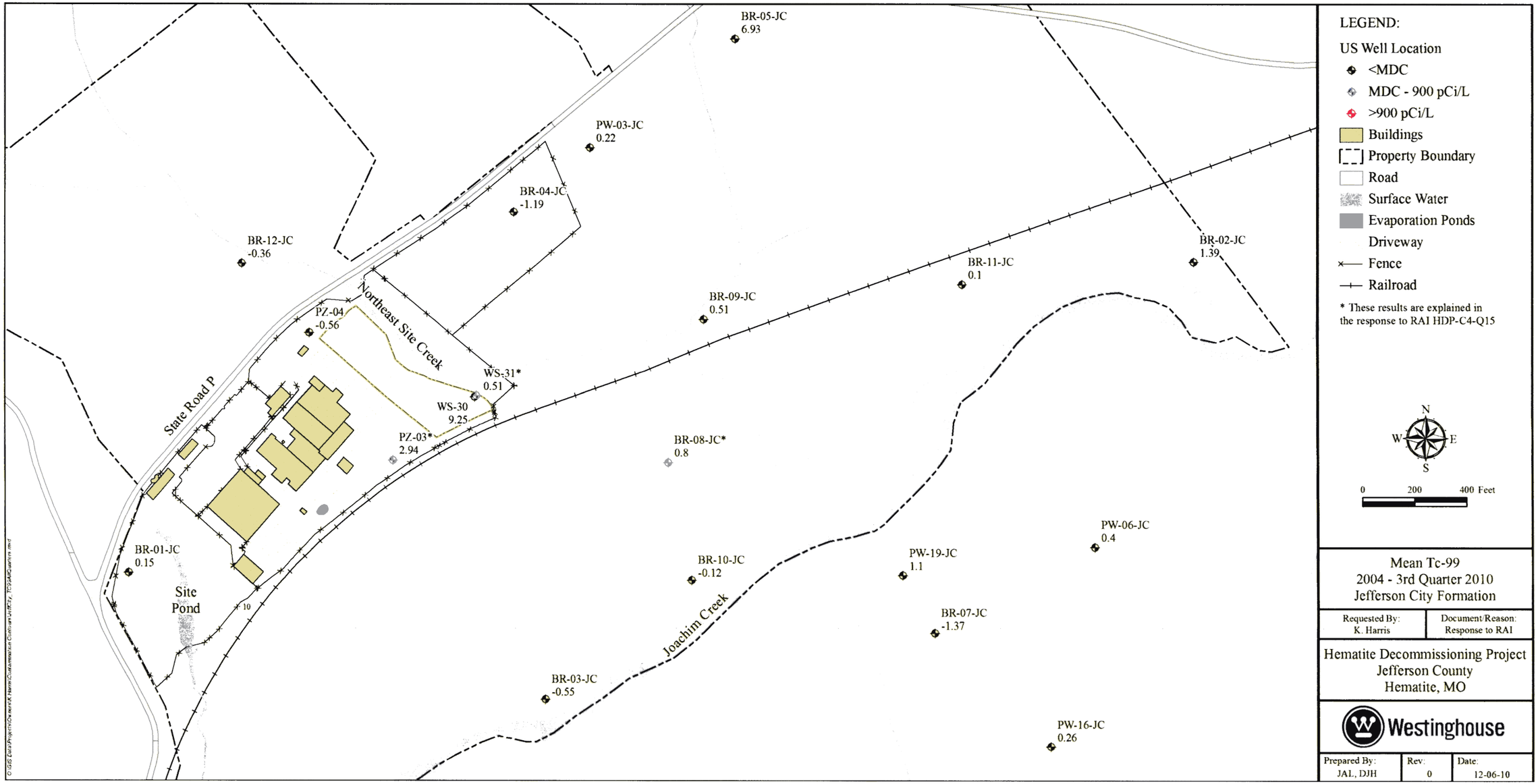


Figure 62

Roubidoux Bedrock Aquifer Mean Total Uranium - 2004 to 3rd Quarter 2010

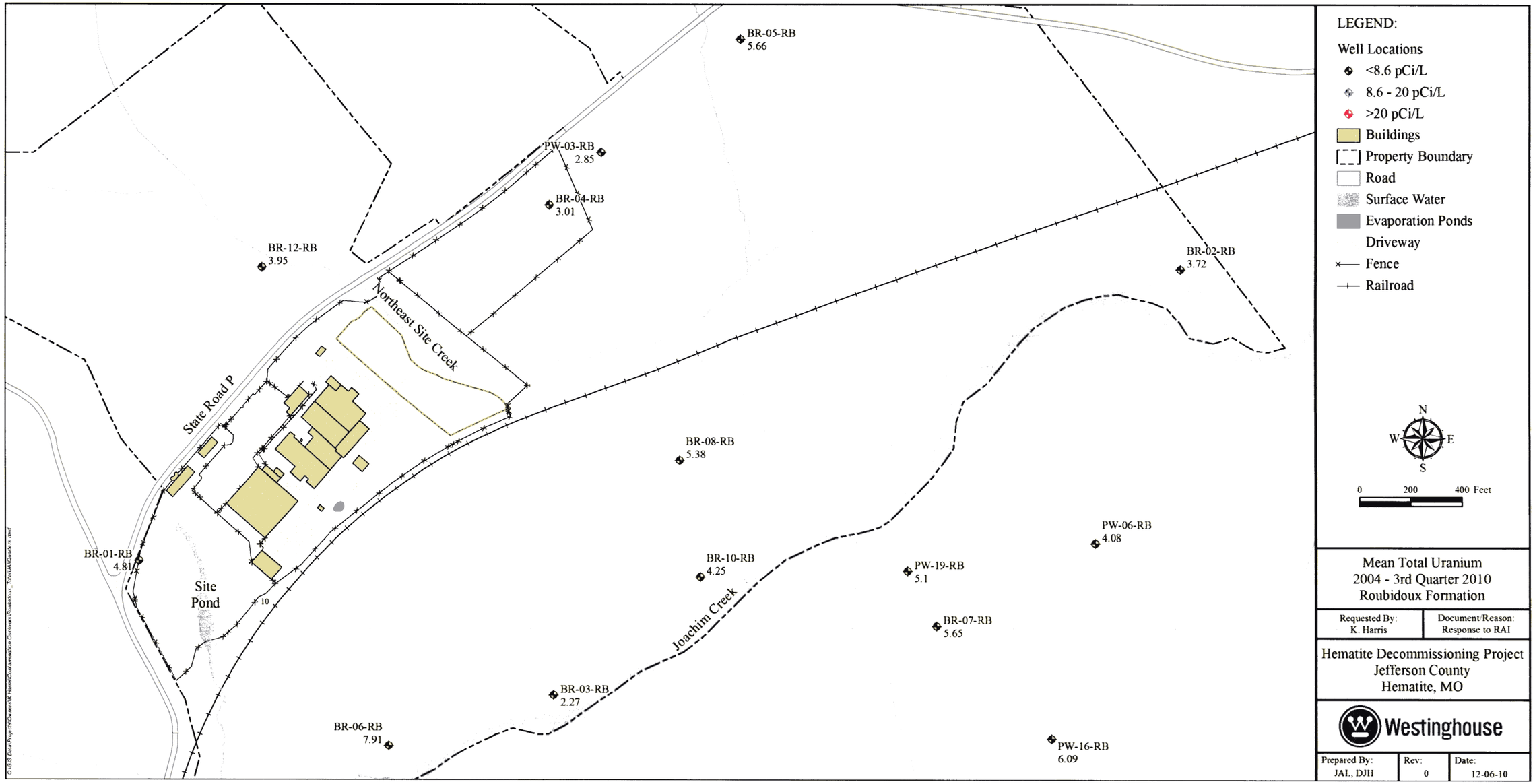
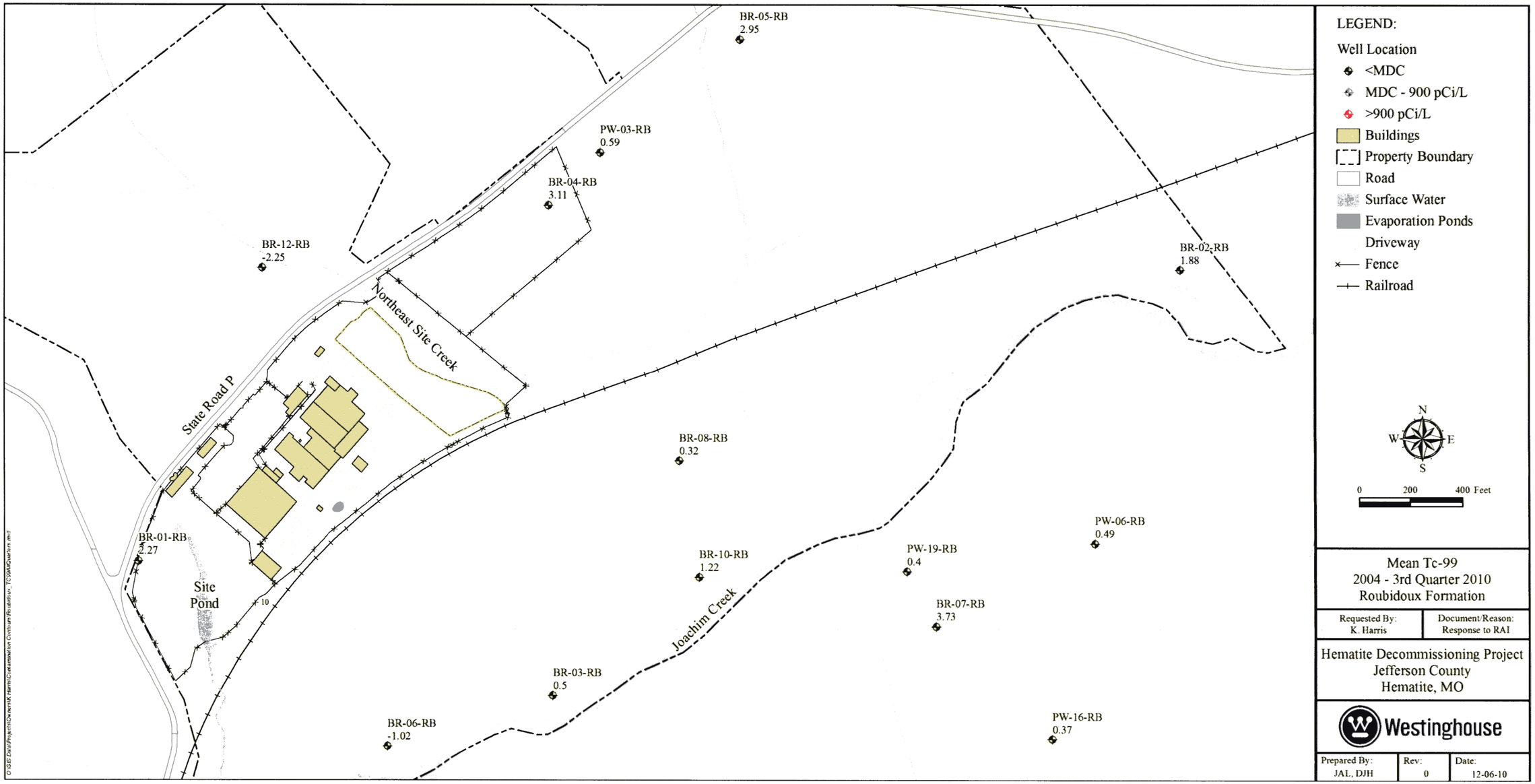


Figure 63

Roubidoux Bedrock Aquifer Tc-99 - 2004 to 3rd Quarter 2010



16. (HDP-4-Q16) Comment: Hybrid wells screened in both the overburden clay and sand/gravel aquifer have the potential to create a hydraulic interconnection between the two overburden units.

    Basis: Contamination in the overburden units has the potential to migrate vertically downward and impact bedrock drinking water supplies as evidenced in the nature and extent of chlorinated hydrocarbon contamination that originated at the Hematite site.

    Path Forward: Evaluate the relationship between radiological contamination found in the hybrid wells and water quality in the lower aquifer-units..

Westinghouse Response:

The response to RAI HDP-4-Q1 contains discussion of the overburden geology at the site and the response to RAI HDP-4-Q8 evaluates the relationship and potential effect of the hybrid wells (i.e., wells screened in both overburden and sand/gravel) on the sand and gravel unit that overlies the bedrock. The potential exists for the hybrid wells to be considered conduits to the lower sand and gravel unit. However in a comparison of hybrid and sand-gravel aquifer well radioanalysis results, in nearly all cases, the radionuclide concentrations detected in the hybrid wells were significantly higher than the concentrations detected in the paired sand/gravel wells. Responses to HDP-4-Q8 and HDP-4-Q12 provide a detailed discussion with supporting data on the existing hybrid and the new sand/gravel wells.

Due to the installation of the well screens of the hybrid monitoring wells which intercept both the overburden and the sand/gravel zone, these wells may serve to provide a pathway for limited downward migration of contaminants to the sand/gravel zone. Efforts to abandon the hybrid wells in the areas with contaminated overburden have been initiated with the Missouri Department of Natural Resources to reduce the potential for enhanced downward migration of radionuclides to the sand/gravel layer and for subsequent lateral migration in this zone.

Hematite Decommissioning Plan Chapter 6 - Environmental Information

1. (HDP-6-Q1) Comment: In HDP Section 6.1.1, a wetland area is identified but the section does not provide what, if anything is going to be done during decommissioning with respect to the wetlands.

   Path Forward: Provide what remediation actions will be taken relative to the wetland area on the Hematite site.

Westinghouse Response:

Response to this RAI was provided in Westinghouse letter HEM-10-126.

2. (HDP-6-Q2) Comment: In HDP Section 6.1.2, it is stated that the Site Creek/Pond and the Northeast Site Creek could potentially require remediation to remove contamination in sediment and nearby soil. Given this uncertainty, there is a potential for inadequate financial assurance since those decommissioning tasks are ill defined.

   Path Forward: Describe the remediation actions which will be taken for the Site Creek/Pond and the Northeast Site Creek. If actions have not been determined, provide which actions are under consideration and describe how these potential actions have been accounted for with respect to ensuring adequate decommissioning funding.

Westinghouse Response:

Response to this RAI was provided in Westinghouse letter HEM-10-126.

3. (HDP-6-Q3) Comment: In HDP Section 6.2, it is stated that a letter was received from U. S. Fish and Wildlife Service which indicated "...no federally listed, proposed or candidate species or critical habitat occurs on or near the project site...". This letter is outdated; consequently, information on Federally-listed species and habitat needs to be updated.

   Path Forward: Westinghouse should secure from the U. S. Fish and Wildlife Service updated information on Federally-listed species and habitats. The DP should be revised reflect this information, including the date it was acquired.

Westinghouse Response:

Response to this RAI was provided in Westinghouse letter HEM-10-126.

Hematite Decommissioning Plan Chapter 7 – ALARA Analysis

1. (HDP-7-Q1) Comment: Section 7.4 of the HDP provides an As Low As Reasonably Achievable (ALARA) evaluation for residual radioactivity levels for building surfaces. In Section 7.4.1, Westinghouse provides the basis for concluding that washing of walls is not justified by the ALARA evaluation. The NRC staff considers the basis for that conclusion to be insufficient.

   Basis: In Section 7.4 of the HDP, on page 7-12, Westinghouse provides results of the calculation for washing walls, in terms of a ratio of concentration [average concentration being evaluated] to the $DCGL_w$, or Conc/$DCGL_w$. Results are provided for cases of zero and 0.07 (7%) discount rates. For zero discount rate, the Conc/$DCGL_w$ result is 0.21, which generally indicates that if the actual average concentration is greater than 21% of the $DCGL_w$, then washing of walls should be performed. Westinghouse indicates that use of a zero discount rate is considered overly conservative "...based on the effort and practicality of performing surveys for residual contamination levels at 21 percent of the DCGL, and the costs to remediate to 21 percent of the DCGLs." The NRC staff considers this statement unsupported by the ALARA calculation. The calculations are intended to address costs of performing the action being evaluated (which can include costs of surveys and costs of needed remediation), so if costs have been factored into the calculation, the calculation result provides the indication of whether the costs are reasonable for the benefit. In this case, the result (value of 0.21) appears to indicate that costs are reasonable for the benefit, when the concentration averages greater than 21% of the DCGL.

   In addition, NRC guidance in NUREG-1757, Vol. 2, Chap. 6 and Appendix N, states that for ALARA during decommissioning, all licensees should use typical good-practice efforts such as floor and wall washing and removal of readily removable radioactivity in buildings. This indicates that washing building surfaces is usually considered a good-practice effort, and should usually be considered ALARA, independent of the results of the cost-benefit ALARA evaluation. Westinghouse has not provided justification that building surface washing should not be performed as a good-practice ALARA effort. The NRC staff concludes that the current ALARA evaluation has not sufficiently justified not performing building surface washing.

   Path Forward: Please commit to washing building surfaces or provide a clear justification that such washing is not ALARA.

Westinghouse Response:

Response to this RAI was provided in Westinghouse letter HEM-10-126.

2. (HDP-7-Q2) Comment: Section 7.4.2 of the HDP provides an ALARA evaluation for scabbling building surfaces and a conclusion that scabbling is not reasonable. The NRC staff considers the basis for that conclusion to be insufficient.

   Basis: Westinghouse provides an initial calculation for zero discount rate, which has a result of 0.21, indicating that scabbling could be reasonable for ALARA when concentrations average greater than 21% of the DCGL. However, Westinghouse further indicates that further reduction of DCGLs is likely to result in additional remedial actions and costs, which were not considered in the initial calculation. Westinghouse then provides an *example* that further reduction in DCGLs *could* require certain actions and cost. However, it is not stated that these actions will be required; this appears to be only an example. The result of the revised calculation is a Conc/$DCGL_w$ value greater than 1, which would indicate that reduction of DCGLs with scabbling is not justified. However, if the revised calculation is just an example, that would seem to NRC staff to indicate that scabbling may be ALARA in some cases but not in others. NRC staff considers that if this is only an example, then Westinghouse has not sufficiently justified that the action (scabbling and reduction of DCGLs) is not reasonable to take.

   Path Forward: Please clarify which calculations in Section 7.4.2 are representative for scabbling building surfaces. In particular, please clarify whether the revised calculation for zero discount rate is representative, or is just an example that *might* apply. If that calculation is an example, please address how other possible example calculations would impact the conclusions of the ALARA evaluation (i.e., given that the initial calculation provides a conflicting result (less than 1)).

Westinghouse Response:

Response to this RAI was provided in Westinghouse letter HEM-10-126.

ATTACHMENT 2

Filename: Att 2 HDP-C4-Q9 Table 4-28 and 29.xlsx

(the electronic spreadsheet file with the above filename is referred to in the Attachment 1 response to RAI HDP-4-Q9)

Westinghouse Electric Company LLC,
Hematite Decommissioning Project

Docket No. 070-00036

ATTACHMENT 3

Filename: Att 3 HDP-4-Q9 Combd Qtrly Field Param.xls

(the electronic spreadsheet file with the above filename is referred to in the Attachment 1 response to RAI HDP-4-Q9)

Westinghouse Electric Company LLC,
Hematite Decommissioning Project

Docket No. 070-00036