Appendix A

Supplemental Groundwater Information

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Acronyms

amsl	above mean sea level
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EW	Extraction Well
FRL	final remediation level
GMA	Great Miami Aquifer
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HTW	horizontal till well
IEMP	Integrated Environmental Monitoring Plan
IW	Re-injection Well
LCS	leachate collection system
LDS	leak detection system
LMICP	Comprehensive Legacy Management and Institutional Controls Plan
OEPA	Ohio Environmental Protection Agency
OSDF	on-site disposal facility
PCB	polychlorinated biphenyls
PRRS	Paddys Run Road Site
RCRA	Resource Conservation and Recovery Act
RW	Recovery Well
TDS	total dissolved solids
TOC	total organic carbon
TOX	total organic halogens
UCL	upper confidence level

Measurement Abbreviations

ft	feet
gpad	gallons per acre per day
gpm	gallons per minute
lb	pound
m	meter
m^3	cubic meter
M gal	million gallons
mg/L	milligrams per liter
µg/L	micrograms per liter
NTU	nephelometric turbidity unit
pCi/L	picocuries per liter
yd^3	cubic yards

Appendix A presents groundwater data and analysis in support of Chapter 3. This appendix consists of five attachments as follows:

- Attachment A.1 provides operational data for the South Field Module, the South Plume Module, and the Waste Storage Area Module for 2008.
- Attachment A.2 provides total uranium data (including summary statistics) and plume maps for the first and second halves of 2008.
- Attachment A.3 provides groundwater elevation data for 2008 and quarterly water level maps.
- Attachment A.4 provides an analysis of the 2008 non-uranium final remediation level (FRL) exceedances both inside and outside the Waste Storage Area (Phase II) design remediation footprint.
- Attachment A.5 presents 2008 leak detection and leachate monitoring results associated with the On-Site Disposal Facility (OSDF) monitoring program.

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Attachment A.1

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A.1.0 Operational Assessment

During 2008, 23 extraction wells were operational. Figure A.1−1 depicts the locations of extraction and former re-injection wells, and identifies surrounding monitoring wells. Table A.1−1 provides summaries of gallons pumped, total uranium removed, and uranium removal indices for 2008 and for August 1993 through December 2008.

Information in this attachment is organized into the following subsections:

- South Field Module (Section A.1.1)
- South Plume Module (Section A.1.2)
- Waste Storage Area Module (Section A.1.3)
- Total Uranium Data (Section A.1.4)
- Pumping Rates (Section A.1.5).

A.1.1 South Field Module

Thirteen extraction wells were operational in the South Field Module in 2008. The 13 active extraction wells are 31550 (EW-18), 31560 (EW-19), 31561 (EW-20), 33326 (EW-17a), 32276 (EW-22), 32446 (EW-24), 32447 (EW-23), 33061 (EW-25), 33262 (EW-15a), 33264 (EW-30), 33265 (EW-31), 33266 (EW-32), and 33298 (EW-21a).

The target combined pumping rate for the South Field Module wells in 2008 was 2,575 gallons per minute (gpm). This target rate is consistent with pumping rates defined for the Waste Storage Area Phase II Model Design. Tables A.1−2 through A.1−14 provide individual extraction well performance data for 2008. The footnotes explain individual extraction well outages of greater than 24 hours. The combined performance data for the South Field Module are presented in Table A.1−1.

During 2008, 1,244.13 million gallons (M gal) of groundwater were pumped by the active extraction wells in the South Field Module resulting in the removal of 437.13 pounds (lbs) of uranium from the Great Miami Aquifer (GMA). Since startup of the South Field Module in July 1998, the module has removed 11.010 billion gallons of water and 5,445.39 lbs of uranium from the GMA.

A.1.2 South Plume Module

Six extraction wells were operational in the South Plume Module in 2008. The six active recovery wells are 3924 (RW-1), 3925 (RW-2), 3926 (RW-3), 3927 (RW-4), 32308 (RW-6), and 32309 (RW-7). These wells are located south of Willey Road and north of New Haven Road.

The target combined pumping rate for the South Plume Module in 2008 was 1,200 gpm. Tables A.1−15 through A.1−20 provide individual extraction well performance data for the South Plume Module extraction wells in 2008. The footnotes explain individual extraction well outages of greater than 24 hours. The combined performance data for the South Plume Module are presented in Table A.1−1.

During 2008, 592.07 million gallons of groundwater were pumped by the six wells in the South Plume Module resulting in the removal of 119.10 lbs of uranium from the GMA. Since startup of the South Plume Module in August 1993, the module has removed 11.158 billion gallons of groundwater and 2,354.31 lbs of uranium from the GMA.

During 2008, the South Plume Module continued to meet the primary objectives of:

- Preventing further southward movement of the total uranium plume while capturing the main lobe of the South Plume without adversely affecting the Paddys Run Road Site (PRRS) plume (3924 [RW-1], 3925 [RW-2], 3926 [RW-3], and 3927 [RW-4]).
- Actively remediating the higher concentration region of the off property plume (32308 [RW-6] and 32309 [RW-7]).

Attachment A.3 presents additional details concerning capture, along with supporting data. In 2008, as in previous years, PRRS constituents of concern (arsenic, phosphorus, potassium, sodium, and volatile organic compounds) were monitored at 11 monitoring well locations immediately south of the South Plume Module to ensure that the operation of the system does not adversely impact the PRRS plume. The 11 wells monitored were 2128, 2625, 2636, 2898, 2899, 2900, 3128, 3636, 3898, 3899, and 3900 (refer to Figure A.1−1).

The Mann Kendall test for trend was run on PRRS data collected from these wells. As indicated in Table A.1−21, Three wells monitored for PRRS constituents of concern had “up, significant” trends

- Arsenic in Well 3898
- Phosphorus in Well 3898
- Potassium in Well 2898
- Potassium in Well 2899

Each year since 2001, Monitoring Wells 2898 and 2899 have had “up, significant” trends for potassium. Potassium concentration versus time plots for these wells are shown in Figures A.1−2 and A.1−3. As reported in Attachment A.3, the groundwater flow direction was from the northeast to southwest at Monitoring Wells 2898 and 2899 and does not appear to be in the extent of capture from the South Plume Wells. This indicates that the increasing potassium concentrations at these two locations were moving toward the PRRS plume, not away from it.

Arsenic and phosphorus concentration versus time plots for Well 3898 are shown in Figures A.1-4 and A.1-5 respectively. The groundwater flow direction at this well is also from the northeast to the southwest, indicating that water is moving toward the PRRS plume, not away from it.

The monitoring activity for PRRS constituents of concern also included sampling for volatile organic compounds. These compounds are monitored because they were present in the PRRS plume, which is not of Fernald origin (ERM Midwest, Inc. 1994). No volatile organic compounds were detected in 2008.

A.1.3 Waste Storage Area Module

Four extraction wells were operational in the former waste storage area in 2008. The four extraction wells are 32761 (EW-26), 33062 (EW-27), 33334 (EW-28a), and 33347 (EW-33a).

The target combined pumping rate for the Waste Storage Area Module wells in 2008 was 1,000 gpm. This target pumping rate is consistent with the Waste Storage Area Phase II Model Design. Tables A.1−22 through A.1−25 provide individual extraction well performance data for the Waste Storage Area Module wells. The combined performance data for the Waste Storage Area Module are presented in Table A.1−1.

During 2008, 483.841 million gallons of groundwater were pumped from extraction wells in the Waste Storage Area Module resulting in the removal of 120.83 lbs of uranium from the GMA. Since startup of the Waste Storage Area Module in May 2002, 2.759 billion gallons of water and 1,402.57 lbs of uranium have been removed from the GMA.

A.1.4 Total Uranium Data

Process control water samples were collected monthly in 2008 from the extraction wells and analyzed for total uranium. The total uranium concentrations are used to calculate the mass of uranium removed by the well, support the statistical trend analysis presented in Attachment A.2, and to determine if a well is routed to treatment or to bypass treatment. Figure A.1−6 provides a graph of the monthly gallons of groundwater extracted versus the monthly gallons of groundwater treated for 2008.

Uranium concentration data collected from the extraction wells are also being tracked graphically in order to predict when the extraction well-specific uranium concentrations will reach the groundwater remediation goal of 30 micrograms per liter (μg/L), and to help determine how long groundwater treatment will be necessary. This is done by plotting uranium concentrations over time and then fitting a regression line to the data set.

Figures A.1−7 through A.1−29 are uranium concentration versus time plots for each extraction well. Each graph displays three different data sets (operational data, 95 percent upper confidence level [UCL] of the operational data, and model predictions). Trend lines for the operational data set and the 95 percent UCL of the operational data set were fitted using the regression analysis function found in Microsoft Excel software.

As pumping continues the uranium concentration of the pumped groundwater will decrease. The slope of a fitted regression curve through the uranium concentration data set collected at each extraction well provides a prediction of when pumping concentrations will decrease below 30 μg/L at each well. However, the slope of a fitted regression curve through the pumped uranium concentration data set is an insufficient statistical measure by itself because future measured concentrations could vary about the trend curve. U.S. Environmental Protection Agency (EPA) guidelines in General Methods for Remedial Operation Performance Evaluations (EPA 1992a) suggest that a 95 percent UCL of the measured uranium concentration data set can be used to help evaluate the uncertainty of the predicted data trend. From this perspective, the concentration trend of the measured data set presents a less conservative prediction of when pumping concentrations will decrease below 30 µg/L and the 95 percent UCL data trend presents a more conservative trend prediction (i.e., longer predicted cleanup times).

The graphs in Figures A.1−7 through A.1−29 predict when the actual measured concentrations and the 95 percent UCL calculated concentrations will reach the 30 µg/L FRL for total uranium. For example, the concentration trend of pumped water from Extraction Well 31550 (refer to Figure A.1−13) reaches 30 µg/L in approximately 2009 (trend for the measured data set) or approximately 2025 (trend for the 95 percent UCL data).

Figures A.1−7 through A.1−29 also show how modeled uranium concentration predictions relate to the measured and 95 percent UCL data trends. The VAM 3D groundwater model uranium concentration predictions are taken from modeling results for the Waste Storage Area (Phase II) Design (DOE 2005d).

The Fernald groundwater model predicts the future average pounds of uranium that will be removed from the aquifer for each year of the modeled remedy. The average annual pounds of uranium actually removed from the aquifer are compared to the model predictions to assess remedy progress. Concentration regression equations based on measured concentration data collected at the extraction wells are also used to provide a prediction of the number of pounds of uranium that will be removed from the aquifer in future years. Regression equations based on uranium concentration data collected at extraction wells through December 31, 2008, are summarized in Table A.1−26.

At the end of December 2008, approximately 9,126 net lbs of uranium had been removed from the GMA by the pump-and-treat remedy. Model predictions indicate that an additional 4,764 lbs of uranium will be removed from the GMA by operating the system according to the Waste Storage Area (Phase II) Design through 2024. The concentration data set indicates that an additional 4,147 lbs of uranium will be removed from the GMA based on regression analyses of the individual well data. The 95 percent UCL measured concentration data set indicates that an additional 14,427 lbs of uranium will be removed from the GMA based on regression analyses of the individual well data. A summary of the predictions are provided below.

	Data	**Model**	**95% UCL**
Net pounds of uranium extracted through December 2008	9126	9126	9126
Predicted pounds of U to be extracted between 2009 and the end of the pump and treat stage of the aquifer remedy	4147	4764	14427
Total predicted pounds of uranium to be removed	**13273**	**13890**	**23553**
Estimated Percent Complete (based on lbs of uranium to be removed)	**69**	**66**	**39**

Table A.1−27 provides a yearly breakdown for the three predictions. Figure A.1−30 illustrates the relationship between the three estimates.

Results indicate that as of January 1, 2009, the estimated percent complete for the pump and treat stage of the aquifer remedy is approximately 69 percent (based on the uranium concentration data set) or 66 percent (based on the model predictions) equaling a difference of approximately 3 percent. The pump and treat stage of the aquifer remedy is approximately 39 percent complete based on the 95 percent UCL data set. The regression trend predictions based on the measured concentration data are very close to the modeled predictions.

A.1.5 Pumping Rates

Daily pumping rate data for each extraction well are presented on the U.S. Department of Energy (DOE) Office of Legacy Management's website under the Fernald Preserve (http://www.lm.doe.gov/land/sites/sites_map.htm); therefore, those data have not been repeated here. The footnotes in the well-specific operational tables explain individual well outages of greater than 24 hours.

Target extraction well pumping rates for 2008 are provided in Table A.1−28. The total target pumping rate of 4,775 gpm is consistent with the rate defined by the Waste Storage Area Phase II Model Design. As additional operational experience is gained, pumping rate changes may occur as efforts are made to maximize the effectiveness of each module.

Table A.1-1. Aquifer Restoration System Operational Summary Sheet

	Reporting Period					
	January 2008 through December 2008			**August 1993 through December 2008**		
	Gallons Pumped/ Re-injected[a] (M gal)	**Total Uranium Removed/ Re-injected (lbs)**	**Uranium Removal Index[b] (lbs/M gal)**	**Gallons Pumped/ Re-injected (M gal)**	**Total Uranium Removed/ Re-injected (lbs)**	**Uranium Removal Index[b] (lbs/M gal)**
South Field Module	1,244.133	437.130	0.35	11,009.836	5,445.393	0.49
Waste Storage Area Module	483.841	120.832	0.25	2,758.948	1,402.566	0.51
South Plume Module	592.068	119.098	0.20	11,158.291	2,354.312	0.21
Re-injection Module[c]	0	0	NA	1,936.478	76.27	NA
Aquifer Restoration Systems Totals						
Extraction Wells	2,320.042	677.060	0.29	24,918.073	9,202.272	0.37
(Re-injection Wells)	0	0	NA	(1,936.478)	(76.27)	NA
Net	2,320.042	677.060	NA	22,981.595	9,126.002	NA

[a] million gallons
[b] NA = not applicable
[c] Re-injection module was shut down in September 2004.

Table A.1-2. Extraction Well 31550 (EW-18) Operational Summary Sheet For 2008

Reference Elevation (feet [ft] amsl) – 572.11 (top of well)
Northing Coordinate ('83) – 477,018.5
Easting Coordinate ('83) – 1,348,979.8

Hours in reporting period – 8760
Hours not pumped – 915

Hours pumped – 7845
Operational percent – 89.55
Adjusted operational percent [a] – 97.77

Target pumping rate – 100 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	107.5	4.800	39.4	0.33
2/08	107.7	4.478	43.2	0.36
3/08	106.5	4.756	50.1	0.42
4/08	66.9	2.891	42.2	0.35
5/08	71.7	3.199	44.2	0.37
6/08	67.7	2.924	44.8	0.37
7/08	105.6	4.712	43.1	0.36
8/08	103.0	4.598	42.6	0.36
9/08	101.4	4.381	36.8	0.31
10/08	110.6	4.937	40.0	0.33
11/08	106.8	4.612	36.3	0.30
12/08	102.7	4.584	34.5	0.29
	Average 96.5	Total 50.871	Average 41.4	Average 0.34

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a sitewide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for April, May, and June.

Table A.1-3. Extraction Well 31560 (EW-19) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 574.93 (top of well)
Northing Coordinate ('83) – 477,403.1
Easting Coordinate ('83) – 1,349,028.9

Hours in reporting period – 8760
Hours not pumped – 906

Hours pumped – 7854
Operational percent – 89.66
Adjusted operational percent[a] – 97.88

Target pumping rate –100 gpm

Monthly Measurements at Well Field							
Month	**Monthly Average Pumping Rate[b] (gpm)**		**M Gal Pumped**		**Monthly Total Uranium Concentration[c] (µg/L)**		**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	106.5		4.754		33.2		0.28
2/08	104.3		4.362		33.7		0.28
3/08	104.2		4.652		35.9		0.30
4/08	69.2		2.988		36.2		0.30
5/08	71.4		3.186		37.0		0.31
6/08	68.4		2.953		36.9		0.31
7/08	102.8		4.588		36.7		0.31
8/08	99.7		4.451		34.6		0.29
9/08	101.4		4.381		30.2		0.25
10/08	110.4		4.930		29.5		0.25
11/08	108.1		4.671		27.6		0.23
12/08	102.4		4.570		24.8		0.21
Average	95.7	Total	50.485	Average	33.0	Average	0.28

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June and July.

Table A.1-4. Extraction Well 31561 (EW-20) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 578.77 (top of well)
Northing Coordinate ('83) – 477,660.8
Easting Coordinate ('83) – 1,349,254.5

Hours in reporting period – 8760
Hours not pumped – 1078

Hours pumped – 7682
Operational percent – 87.69
Adjusted operational percent[a] – 95.91

Target pumping rate – 100 gpm

	Monthly Measurements at Well Field			
Month	**Monthly Average Pumping Rate [b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration [c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	111.2	4.963	33.9	0.28
2/08	97.9	4.125	34.9	0.29
3/08	111.0	4.956	32.4	0.27
4/08	60.1	2.596	29.7	0.25
5/08	71.3	3.185	28.9	0.24
6/08	67.9	2.934	30.3	0.25
7/08	105.1	4.690	32.7	0.27
8/08	99.5	4.440	36.7	0.31
9/08	96.8	4.181	32.9	0.27
10/08	108.1	4.823	39.0	0.33
11/08	107.3	4.637	37.3	0.31
12/08	104.4	4.661	37.5	0.31
	Average 95.0	Total 50.192	Average 33.9	Average 0.28

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 16 to April 17 for a chemical treatment.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from July 31 to August 1 for a chemical treatment.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-5. Extraction Well 31567 (EW-17) and 33326 (EW-17a) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 574.84 (top of well)
Northing Coordinate ('83) – 477,905.5
Easting Coordinate ('83) – 1,348,854.1

Hours in reporting period – 8760
Hours not pumped – 953

Hours pumped – 7807
Operational percent – 89.12
Adjusted operational percent[a] – 97.34

Target pumping rate – 175 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	163.4	7.292	26.7	0.22
2/08	161.0	6.722	27.0	0.23
3/08	151.2	6.751	28.9	0.24
4/08	96.5	4.170	29.7	0.25
5/08	113.9	5.085	32.2	0.27
6/08	121.7	5.257	32.7	0.27
7/08	172.0	7.677	26.4	0.22
8/08	156.0	6.962	27.4	0.23
9/08	151.3	6.536	23.1	0.19
10/08	167.8	7.492	21.5	0.18
11/08	170.6	7.371	22.7	0.19
12/08	160.5	7.164	23.3	0.19
	Average 148.8	Total 78.479	Average 26.8	Average 0.22

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 16 to April 17 for a chemical treatment.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-6. Extraction Well 32276 (EW-22) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 567.14 (top of well)
Northing Coordinate ('83) – 476,447.3
Easting Coordinate ('83) – 1,348,857.3

Hours in reporting period – 8760
Hours not pumped – 1142

Hours pumped – 7618
Operational percent – 86.96
Adjusted operational percent[a] – 95.18

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	303.3	13.538	43.5	0.36
2/08	291.3	12.174	44.2	0.37
3/08	255.8	11.418	47.5	0.40
4/08	202.7	8.757	48.2	0.40
5/08	190.5	8.502	49.7	0.42
6/08	183.6	7.933	50.3	0.42
7/08	286.5	12.788	48.5	0.40
8/08	256.9	11.467	47.1	0.39
9/08	268.5	11.600	40.0	0.33
10/08	295.6	13.195	43.8	0.37
11/08	298.6	12.897	39.8	0.33
12/08	276.2	12.328	36.6	0.31
	Average 259.1	Total 136.598	Average 44.9	Average 0.37

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from March 28 to March 31 to decrease the uranium concentration at the Parshall Flume.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from July 2 to July 3 for a chemical treatments.
Well was down from August 5 to August 6 for a chemical treatment.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-7. Extraction Well 32446 (EW-24) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 578.367 (top of well)
Northing Coordinate ('83) – 476,634.53
Easting Coordinate ('83) – 1,349,312.38

Hours in reporting period – 8760
Hours not pumped – 1352.5

Hours pumped – 7407.5
Operational percent – 84.56
Adjusted operational percent[a] – 92.78

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	317.3	14.162	51.5	0.43
2/08	260.0	10.484	44.2	0.43
3/08	237.8	10.616	55.3	0.46
4/08	205.6	8.882	49.8	0.42
5/08	208.4	9.303	49.8	0.42
6/08	209.0	9.030	49.1	0.41
7/08	316.0	14.108	46.9	0.39
8/08	277.2	12.376	49.0	0.41
9/08	288.5	12.464	43.7	0.36
10/08	331.3	14.787	47.0	0.39
11/08	296.5	12.809	46.7	0.39
12/08	286.4	12.783	45.9	0.38
	Average 269.5	Total 141.804	Average 48.2	Average 0.41

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from February 23 to March 6 for a motor replacement.
Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from July 1 to July 2 to check the motor.
Well was down from August 30 to September 3 due to a site-wide power outage.
Well was down from September 11 to September 12 for a chemical treatment.
Well was down from November 3 to November 6 due to electrical problems.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-8. Extraction Well 32447 (EW-23) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 574.528 (top of well)
Northing Coordinate ('83) – 477,150.24
Easting Coordinate ('83) – 1,349,421.19

Hours in reporting period – 8760
Hours not pumped – 1668

Hours pumped – 7092
Operational percent – 80.96
Adjusted operational percent[a] – 89.18

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	62.8	2.803	69.8	0.58
2/08	310.8	12.984	66.4	0.55
3/08	293.8	13.113	71.5	0.60
4/08	182.6	7.889	68.6	0.57
5/08	198.3	8.853	70.5	0.59
6/08	141.1	6.096	63.4	0.53
7/08	278.4	12.428	67.0	0.56
8/08	289.9	12.941	77.3	0.65
9/08	287.0	12.399	65.3	0.54
10/08	305.6	13.641	75.1	0.63
11/08	295.8	12.780	78.9	0.66
12/08	308.8	13.784	68.4	0.57
	Average 246.2	Total 129.711	Average 70.2	Average 0.59

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from January 9 to January 30 for rehabilitation and a pump replacement.
Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from June 13 to June 16 to decrease the uranium concentration at the Parshall Flume.
Well was down from June 27 to June 30 to decrease the uranium concentration at the Parshall Flume.
Well was down from July 30 to July 31 for a chemical treatment.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-9. Extraction Well 33061 (EW-25) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 575.56 (top of well)
Northing Coordinate ('83) – 478318.82
Easting Coordinate ('83) – 1349531.03

Hours in reporting period – 8760
Hours not pumped – 1139

Hours pumped – 7621
Operational percent – 87.00
Adjusted operational percent[a] – 95.21

Target pumping rate – 100 gpm

Monthly Measurements at Well Field								
Month		**Monthly Average Pumping Rate[b] (gpm)**		**M Gal Pumped**		**Monthly Total Uranium Concentration[c] (µg/L)**		**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08		127.3		5.684		36.10		0.30
2/08		105.4		4.403		31.80		off
3/08		162.5		7.252		47.40		off
4/08		104.0		4.495		60.53		0.51
5/08		89.9		4.014		62.20		0.52
6/08		81.3		3.512		59.28		0.49
7/08		144.0		6.428		53.10		0.44
8/08		136.4		6.091		47.10		0.39
9/08		133.3		5.760		41.70		0.35
10/08		152.2		6.796		35.70		0.30
11/08		142.8		6.168		35.00		0.29
12/08		134.1		5.987		31.50		0.26
	Average	126.0	Total	66.591	Average	45.10	Average	0.39

[a] Adjusted for planned annual well field shutdown.
[b] Well was down on March 3 for a chemical cleaning.
Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from June 13 to June 16 to decrease the uranium concentration at the Parshall Flume
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-10. Extraction Well 33262 (EW-15a) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 568.368 (top of well)
Northing Coordinate ('83) – 477,799.912
Easting Coordinate ('83) – 1,348,149.97

Hours in reporting period – 8760
Hours not pumped – 1009.5

Hours pumped – 7751
Operational percent – 88.48
Adjusted operational percent[a] – 96.70

Target pumping rate – 200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate[b] (gpm)	M Gal Pumped	Monthly Total Uranium Concentration[c] (µg/L)	Uranium Removal Index (lbs of total uranium removed/M gal pumped)
1/08	216.8	9.677	32.4	0.27
2/08	220.2	9.168	35.8	0.30
3/08	181.5	8.103	41.9	0.35
4/08	136.1	5.881	45.2	0.38
5/08	142.6	6.367	46.5	0.39
6/08	138.9	6.002	46.6	0.39
7/08	219.3	9.789	40.8	0.34
8/08	199.4	8.901	44.7	0.37
9/08	196.1	8.470	38.4	0.32
10/08	217.2	9.696	44.2	0.37
11/08	215.6	9.316	34.3	0.29
12/08	212.7	9.495	40.4	0.34
	Average 191.4	Total 100.866	Average 40.9	Average 0.34

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from March 28 to March 31 to decrease the uranium concentration at the Parshall Flume.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-11. Extraction Well 33264 (EW-30) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 573.818 (top of well)
Northing Coordinate ('83) – 477,200.945
Easting Coordinate ('83) – 1,349,751.49

Hours in reporting period – 8760
Hours not pumped – 1222.0

Hours pumped – 7538.0
Operational percent – 86.05
Adjusted operational percent[a] – 94.27

Target pumping rate–200 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	217.0	9.687	71.4	0.60
2/08	218.7	9.170	76.1	0.64
3/08	202.9	9.058	75.9	0.63
4/08	131.6	5.684	66.2	0.55
5/08	142.5	6.362	71.4	0.60
6/08	97.9	4.228	70.3	0.59
7/08	202.7	9.047	66.8	0.56
8/08	197.3	8.809	69.6	0.58
9/08	191.4	8.269	61.7	0.51
10/08	187.2	8.358	68.1	0.57
11/08	201.2	8.691	60.0	0.50
12/08	199.7	8.913	55.2	0.46
	Average 182.5	Total 96.276	Average 67.7	Average 0.57

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from June 13 to June 16 to decrease the uranium concentration at the Parshall Flume.
Well was down from June 27 to June 30 to decrease the uranium concentration at the Parshall Flume.
Well was down from July 31 to August 1 for a chemical treatment.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-12. Extraction Well 33265 (EW-31) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 577.474 (top of well)
Northing Coordinate ('83) – 477,598.909
Easting Coordinate ('83) – 1,349,849.01

Hours in reporting period – 8760
Hours not pumped – 964.0
Hours pumped – 7796.0
Operational percent – 89.00
Adjusted operational percent[a] – 97.21
Target pumping rate – 300 gpm

Monthly Measurements at Well Field								
Month		**Monthly Average Pumping Rate[b] (gpm)**		**M Gal Pumped**		**Monthly Total Uranium Concentration[c] (µg/L)**		**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08		221.6		9.892		18.7		0.16
2/08		219.1		9.151		18.6		0.16
3/08		273.3		12.202		19.9		0.17
4/08		225.7		9.748		19.0		0.16
5/08		214.0		9.552		19.9		0.17
6/08		229.3		9.904		19.3		0.16
7/08		328.8		14.676		20.4		0.17
8/08		305.3		13.627		19.7		0.16
9/08		289.3		12.497		15.9		0.13
10/08		323.8		14.452		19.1		0.16
11/08		318.4		13.756		18.0		0.15
12/08		309.1		13.798		17.4		0.15
	Average	271.5	Total	143.254	Average	18.8	Average	0.16

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from January 6 to January 7 due to a blown fuse caused by a goose flying into the power line.
Well was down from March 10 to March 11 for a pump replacement and performance testing.
Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-13. Extraction Well 33266 (EW-32) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 579.625 (top of well)
Northing Coordinate ('83) – 476,997.576
Easting Coordinate ('83) – 1,350,046.97

Hours in reporting period – 8760
Hours not pumped – 985.5
Hours pumped – 7774.5
Operational percent – 88.75
Adjusted operational percent[a] – 96.97
Target pumping rate – 200 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration [c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	214.3	9.567	11.1	0.09
2/08	211.3	8.815	11.4	0.10
3/08	204.3	9.121	10.0	0.08
4/08	144.2	6.231	8.8	0.07
5/08	141.0	6.296	11.3	0.09
6/08	140.0	6.047	9.7	0.08
7/08	209.0	9.331	8.8	0.07
8/08	201.0	8.974	8.5	0.07
9/08	186.1	8.040	8.3	0.07
10/08	218.0	9.731	9.0	0.08
11/08	214.3	9.259	8.6	0.07
12/08	203.5	9.082	8.6	0.07
	Average 190.6	Total 100.496	Average 9.5	Average 0.08

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from July 3 to July 4 for a chemical treatment.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-14. Extraction Well 33298 (EW-21a) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 576.21 (top of well)
Northing Coordinate ('83) – 477,953.1
Easting Coordinate ('83) – 1,349,499.9

Hours in reporting period – 8760
Hours not pumped – 1154
Hours pumped – 7606
Operational percent – 86.83
Adjusted operational percent[a] – 95.05
Target pumping rate –200 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	215.6	9.625	51.4	0.43
2/08	222.1	9.286	52.8	0.44
3/08	203.7	9.094	63.9	0.53
4/08	134.2	5.797	57.3	0.48
5/08	143.1	6.388	60.5	0.51
6/08	99.5	4.299	62.5	0.52
7/08	217.0	9.689	62.6	0.52
8/08	197.1	8.797	55.5	0.46
9/08	201.3	8.697	54.0	0.45
10/08	210.5	9.398	59.1	0.49
11/08	203.8	8.803	49.6	0.41
12/08	193.5	8.638	51.6	0.43
	Average 186.8	Total 98.510	Average 56.7	Average 0.47

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be recharged.
Well was down from April 21 to May 6 for the first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from June 13 to June 16 to decrease the uranium concentration at the Parshall Flume.
Well was down from June 27 to June 30 to decrease the uranium concentration at the Parshall Flume.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-15. Extraction Well 3924 (RW-1) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 533.51 (top of well)
Northing Coordinate ('83) – 474,219.7
Easting Coordinate ('83) – 1,348,314.3

Hours in reporting period – 8760 | Hours pumped – 7672 | Target pumping rate – 200 gpm
Hours not pumped – 1088 | Operational percent – 87.58

Monthly Measurements at Well Field								
Month		**Monthly Average Pumping Rate[a] (gpm)**		**M Gal Pumped**		**Monthly Total Uranium Concentration[b] (µg/L)**		**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08		213.6		9.537		28.1		0.23
2/08		211.5		8.842		25.4		0.21
3/08		201.1		8.978		21.3		0.18
4/08		184.4		7.966		17.5		0.15
5/08		197.1		8.799		19.0		0.16
6/08		32.6		1.410		15.2		0.13
7/08		198.7		8.871		16.4		0.14
8/08		198.2		8.846		18.1		0.15
9/08		193.4		8.353		15.9		0.13
10/08		218.9		9.770		17.3		0.14
11/08		218.1		9.420		17.6		0.15
12/08		209.2		9.339		17.7		0.15
	Average	189.7	Total	100.131	Average	19.1	Average	0.16

[a] Well was shut down from March 3 to March 4 due to a leak at the top of the well.
Well was down from March 19 to March 20 due to a high level of the Great Miami River causing the outfall line to be surcharged.
Well was down from April 21 to April 24 for Cla-Val PM.
Well was down from April 28 to April 29 to replace a downstream flow valve.
Well was down from May 20 to May 22 for chemical treatment.
Well was down from May 31 to June 23 due to an electrical problem.
Well was down from June 27 to July 1 due to lightning.
Well was down on July 7 because the flow control valve failed closed.
Well was down from August 30 to September 3 due to a site-wide power outage.
[b] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, and July.

Table A.1-16. Extraction Well 3925 (RW-2) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 542.01 (top of well)
Northing Coordinate ('83) – 474,319.7
Easting Coordinate ('83) – 1,348,565.4

Hours in reporting period – 8760 Hours pumped – 7675 Target pumping rate – 200 gpm
Hours not pumped – 1085 Operational percent – 87.61

Monthly Measurements at Well Field								
Month		**Monthly Average Pumping Rate[a] (gpm)**		**M Gal Pumped**		**Monthly Total Uranium Concentration[b] (µg/L)**		**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08		107.1		4.783		20.5		0.17
2/08		79.5		3.522		20.2		0.17
3/08		211.3		9.434		19.3		0.16
4/08		189.7		8.193		21.5		0.18
5/08		218.0		9.733		20.2		0.17
6/08		187.4		8.094		19.8		0.17
7/08		204.6		9.135		19.3		0.16
8/08		208.2		9.293		19.9		0.17
9/08		188.5		8.145		18.5		0.15
10/08		219.1		9.781		19.7		0.16
11/08		212.2		9.167		19.6		0.16
12/08		195.1		8.711		17.9		0.15
	Average	185.1	Total	97.991	Average	19.7	Average	0.16

[a] Well was down from January 23 to February 18 due to operational problems and rehabilitation.
Well was down from March 19 to March 20 due to a high level of the Great Miami River causing outfall line to be recharged.
Well was down from April 21 to April 24 for Cla-Val PM
Well was down from April 28 to April 29 to replace a downstream flow valve.
Well was down from June 14 to June 17 due to a blown fuse caused by an owl hitting the power line.
Well was down from July 16 to July 17 for chemical treatment.
Well was down from August 30 to September 3 due to a site-wide power outage.
Well was down from December 7 to December 10 due to a hole in the discharge pipe.
[b] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-17. Extraction Well 3926 (RW-3) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 586.73 (top of well)
Northing Coordinate ('83) – 474,428.6
Easting Coordinate ('83) – 1,348,837.5

Hours in reporting period – 8760　Hours pumped – 8260.5　Target pumping rate –200 gpm
Hours not pumped – 499.5　Operational percent – 94.3

Monthly Measurements at Well Field								
Month		**Monthly Average Pumping Rate[a] (gpm)**		**M Gal Pumped**		**Monthly Total Uranium Concentration[b] (µg/L)**		**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08		143.0		6.383		36.9		0.31
2/08		128.3		5.338		30.8		0.26
3/08		113.4		5.062		29.0		0.24
4/08		157.6		6.810		28.4		0.24
5/08		219.7		9.807		28.9		0.24
6/08		190.2		8.218		29.9		0.25
7/08		211.9		9.461		29.1		0.24
8/08		201.2		8.982		28.2		0.24
9/08		203.2		8.777		26.9		0.22
10/08		221.7		9.897		30.8		0.26
11/08		210.7		9.103		28.8		0.24
12/08		207.9		9.278		28.2		0.24
	Average	184.1	Total	97.115	Average	29.7	Average	0.25

[a] Well was down from March 12 to March 14 for chemical cleaning.
Well was down from March 19 to March 20 due to a high level of the Great Miami River causing outfall line to be recharged
Well was down from April 10 to April 11 to replace the pump.
Well was down from April 21 to April 24 for Cla-Val PM.
Well was down from April 28 to April 29 to replace a downstream flow valve.
Well was down from June 14 to June 17 due to a blown fuse caused by an owl hitting the power line.
Well was down from August 30 to September 3 due to a site-wide power outage.
Well was down from November 30 to December 1 due to a power outage.
[b] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-18. Extraction Well 3927 (RW-4) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 591.84 (top of well)
Northing Coordinate ('83) – 474,541.8
Easting Coordinate ('83) – 1,349,127.3

Hours in reporting period – 8760
Hours not pumped – 462.5

Hours pumped – 8297.5
Operational percent – 94.72

Target pumping rate–400/200 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[a] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[b] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	215.4	9.617	3.2	0.03
2/08	213.0	8.903	3.4	0.03
3/08	208.6	9.310	4.3	0.04
4/08	185.5	8.014	3.8	0.03
5/08	207.5	9.265	3.6	0.03
6/08	202.1	8.729	3.5	0.03
7/08	216.7	9.674	3.6	0.03
8/08	200.1	8.934	3.2	0.03
9/08	192.9	8.332	2.8	0.02
10/08	219.8	9.813	3.1	0.03
11/08	213.3	9.214	2.7	0.02
12/08	209.2	9.338	2.9	0.02
	Average 207.0	Total 109.144	Average 3.3	Average 0.03

[a] Well was down from March 19 to March 20 due to a high level on Great Miami River causing outfall line to be surcharged.
Well was down from April 21 to April 24 for Cla-Val PM.
Well was down from April 28 to April 29 to replace a downstream flow valve.
Well was down from May 21 to May 23 for repairs and chemical treatment.
Well was down from June 14 to June 16 due to a blown fuse caused by an owl hitting the power line.
Well was down from August 30 to September 3 due to a site-wide power outage.
[b] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-19. Extraction Well 32308 (RW-6) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 582.05 (top of casing)
Northing Coordinate ('83) – 475,078.83
Easting Coordinate ('83) – 1,348,693.9

Hours in reporting period – 8760
Hours not pumped – 1081.5

Hours pumped – 7678.5
Operational percent – 87.65
Adjusted operational percent[a] – 95.87

Target pumping rate –200 gpm

Monthly Measurements at Well Field								
Month		**Monthly Average Pumping Rate[b] (gpm)**		**M Gal Pumped**		**Monthly Total Uranium Concentration[c] (µg/L)**		**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08		154.4		6.892		44.2		0.37
2/08		136.6		5.692		45.1		0.38
3/08		102.3		4.567		45.3		0.38
4/08		103.2		4.458		41.4		0.35
5/08		142.7		6.370		41.9		0.35
6/08		148.2		6.403		41.5		0.35
7/08		217.8		9.724		38.2		0.32
8/08		200.9		8.970		41.3		0.34
9/08		196.9		8.504		36.6		0.31
10/08		210.1		9.381		41.2		0.34
11/08		219.4		9.479		42.9		0.36
12/08		214.0		9.554		39.9		0.33
	Average	170.6	Total	89.994	Average	41.6	Average	0.35

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing outfall line to be recharged.
Well was down March 28 to decrease the uranium concentration at the Parshall Flume.
Well was down from April 14 to April 15 to replace the pump.
Well was down from April 21 to May 6 for first part of annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from June 14 to June 16 due to a blown fuse caused by an owl hitting the power line.
Well was down from August 30 to September 3 due to a site power outage.
Well was down from October 14 to October 15 for a chemical treatment.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-20. Extraction Well 32309 (RW-7) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 582.05 (top of casing)
Northing Coordinate ('83) – 475,109.60
Easting Coordinate ('83) – 1,348,366.34

Hours in reporting period – 8760
Hours not pumped – 1290.5

Hours re-injected – 7469.5
Operational percent – 85.27
Adjusted operational percent[a] – 93.49

Target pumping rate –200 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	217.1	9.692	39.2	0.33
2/08	215.8	9.016	41.4	0.35
3/08	182.6	8.150	41.1	0.34
4/08	134.8	5.825	39.2	0.33
5/08	142.7	6.372	39.6	0.33
6/08	131.3	5.671	39.6	0.33
7/08	204.1	9.110	39.6	0.33
8/08	200.9	8.970	41.4	0.35
9/08	142.1	6.139	37.2	0.31
10/08	219.3	9.790	43.3	0.36
11/08	217.2	9.384	39.3	0.33
12/08	214.5	9.576	35.9	0.30
	Average 185.2	Total 97.694	Average 39.7	Average 0.33

[a] Adjusted for planned annual well field shutdown.
[b] Well was down from March 19 to March 20 due to a high level of the Great Miami River causing outfall line to be surcharged.
Well was down March 28 to decrease the uranium concentration at the Parshall Flume.
Well was down from April 21 to May 6 for first part of the annual shutdown.
Well was down from May 26 to June 10 for the second part of the annual shutdown.
Well was down from June 14 to June 16 due to a blown fuse caused by an owl hitting the power line.
Well was down from June 30 to July 2 for a chemical treatment.
Well was down from August 30 to September 3 due to a site-wide power outage.
Well was down from September 9 to September 18 to replace the pump motor.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-21. PRRS Groundwater Summary Statistics and Trend Analysis

Analyte	Monitoring Well	Number of Samples[a,b,c]	Min.[a,b,c,d] (mg/L)	Max.[a,b,c,d] (mg/L)	Avg.[a,b,c,d] (mg/L)	SD[a,b,c,d]	Trend[a,b,c,d,e]
Arsenic	2128	232	0.000195	0.1876	0.0115	0.0208	Down, Significant
	2625	208	0.001095	0.0706	0.0118	0.0096	Down, Significant
	2636	178	0.01	0.0939	0.0443	0.0187	Down, Significant
	2898	49	0.000147	0.082	0.0039	0.0119	No Significant Trend
	2899	42	0.00032	0.0114	0.0015	0.0018	No Significant Trend
	2900	231	0.00032	0.0609	0.0049	0.0053	Down, Significant
	3128	52	0.0004	0.234	0.0076	0.0323	No Significant Trend
	3636	51	0.0005	0.0152	0.0023	0.0029	Up, Marginal
	3898	49	0.0005	0.0434	0.0036	0.0062	Up, Significant
	3899	50	0.000147	0.0167	0.002	0.0029	No Significant Trend
	3900	50	0.000375	0.016	0.0025	0.0024	Down, Significant
Phosphorus	2128	58	0.025	16.2	1.54	2.54	Down, Significant
	2625	32	0.307	12.3	3.06	2.87	No Significant Trend
	2636	30	9.6	170	89.9	45.5	No Significant Trend
	2898	50	0.005	9.95	0.303	1.42	No Significant Trend
	2899	41	0.005	0.831	0.061	0.129	No Significant Trend
	2900	48	0.05	4.74	0.53	0.715	Down, Significant
	3128	59	0.005	13	0.274	1.69	No Significant Trend
	3636	50	0.00955	1.1	0.077	0.156	No Significant Trend
	3898	48	0.00955	1.24	0.117	0.187	Up, Significant
	3899	49	0.005	0.83	0.1	0.16	Down, Significant
	3900	50	0.005	1.38	0.1	0.257	Down, Significant
Potassium	2128	50	0.83	18	3.59	3.59	No Significant Trend
	2625	33	0.64	9.49	3.25	1.96	No Significant Trend
	2636	30	5.31	218	71.5	53.2	Down, Significant
	2898	50	1.11	9.64	4.3	1.32	Up, Significant
	2899	42	1.36	8.85	3.99	1.07	Up, Significant
	2900	49	0.0095	6	2.03	1.13	No Significant Trend
	3128	52	1.085	3.7	2.02	0.66	Down, Significant
	3636	50	1.09	4.24	2.28	0.54	Down, Significant
	3898	49	0.61	3.93	2.35	0.53	Up, Marginal
	3899	50	0.875	3.22	2.43	0.36	No Significant Trend
	3900	50	0.975	3.19	1.75	0.42	Down, Significant
Sodium	2128	50	12.3	75.2	34.9	11.6	Down, Significant
	2625	33	16.5	50.7	32.2	7.72	Down, Significant
	2636	30	23	148	52.7	24.2	No Significant Trend
	2898	50	4.945	29.2	17.8	3.68	Down, Significant
	2899	42	11.2	22.9	16.6	2.58	Down, Marginal
	2900	49	0.01355	43.3	27.4	7.74	No Significant Trend
	3128	52	3.56	13.4	5.81	2.73	Down, Significant
	3636	50	3.14	13	6.17	2.9	Down, Significant
	3898	49	7.29	14.6	9.66	1.59	Up, Marginal
	3899	50	6.24	12.1	8.74	1.22	No Significant Trend
	3900	50	3.13	10.8	5.04	1.9	Down, Significant

Table A.1-21 (continued). PRRS Groundwater Summary Statistics and Trend Analysis

[a]The data are based on unfiltered samples from the Operable Unit 5 remedial investigation/feasibility study data set (1988 through 1993) and 1994 through 2008 groundwater data (unfiltered and filtered for 2001 through 2008).
[b]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the total number of samples and the sample with the maximum concentration is used to determine the summary statistics (minimum, maximum, average, standard deviation, and Mann-Kendall test for trend).
[c]Rejected data qualified with either an R or Z were not included in this count or the summary statistics.
[d]Where concentrations are below the detection limit each result used in the summary statistics is set at half the detection limit.
[e]Trend starts on August 27, 1993, and is based on the start-up of the South Plume Extraction Wells (DOE 1993).

Table A.1-22. Extraction Well 32761 (EW-26) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 570.88 (top of casing)
Northing Coordinate ('83) – 479892.36
Easting Coordinate ('83) – 1347364.02

Hours in reporting period – 8760
Hours not pumped – 1041

Hours pumped – 7719
Operational percent – 88.12
Adjusted operational percent[a] – 96.34

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	311.5	13.907	39.7	0.33
2/08	319.4	13.334	40.2	0.34
3/08	270.1	12.056	42.3	0.35
4/08	204.0	8.812	50.3	0.42
5/08	209.6	9.356	45.8	0.38
6/08	228.2	9.857	45.4	0.38
7/08	318.7	14.225	38.8	0.32
8/08	294.9	13.166	39.0	0.33
9/08	281.2	12.148	36.0	0.30
10/08	320.5	14.306	35.4	0.30
11/08	319.1	13.785	33.8	0.28
12/08	316.0	14.105	31.5	0.26
	Average 282.8	Total 149.058	Average 39.8	Average 0.33

[a] Adjusted for planned annual well field shutdown.
[b] Well was down January 6 to January 7 due to a blown fuse caused by a goose flying into the power line.
Well was down from March 19 to March 20 because a high Great Miami River level caused the outfall line to surcharge.
Well was down on March 28 to decrease the uranium outfall concentration at the Parshall Flume.
Well was down for 15 days from April 21 to May 6 for the first part of the annual shutdown.
Well was down for 15 days from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-23. Extraction Well 33062 (EW-27) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 575.1 (top of casing)
Northing Coordinate ('83) – 480013.01
Easting Coordinate ('83) – 1348037.2

Hours in reporting period – 8760
Hours not pumped – 1016.5

Hours pumped – 7744 Target pumping rate–200 gpm
Operational percent – 88.40
Adjusted operational percent [a] – 96.62

Monthly Measurements at Well Field								
Month		Monthly Average Pumping Rate[b] (gpm)		M Gal Pumped		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lbs of total uranium removed/M gal pumped)
1/08		134.0		5.981		54		0.45
2/08		130.7		5.490		50.9		0.42
3/08		260.8		11.642		49.2		0.41
4/08		135.5		5.854		48.8		0.41
5/08		140.0		6.248		49.0		0.41
6/08		140.9		6.085		46.5		0.39
7/08		217.2		9.697		43.3		0.36
8/08		199.7		8.914		46.4		0.39
9/08		193.1		8.341		40.4		0.34
10/08		211.5		9.439		46.1		0.38
11/08		217.9		9.412		43.7		0.36
12/08		209.8		9.364		41.9		0.35
	Average	182.6	Total	96.466	Average	46.67	Average	0.39

[a] Adjusted for planned annual well field shutdown.
[b] Well was down January 6 to January 7 due to a blown fuse caused by a goose flying into the power line.
Well was down from March 3 to March 4 to replace the pump.
Well was down from March 19 to March 20 because a high Great Miami River level caused the outfall line to surcharge.
Well was down for 15 days from April 21 to May 6 for the first part of the annual shutdown.
Well was down for 15 days from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-24. Extraction Well 33334 (EW-28a) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 570.441 (top of casing)
Northing Coordinate ('83) – 479918.959
Easting Coordinate ('83) – 1348686.378

Hours in reporting period – 8760
Hours not pumped – 917

Hours pumped – 7843 Target pumping rate–200 gpm
Operational percent – 89.53
Adjusted operational percent[a] – 97.75

Monthly Measurements at Well Field				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**M Gal Pumped**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lbs of total uranium removed/M gal pumped)**
1/08	209.9	9.368	20.0	0.17
2/08	220.0	9.214	22.1	0.18
3/08	210.0	9.374	19.0	0.16
4/08	147.5	6.372	17.0	0.14
5/08	138.2	6.168	16.6	0.14
6/08	156.9	6.777	16.6	0.14
7/08	215.5	9.620	16.9	0.14
8/08	201.1	8.975	17.9	0.15
9/08	195.0	8.425	16.5	0.14
10/08	210.8	9.411	18.4	0.15
11/08	214.2	9.253	17.3	0.14
12/08	210.2	9.382	16.4	0.14
	Average 194.1	Total 102.340	Average 17.9	Average 0.15

[a] Adjusted for planned annual well field shutdown.
[b] Well was down January 6 to January 7 due to a blown fuse caused by a goose flying into the power line.
Well was down from March 19 to March 20 because a high Great Miami River level caused the outfall line to surcharge.
Well was down for 15 days from April 21 to May 6 for the first part of the annual shutdown.
Well was down for 15 days from May 26 to June 10 for the second part of the annual shutdown.
Well was down from August 30 to September 3 due to a site-wide power outage.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, June, and July.

Table A.1-25. Extraction Well 33347 (EW-33a) Operational Summary Sheet For 2008

Reference Elevation (ft amsl) – 574.86 (top of casing)
Northing Coordinate ('83) – 481031.762
Easting Coordinate ('83) – 1346715.817

Hours in reporting period – 8760
Hours not pumped – 1742.5

Hours pumped – 7018 Target pumping rate–300 gpm
Operational percent – 80.11
Adjusted operational percent[a] – 88.33

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate[b] (gpm)	M Gal Pumped	Monthly Total Uranium Concentration[c] (µg/L)	Uranium Removal Index (lbs of total uranium removed/M gal pumped)
1/08	310.4	13.850	14.6	0.12
2/08	330.2	13.789	15.6	0.13
3/08	278.9	12.450	17.6	0.15
4/08	221.9	9.586	20.0	0.17
5/08	210.2	9.384	18.0	0.15
6/08	0.0	0.000	NA	NA
7/08	188.8	8.428	16.8	0.14
8/08	300.4	13.408	22.7	0.19
9/08	288.5	12.463	19.4	0.16
10/08	328.8	14.676	16.9	0.14
11/08	320.5	13.846	15.0	0.13
12/08	315.6	14.088	15.0	0.13
	Average 257.8	Total 135.980	Average 17.41	Average 0.15

[a] Adjusted for planned annual well field shutdown.
[b] Well was down January 6 to January 7 due to a blown fuse caused by a goose flying into the power lines.
Well was down from March 19 to March 20 because a high Great Miami River level caused the outfall line to surcharge.
Well was down from March 20 to March 24 due to a leaking valve outside the valve house.
Well was down for 15 days from April 21 to May 6 for the first part of the annual shutdown.
Well was down for 15 days from May 26 to June 10 for the second part of the annual shutdown.
Well was down from June 10 to July 14 due to maintenance problems.
[c] Average is used if more than one concentration measurement is available for a particular month. In 2008, an average was used for March, April, May, and July

Table A.1−26. Regression Equations for Uranium Concentration Data Collected at Extraction Wells Data Collected Through December 31, 2008

Well ID	SED ID	Data Trend	R2	95% UCL	R2	Function Type
RW-1	3924	y=2.72E+05e-2.44E-04x	0.78	y=8.06E+03e-1.31E-04x	0.73	Exponential Function
RW-2	3925	y=-5.35E-03x+2.27E+02	0.62	y=-5.35E-03x+2.42E+02	0.62	Linear
RW-3	3926	y=-2.29E-06x^2+1.75E-01x-3.31E+03	0.78	y=-2.29E-06x^2+1.75E-01x-3.29E+03	0.78	Polynomial
RW-4	3927	y=6.25E-33x^7.12	0.34	y=1.27E-14x^3.19	0.28	Power Function
RW-6	32308	y=1.48E+05e-2.10E-04x	0.79	y=1.61E+04e-1.40E-04x	0.80	Exponential Function
RW-7	32309	y=5.60E+05e-2.45E-04x	0.85	y=2.84E+04e-1.53E-04x	0.83	Exponential Function
EW-15a	33262	y=5.31E+67x^-1.44E+01	0.69	y=1.81E+47x^-9.89E+00	0.70	Power Function
EW-17a	33326	y=3.49E+03e-1.25E-04x	0.34	y=1.23E+03e-8.64E-05x	0.34	Exponential Function
EW-18	31550	y=1.24E+05e-2.08E-04x	0.48	y=1.01E+04e-1.25E-04x	0.47	Exponential Function
EW-19	31560	y=8.74E+08e-4.40E-04x	0.85	y=3.20E+05e-2.07E-04x	0.79	Exponential Function
EW-20	31561	y=8.58E+03e-1.42E-04x	0.43	y=2.26E+03e-9.62E-05x	0.42	Exponential Function
EW-21a	32398	y=8.57E+06e-3.09E-04x	0.76	y=9.49E+04e-1.73E-04x	0.76	Exponential Function
EW-22	32276	y=1.65E+10e-5.05E-04x	0.95	y=1.26E+06e-2.30E-04x	0.92	Exponential Function
EW-23	32447	y=3.06E+09e-4.51E-04x	0.90	y=2.32E+06e-2.45E-04x	0.88	Exponential Function
EW-24	32446	y=9.81E+05e-2.55E-04x	0.71	y=4.65E+04e-1.61E-04x	0.67	Exponential Function
EW-25	33061	y=5.94E+03e-1.27E-04x	0.14	y=1.57E+03e-8.27E-05x	0.12	Exponential Function
EW-30	33264	y=8.31E+09e-4.73E-04x	0.77	y=1.53E+07e-2.97E-04x	0.75	Exponential Function
EW-31	33265	y=2.99E+07e-3.63E-04x	0.58	y=2.04E+05e-2.21E-04x	0.52	Exponential Function
EW-32	33266	y=6.70E+12e-6.89E-04x	0.83	y=6.26E+07e-3.73E-04x	0.75	Exponential Function
EW-26	32761	y=1.47E+11e-5.61E-04x	0.85	y=1.14E+07e-2.96E-04x	0.80	Exponential Function
EW-27	33062	y=5.57E+12e-6.53E-04x	0.82	y=2.75E+07e-3.12E-04x	0.75	Exponential Function
EW-28a	33334	y=1.76E+16e-8.77E-04x	0.81	y=1.37E+07e-2.98E-04	0.65	Exponential Function
EW-33a	33347	Y=1.08E+40e-2.26E-03x	0.73	y=2.01E+16e-8.38E-04x	0.64	Exponential Function

Table A.1−27. Estimated Percent Complete Based on Pounds of Uranium Removed from the Aquifer

	Annual Uranium To Be Extracted From GMA (pounds) Based on Conc. Data	**Annual Uranium To Be Extracted From GMA (pounds) Based on Model**	**Annual Uranium To Be Extracted From GMA (pounds) Based on 95% UCL**
2009	573	586	1,571
2010	490	509	1,419
2011	424	450	1,286
2012	369	404	1,170
2013	322	366	1,066
2014	280	335	974
2015	243	307	890
2016	243	276	905
2017	215	247	834
2018	192	225	770
2019	171	208	711
2020	153	193	657
2021	137	180	608
2022	123	169	562
2023	111	159	521
2024	101	150	483
Total To Be Extracted	4,147	4,764	14,427
Pounds Already Extracted Through 12-31-2008	9,126	9,126	9126
Total	13,273	13,890	23,553
% Complete Based on Pounds (2008)	69	66	39
% Complete Based on Pounds (2007)	66	61	37
% Complete Based on Pounds (2006)	59	55	33

Table A.1-28. 2007 Extraction Well Target Pumping Rates

Module	Extraction Well	January 1 to December 31 (gpm)
South Plume	3924 (RW-1)	200
	3925 (RW-2)	200
	3926 (RW-3)	200
	3927 (RW-4)	200
	32308 (RW-6)	200
	32309 (RW-7)	200
Subtotal		1,200
Waste Storage Area	32761 (EW-26)	300
	33062 (EW-27)	200
	33334 (EW-28a)	200
	33347 (EW-33a)	300
Subtotal		1,000
South Field Extraction	31550 (EW-18)	100
	31560 (EW-19)	100
	31561 (EW-20)	100
	33298 (EW-21a)	200
	33326 (EW-17a)	175
	32276 (EW-22)	300
	32446 (EW-24)	300
	32447 (EW-23)	300
	33061 (EW-25)	100
	33264 (EW-30)	200
	33265 (EW-31)	300
	33266 (EW-32)	200
	33262 (EW-15a)	200
Subtotal		2,575
Total Pumping		4,775

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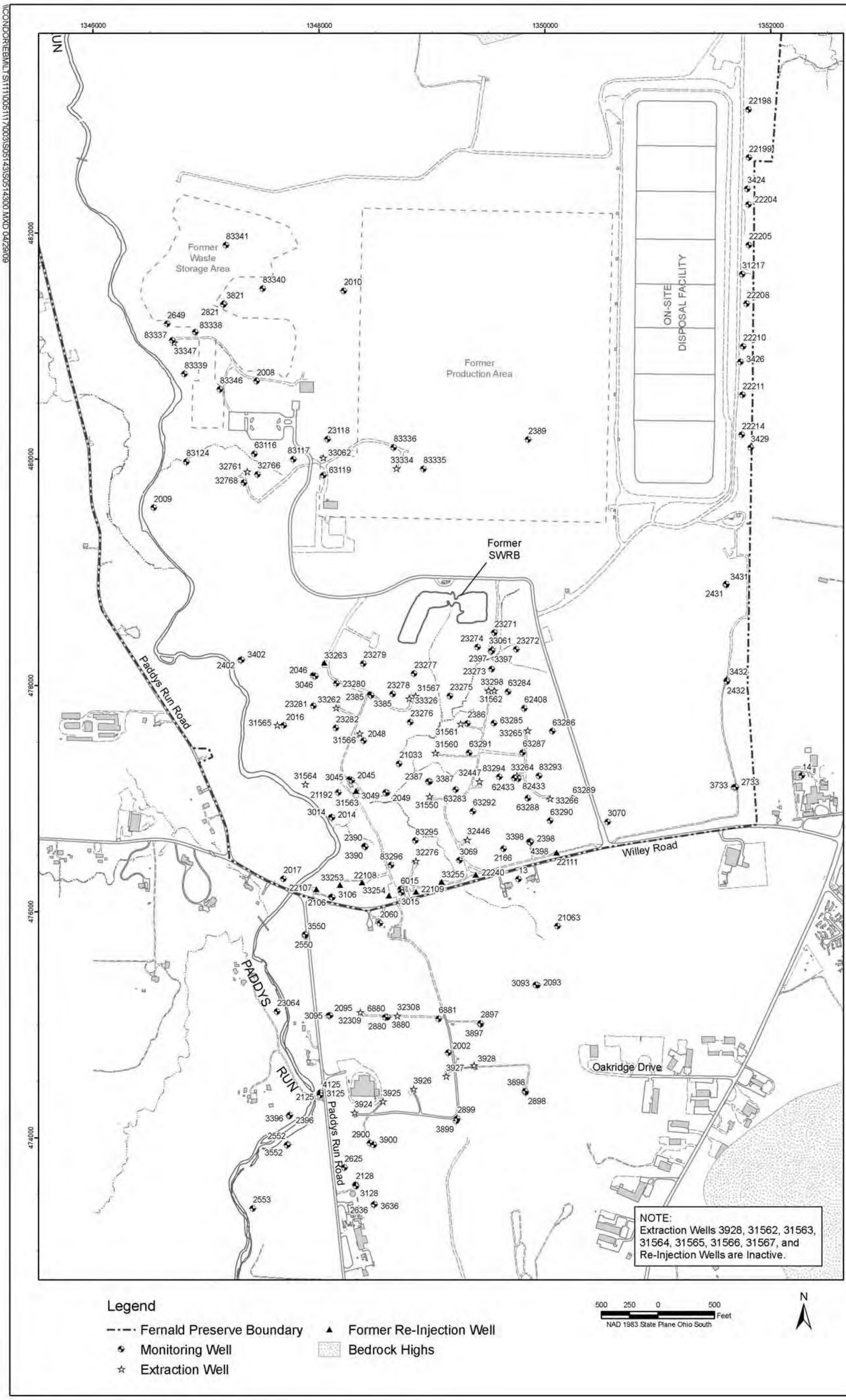

Figure A.1−1. Well Locations for South Plume, South Field, Waste Storage Area, and PRRS Monitoring Activities

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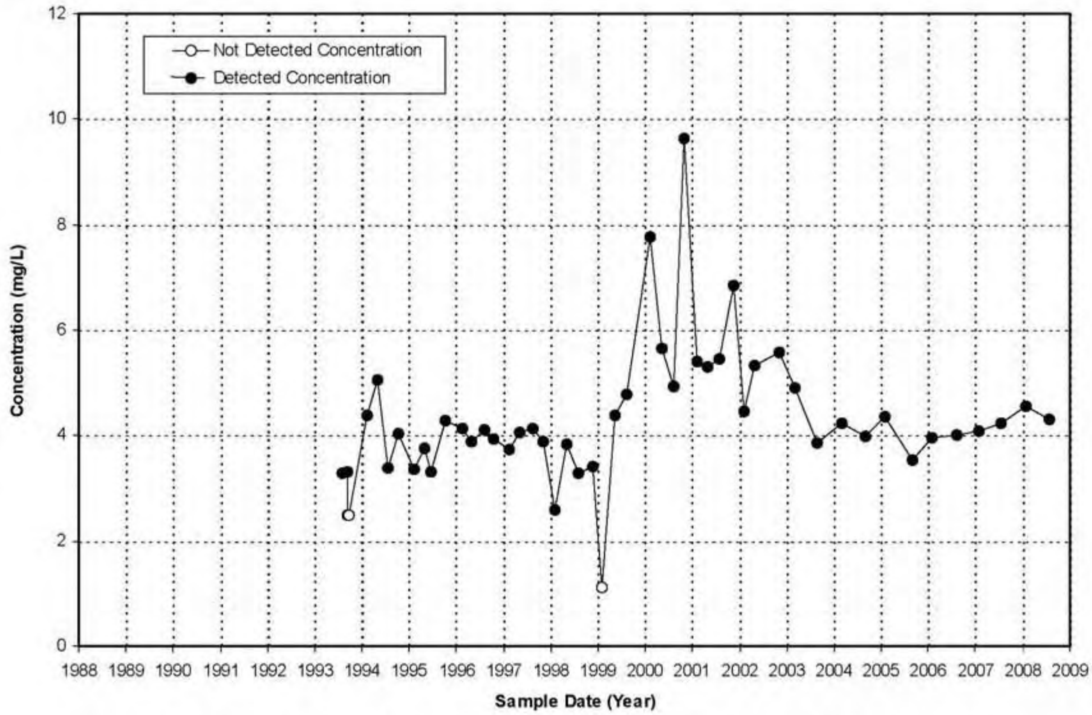

FIGURE A.1-2. POTASSIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2898

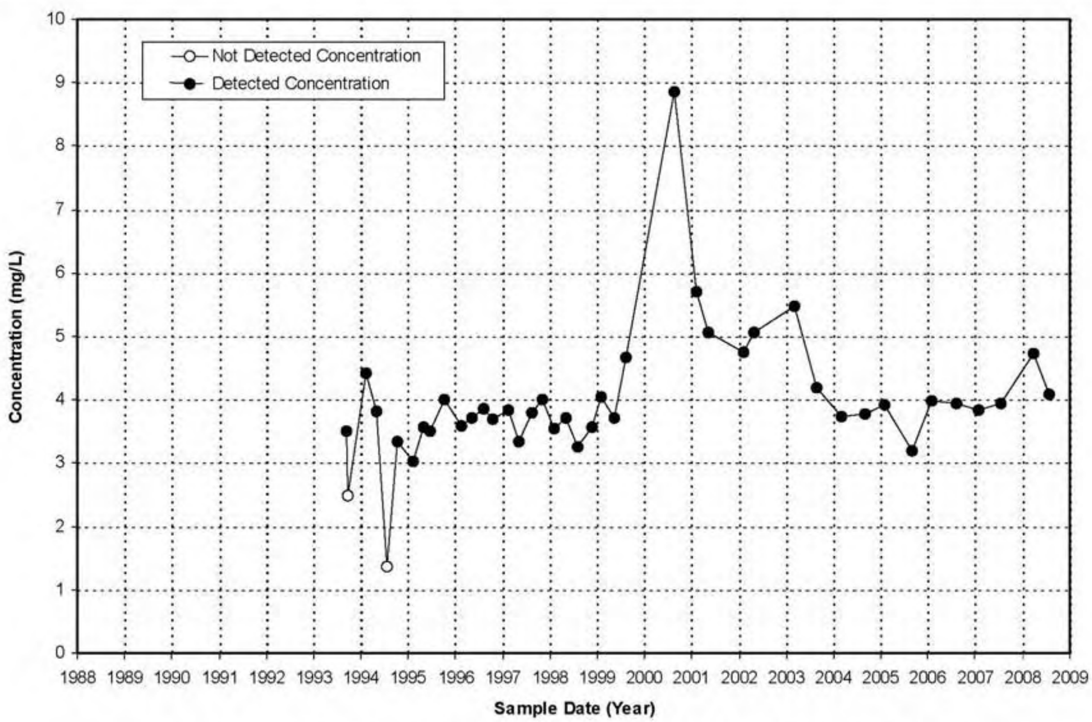

FIGURE A.1-3. POTASSIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2899

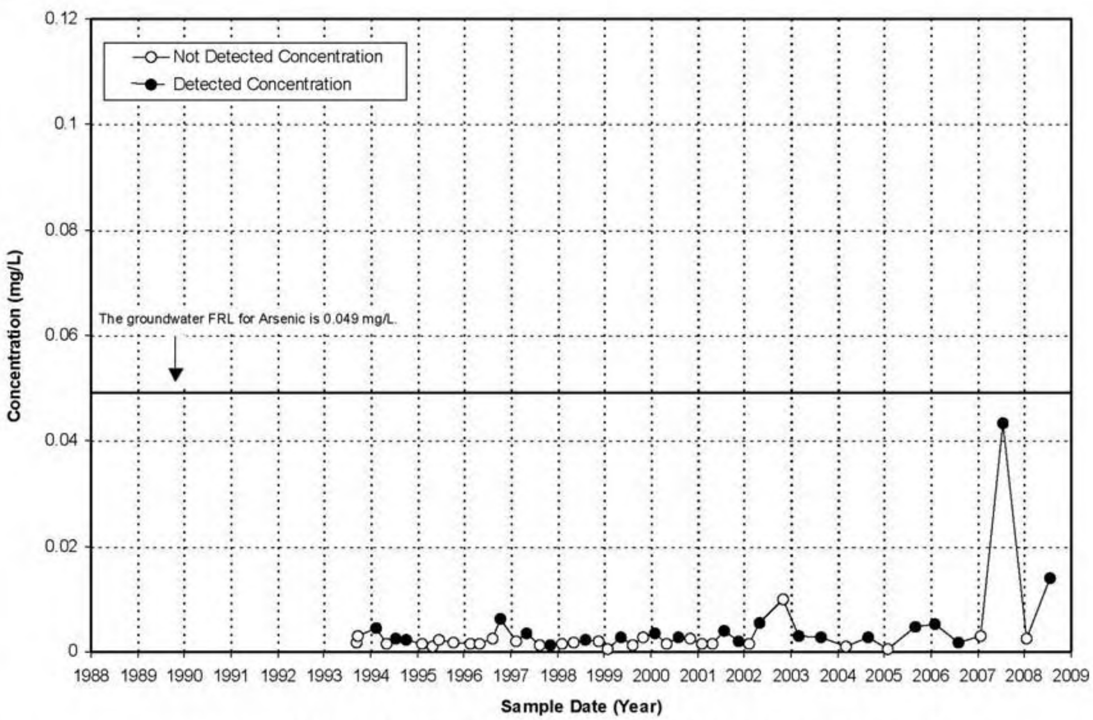

FIGURE A.1-4. ARSENIC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3898

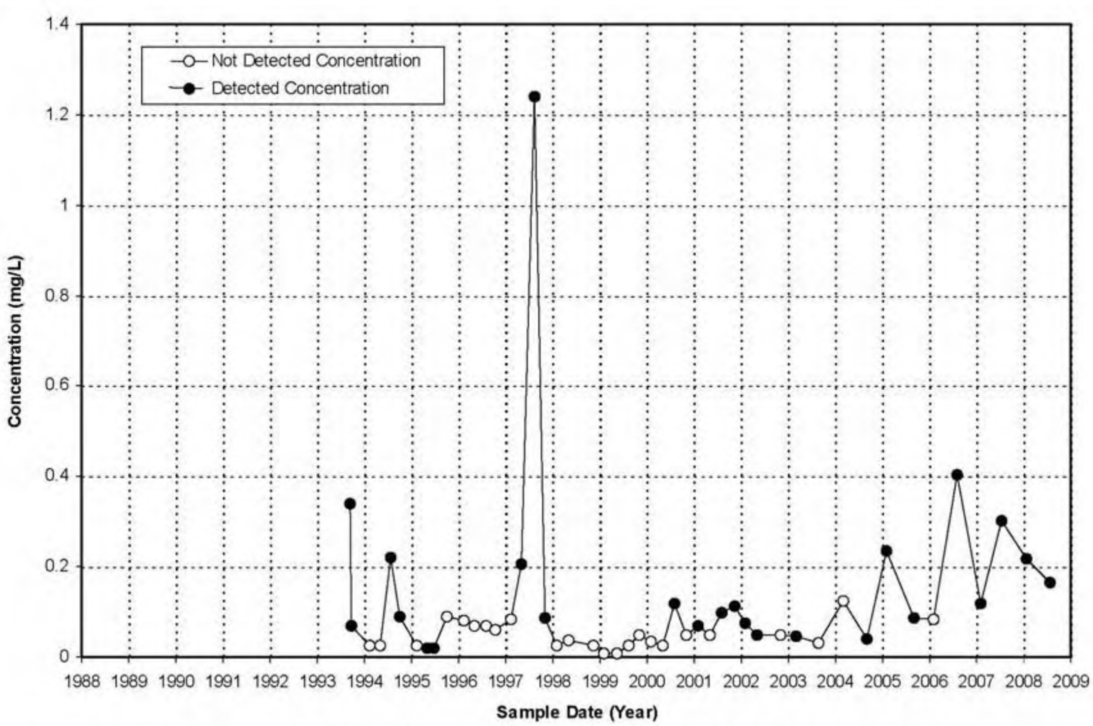

FIGURE A.1-5. PHOSPHORUS CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3898

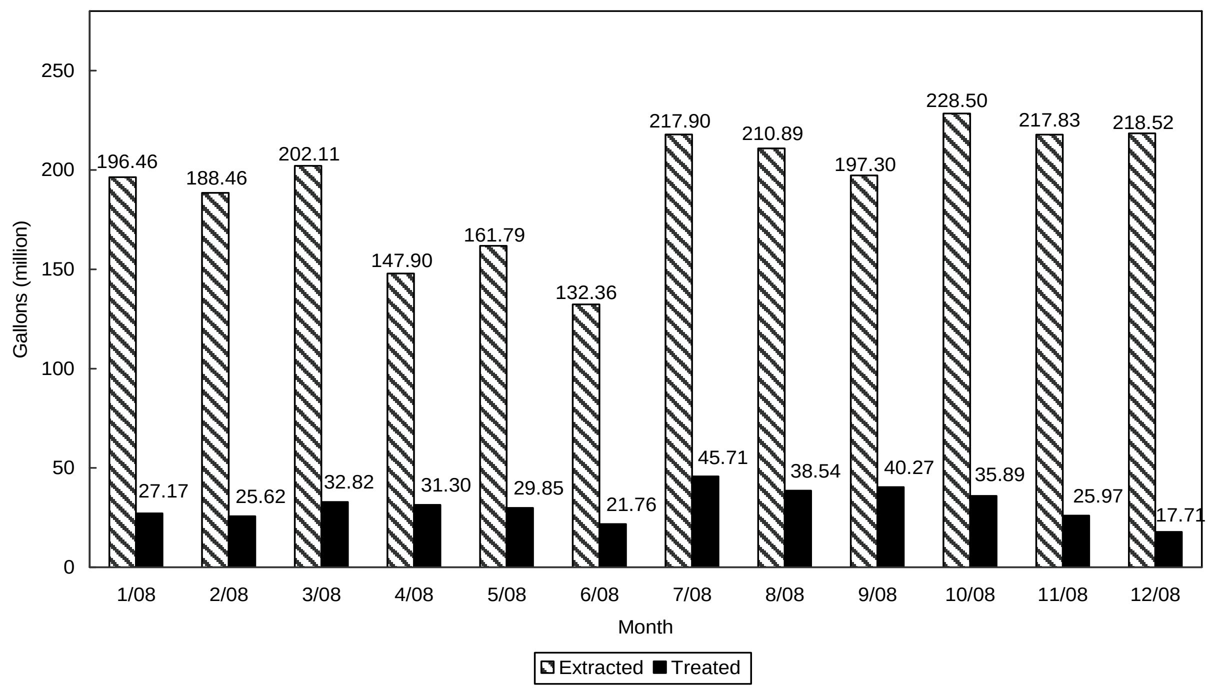

FIGURE A.1-6. TOTAL GROUNDWATER EXTRACTED VS. GROUNDWATER TREATED FOR 2008

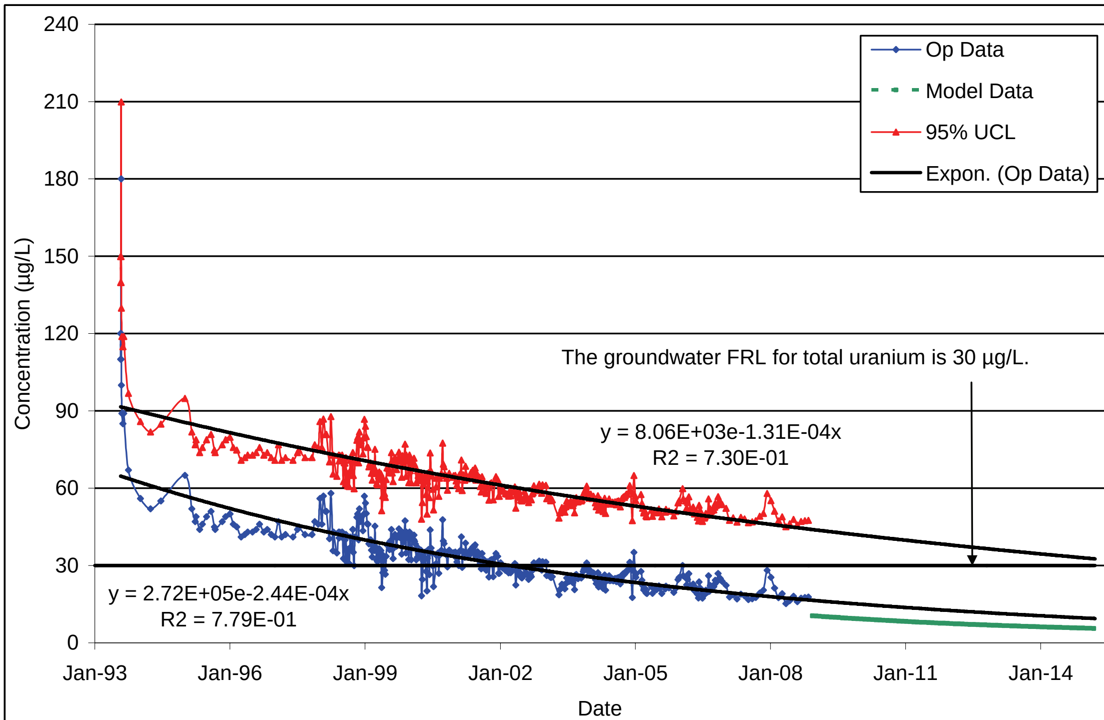

FIGURE A.1-7. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 3924 (RW-1) WITH REGRESSION ANALYSIS

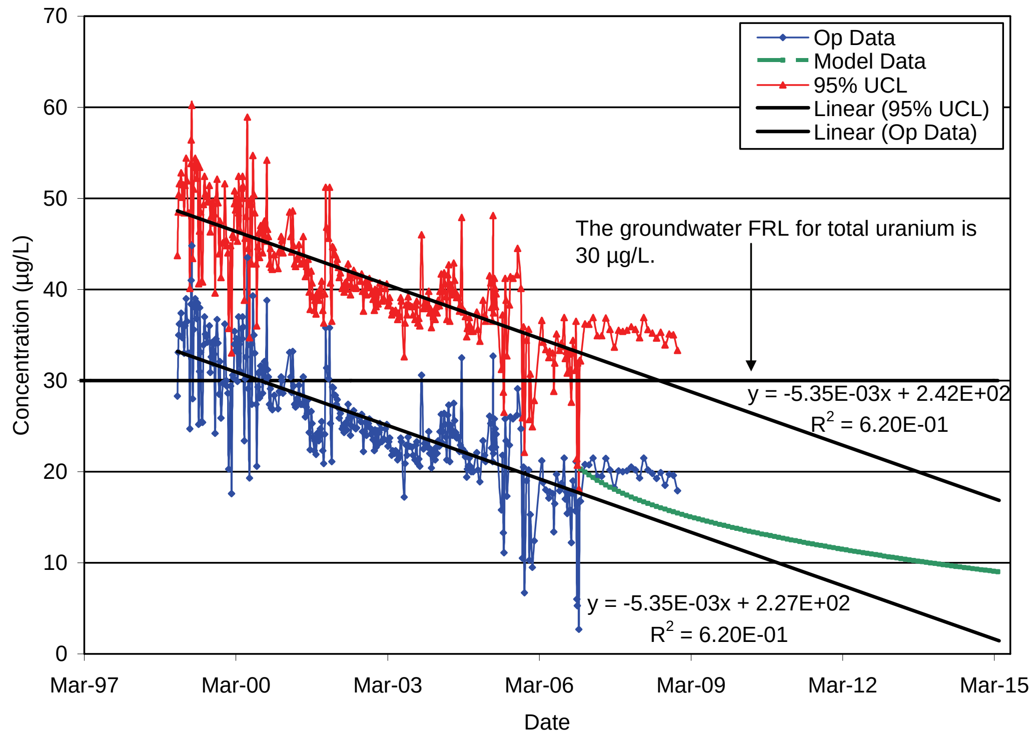

FIGURE A.1-8. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 3925 (RW-2) WITH REGRESSION ANALYSIS

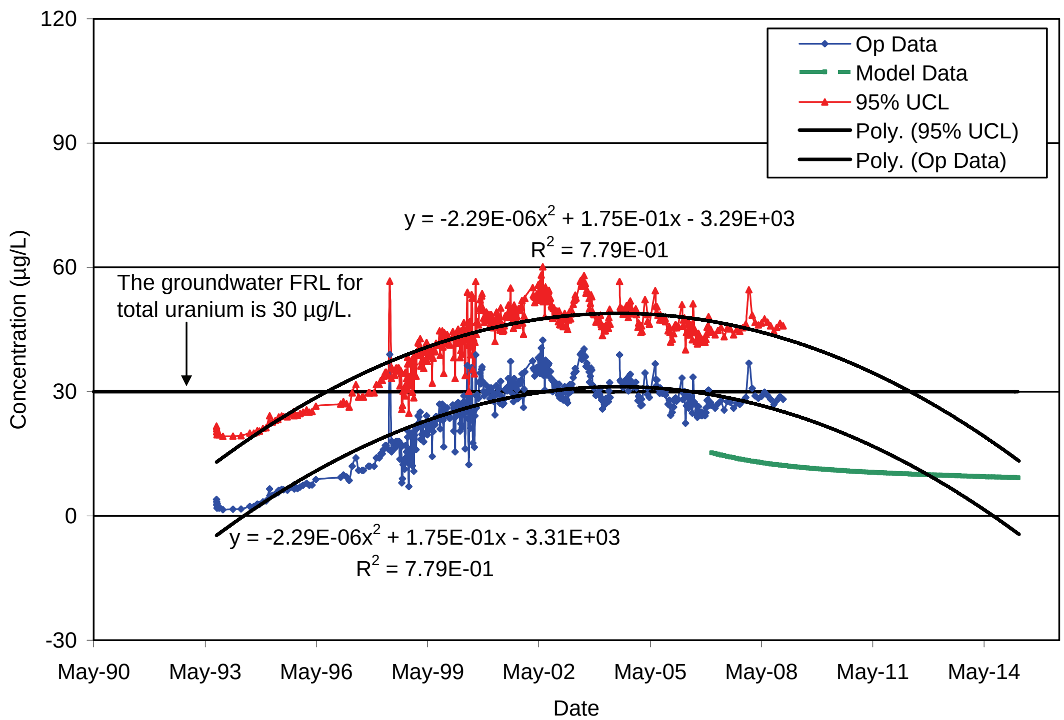

FIGURE A.1-9. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 3926 (RW-3) WITH REGRESSION ANALYSIS

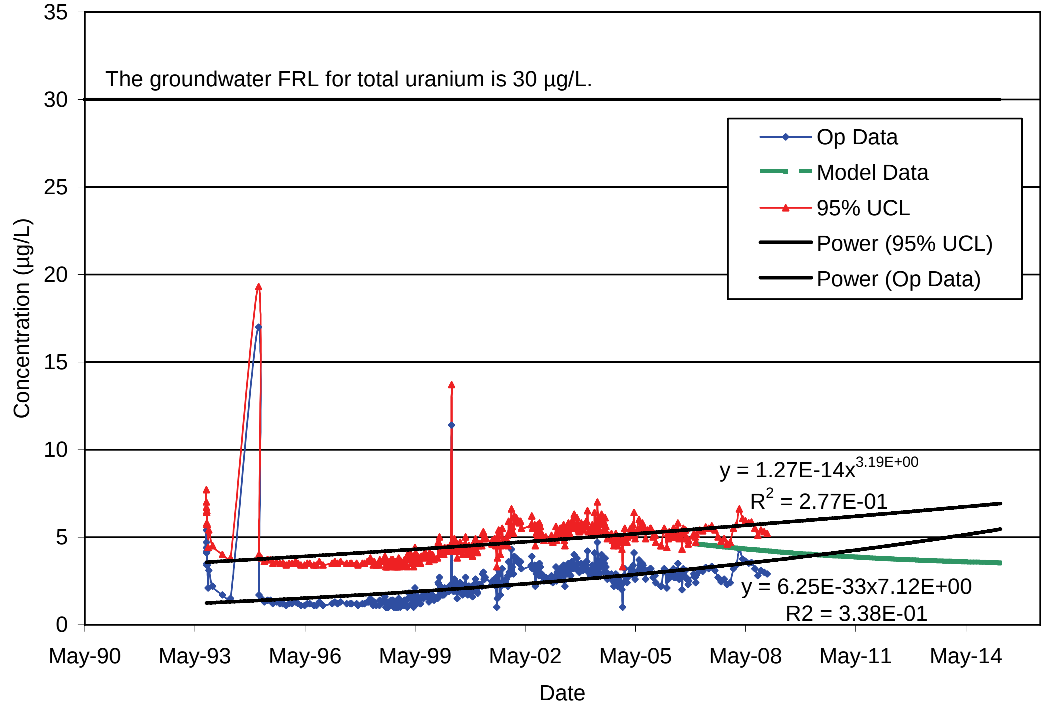

FIGURE A.1-10. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 3927 (RW-4) WITH REGRESSION ANALYSIS

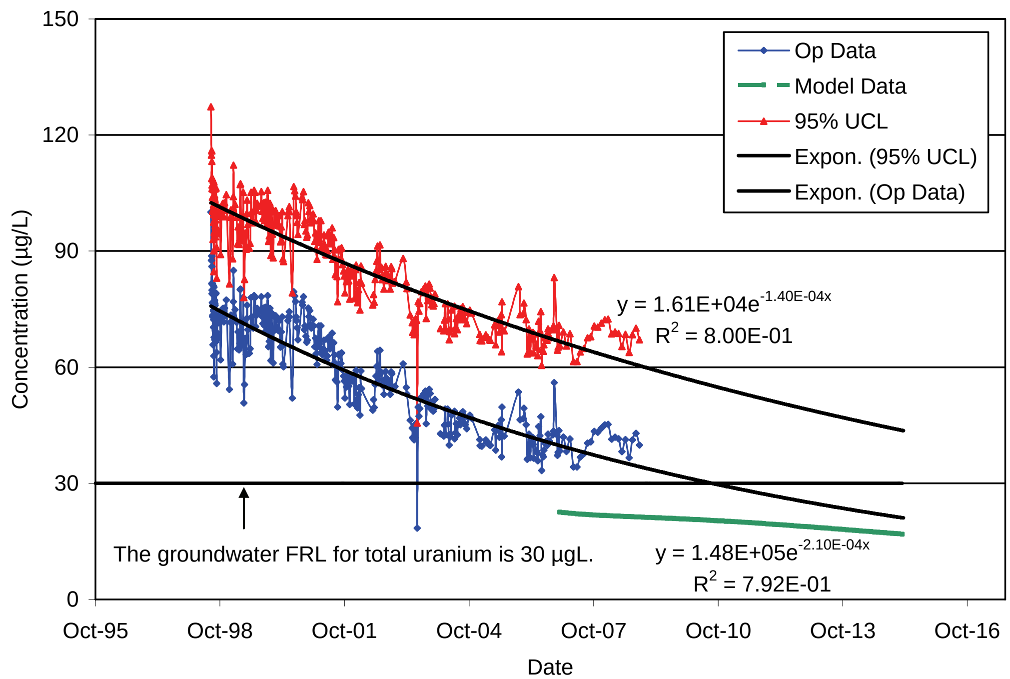

FIGURE A.1-11. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32308 (RW-6) WITH REGRESSION ANALYSIS

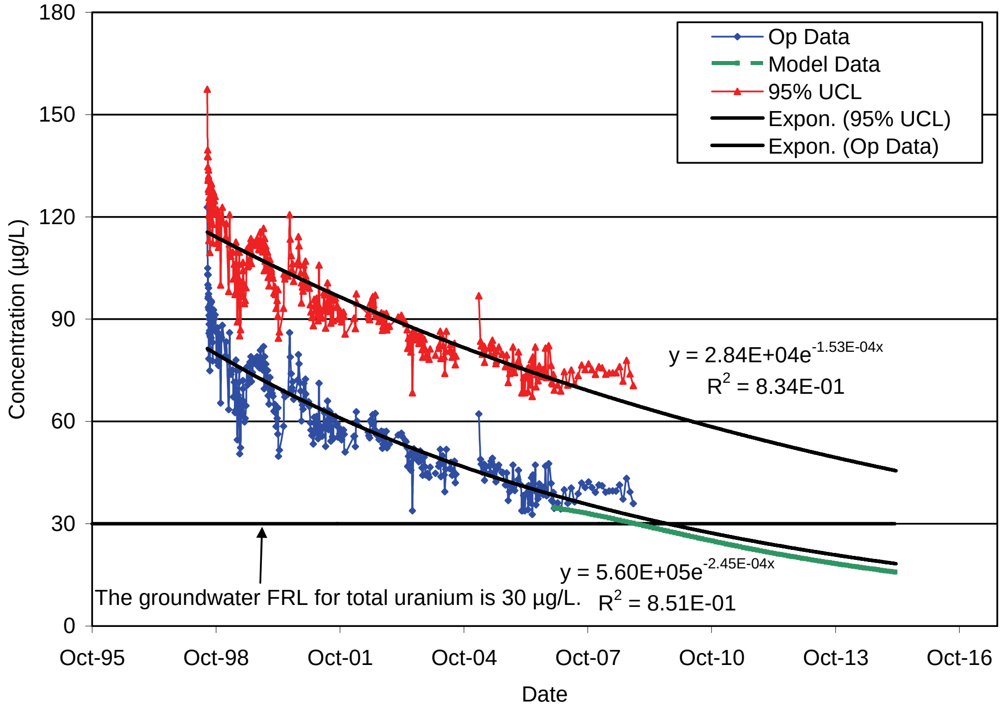

FIGURE A.1-12. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32309 (RW-7) WITH REGRESSION ANALYSIS

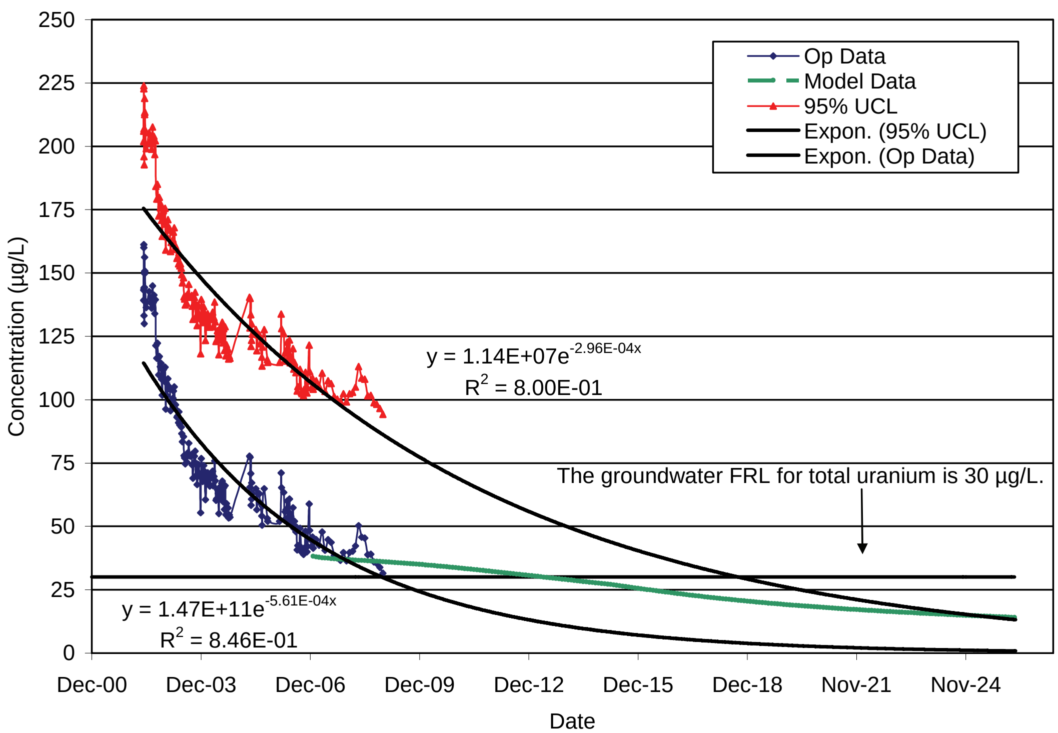

FIGURE A.1-13. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32761 (EW-26) WITH REGRESSION ANALYSIS

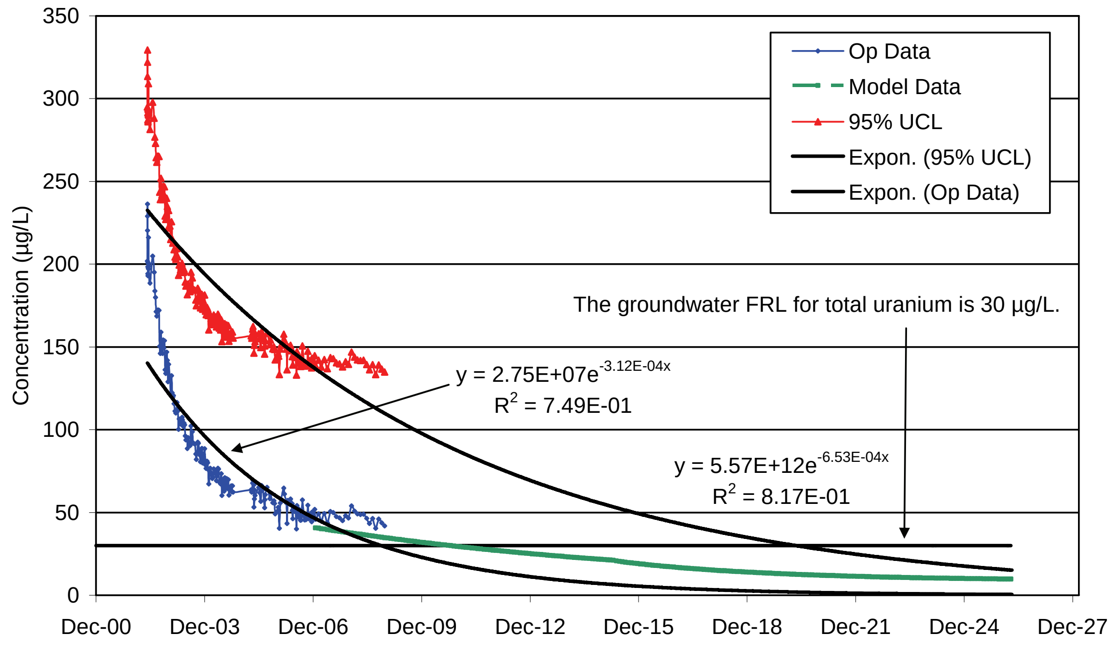

FIGURE A.1-14. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33062 (EW-27) WITH REGRESSION ANALYSIS

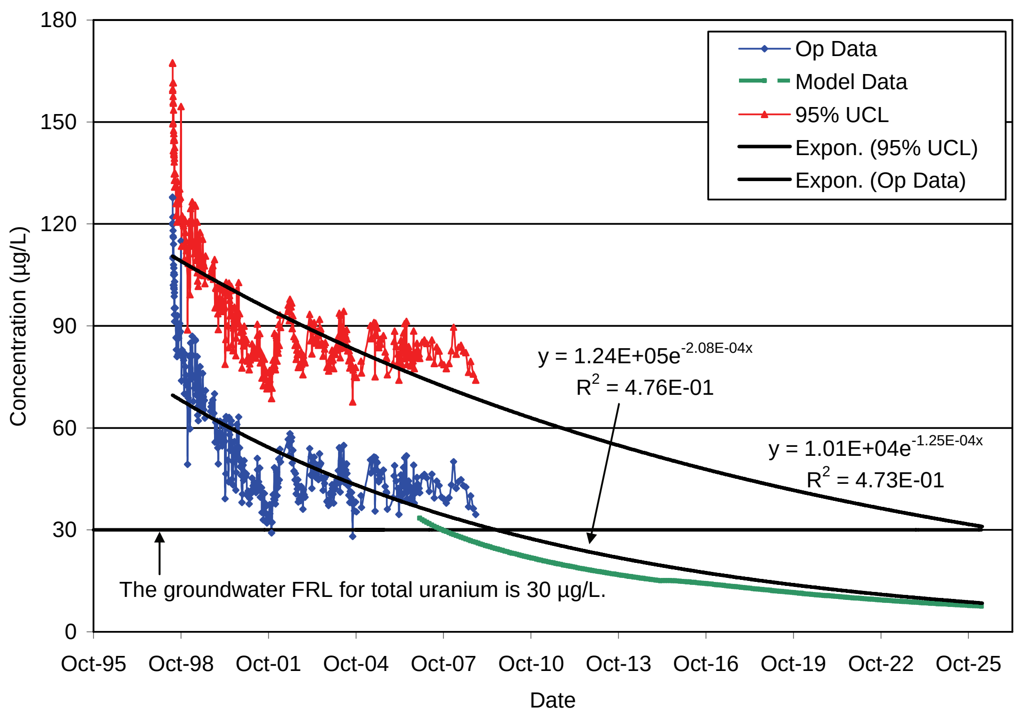

FIGURE A.1-15. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 31550 (EW-18) WITH REGRESSION ANALYSIS

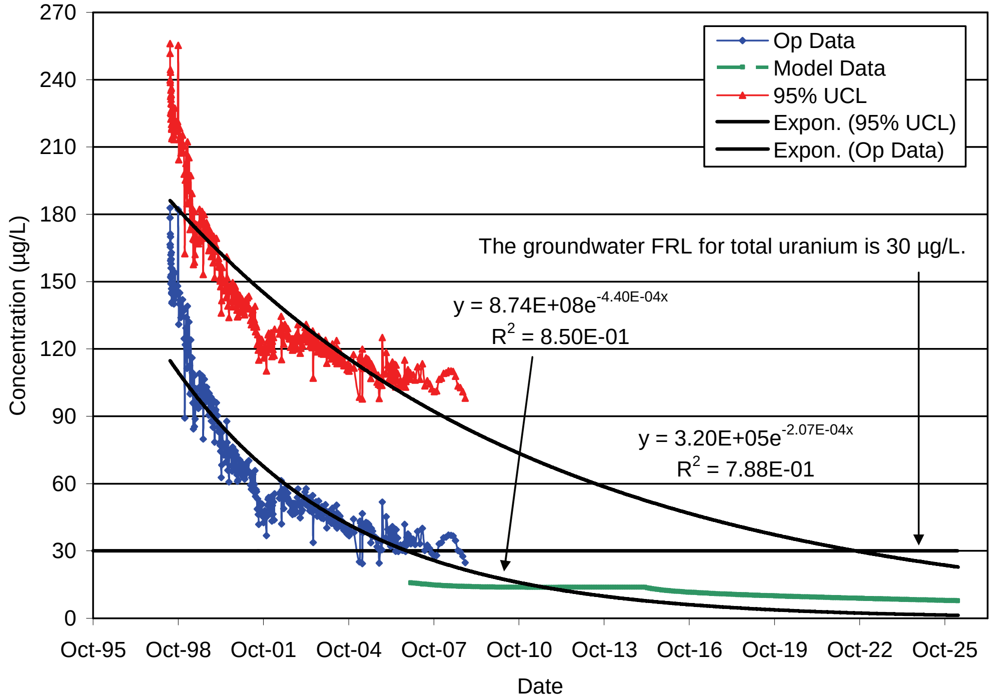

FIGURE A.1-16. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 31560 (EW-19) WITH REGRESSION ANALYSIS

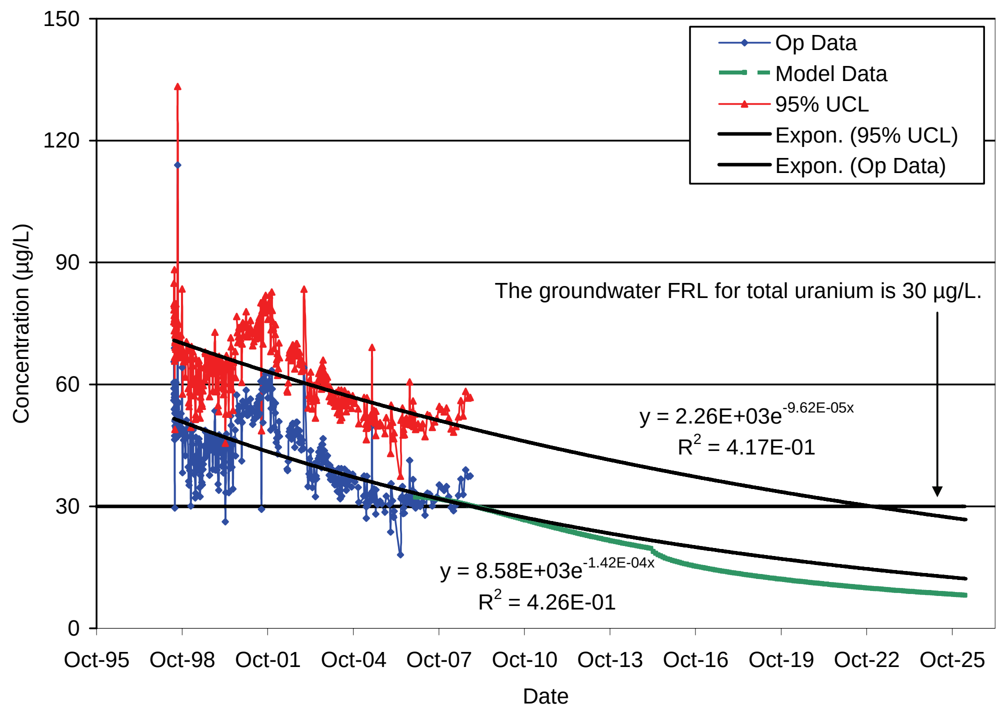

FIGURE A.1-17. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRATION WELL 31561 (EW-20) WITH REGRESSION ANALYSIS

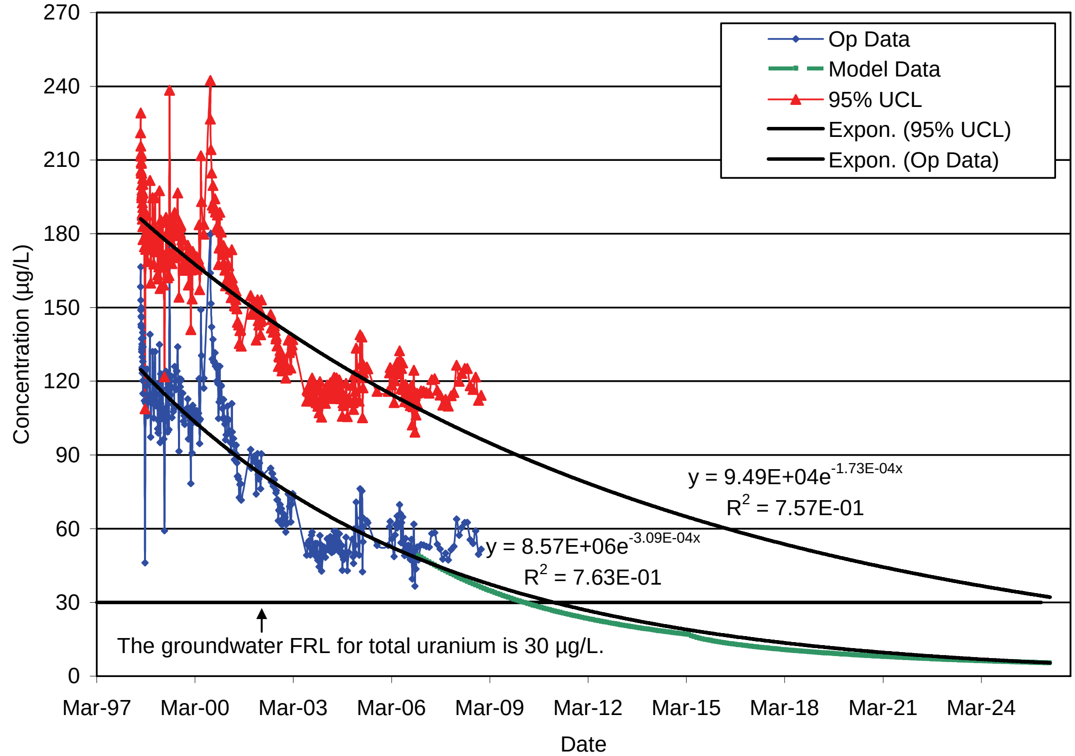

FIGURE A.1-18. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 31562 (EW-21) / 33298 (EW-21a) WITH REGRESSION ANALYSIS

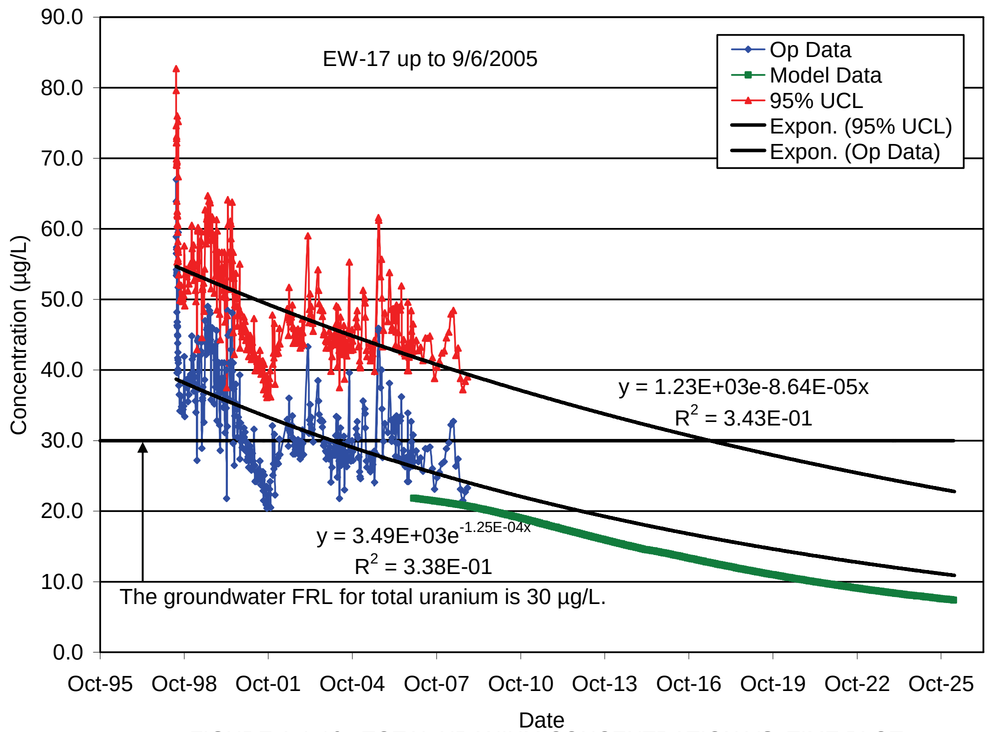

FIGURE A.1-19. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 31567 (EW-17)/ 33326 (EW-17a) WITH REGRESSION ANALYSIS

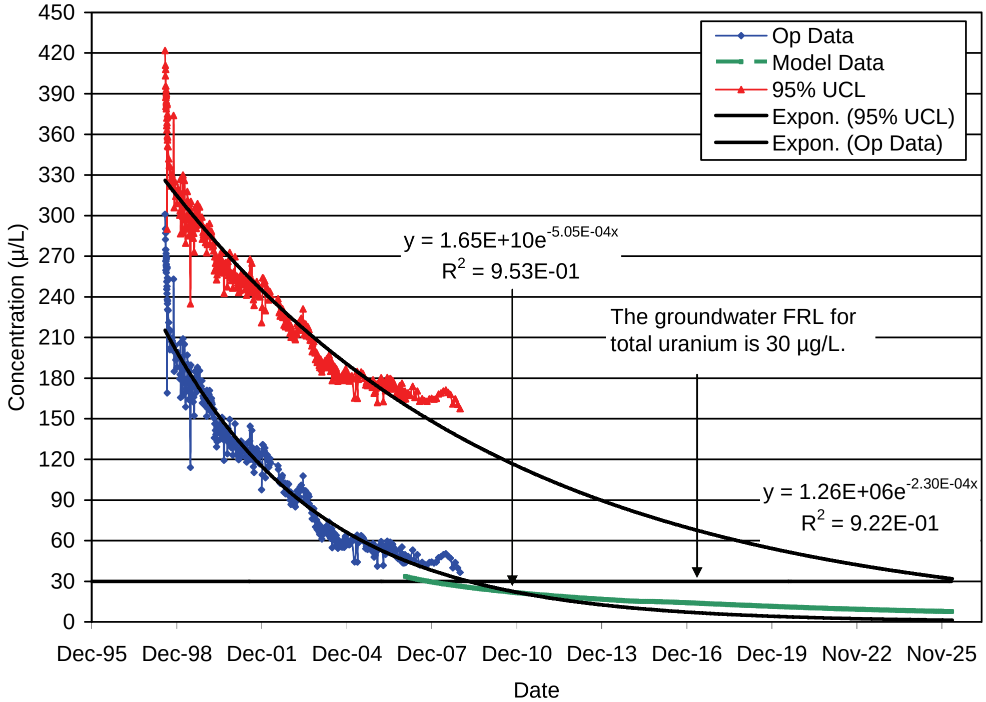

FIGURE A.1-20. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32276 (EW-22) WITH REGRESSION ANALYSIS

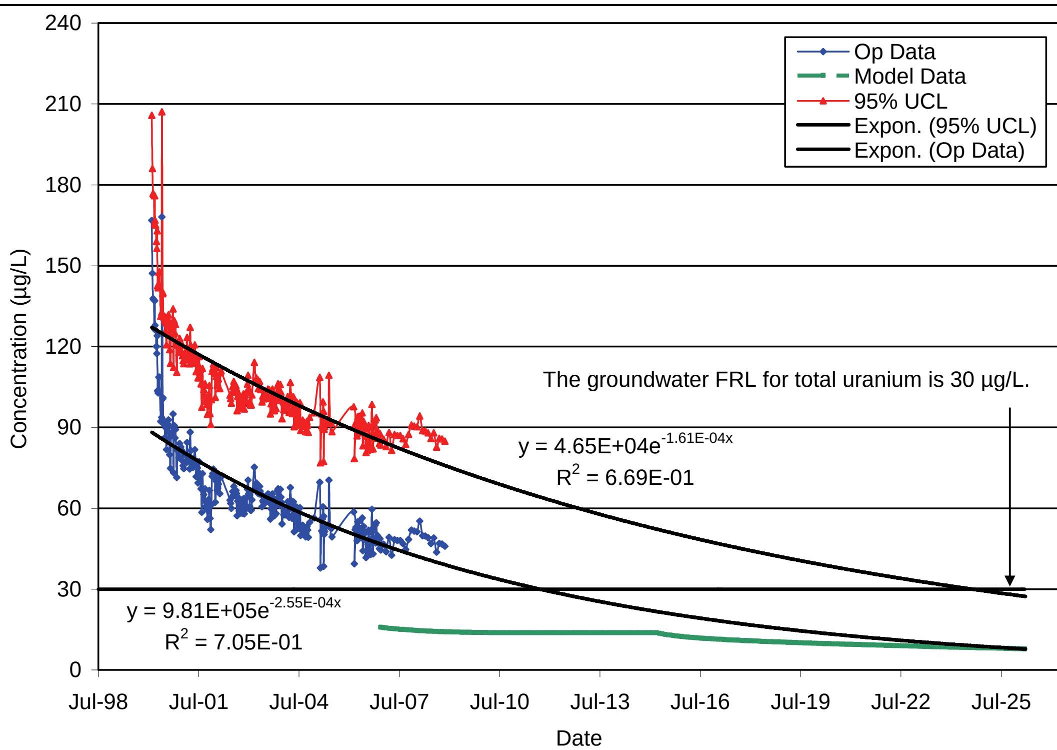

FIGURE A.1-21. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32446 (EW-24) WITH REGRESSION ANALYSIS

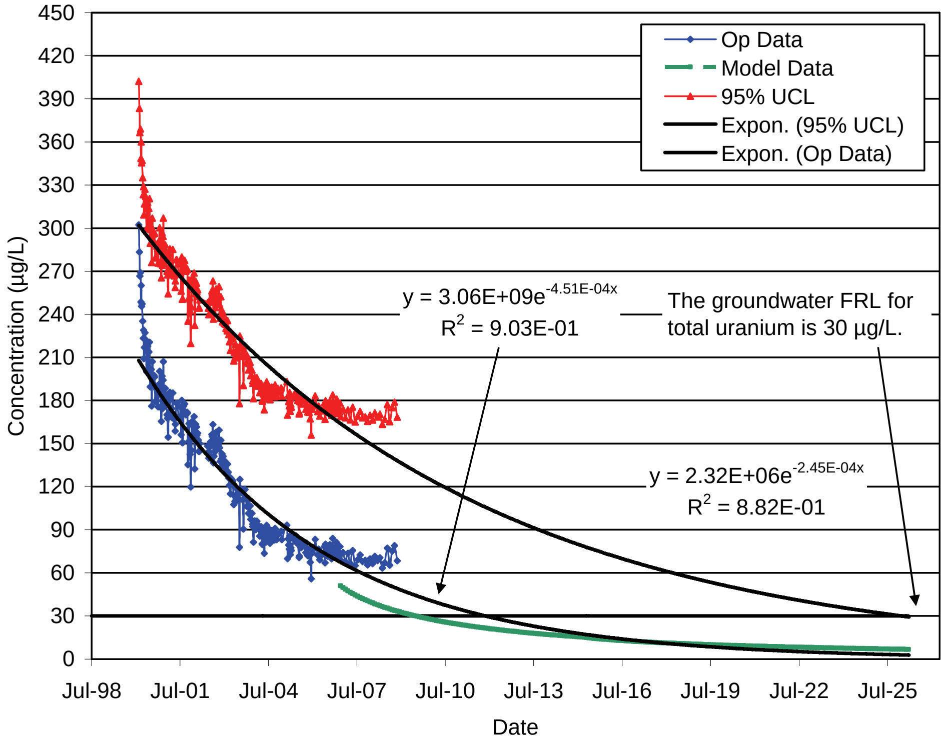

FIGURE A.1-22. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32447 (EW-23) WITH REGRESSION ANALYSIS

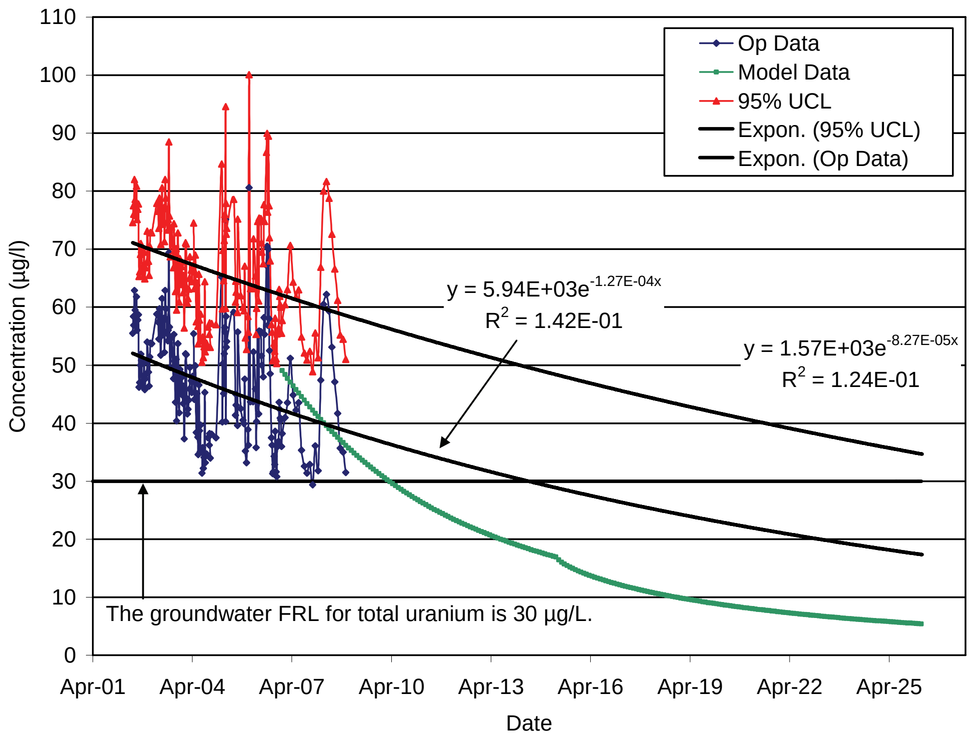

FIGURE A.1-23. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33061 (EW-25) WITH REGRESSION ANALYSIS

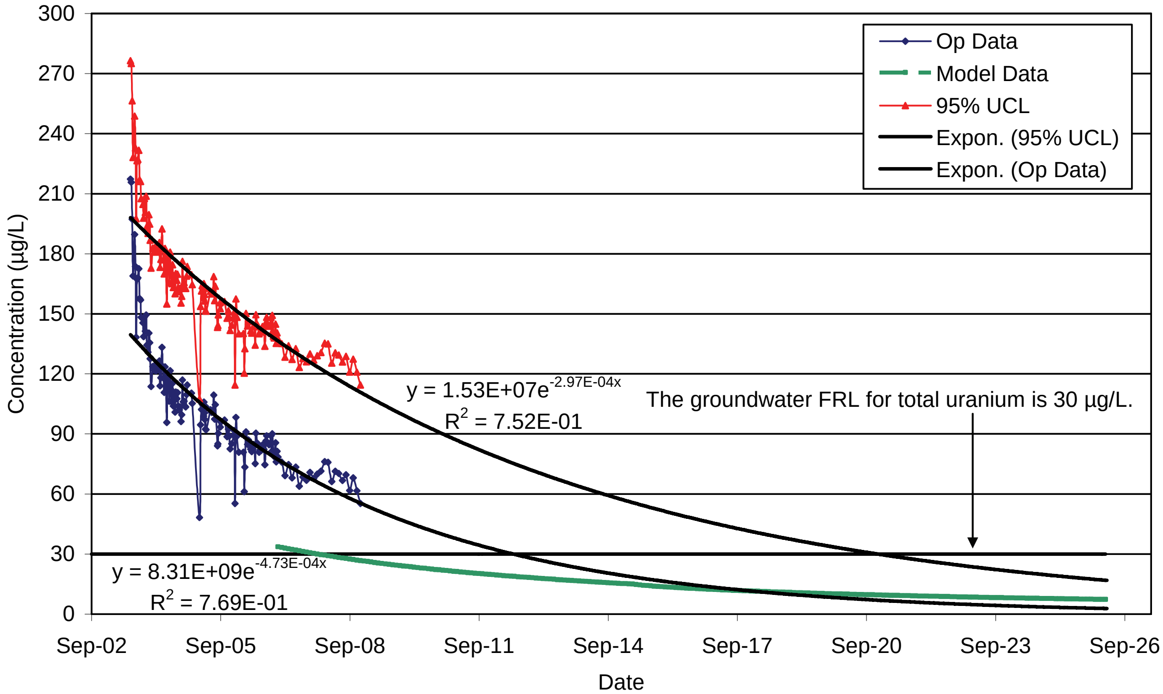

FIGURE A.1.24. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33264 (EW-30) WITH REGRESSION ANALYSIS

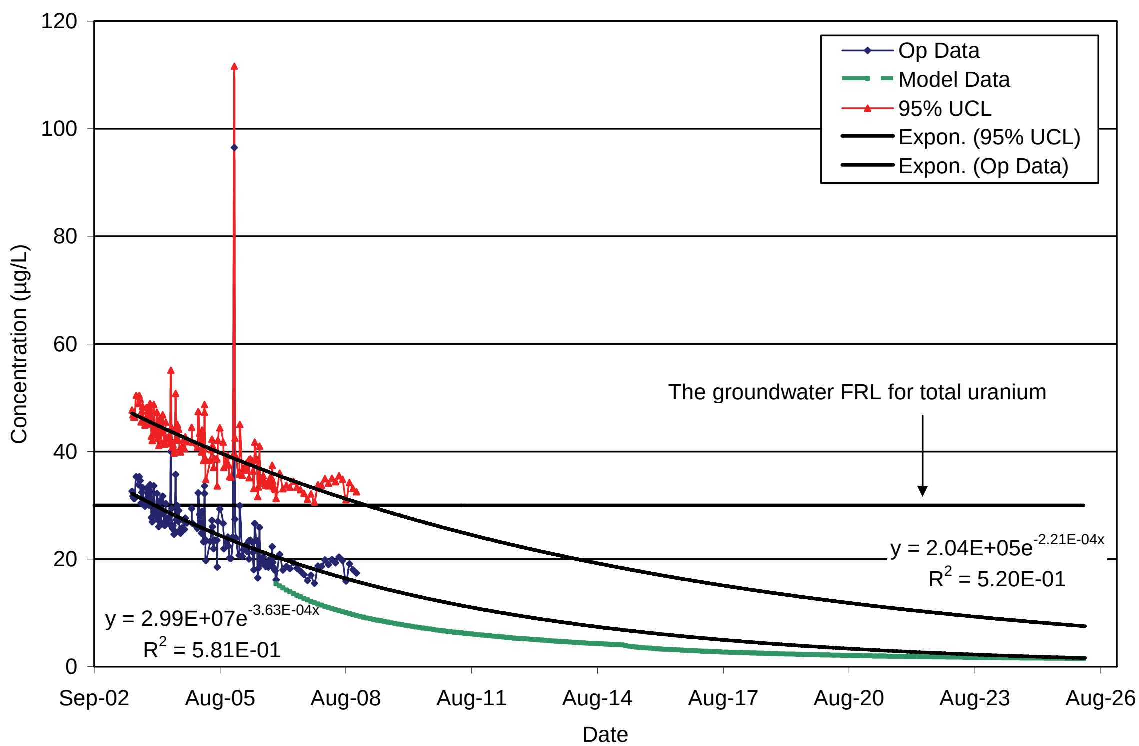

FIGURE A.1-25. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33265 (EW-31) WITH REGRESSION ANALYSIS

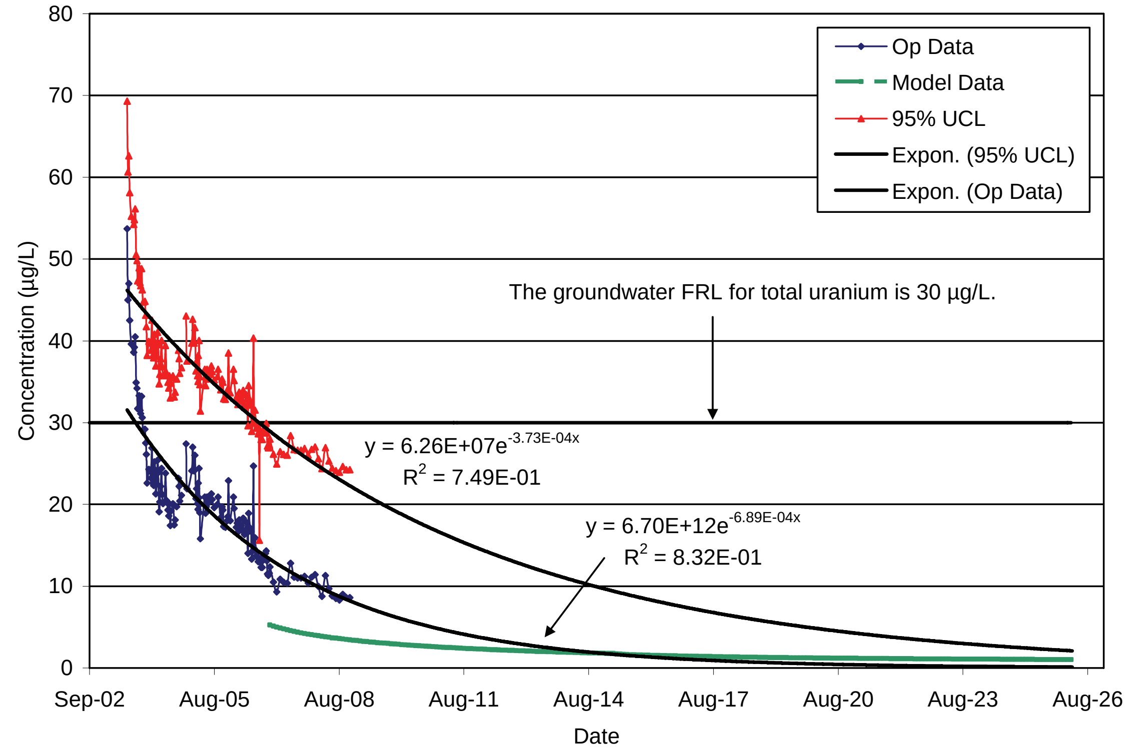

FIGURE A.1-26. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33266 (EW-32) WITH REGRESSION ANALYSIS

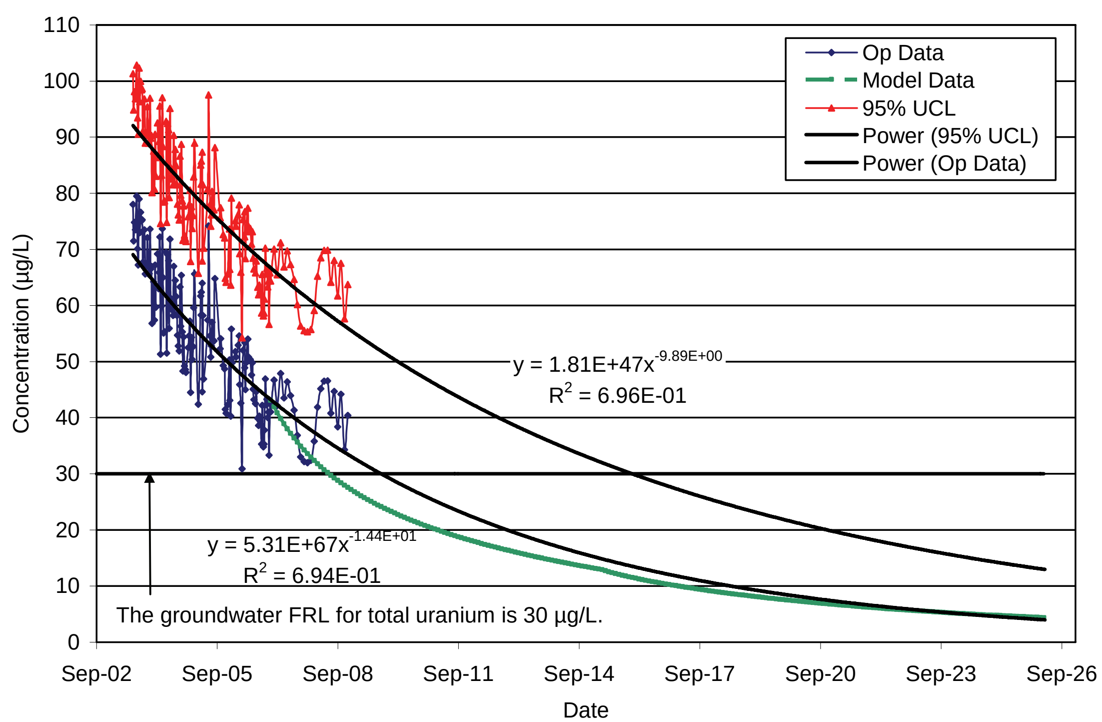

FIGURE A.1-27. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33262 (EW-15a) WITH REGRESSION ANALYSIS

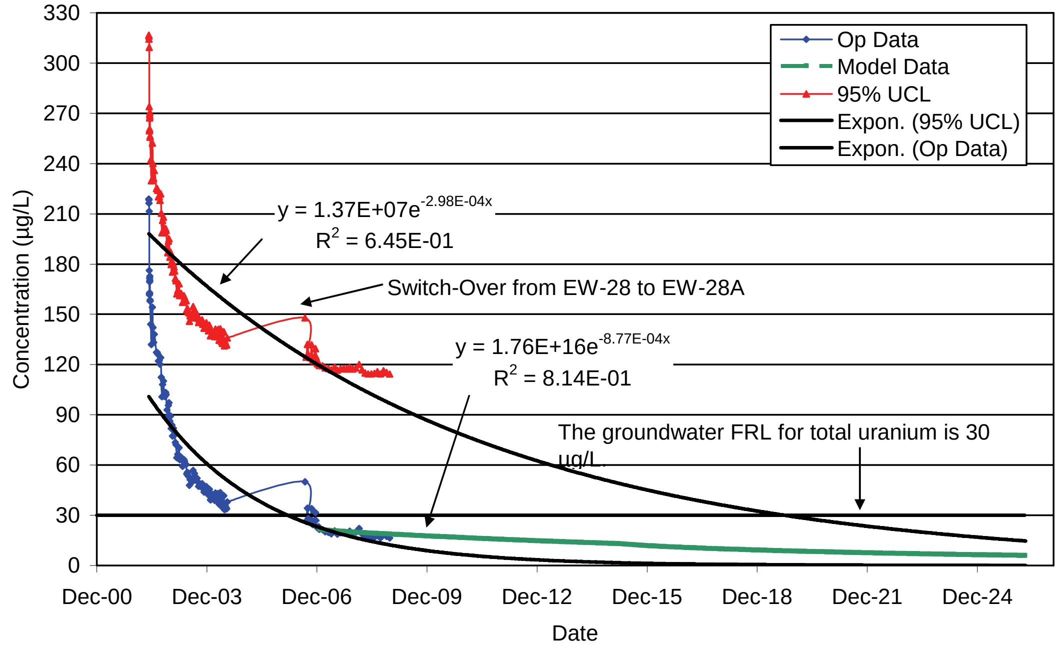

FIGURE A.1-28. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 33063 (EW-28) / 33334 (EW-28a) WITH REGRESSION ANALYSIS

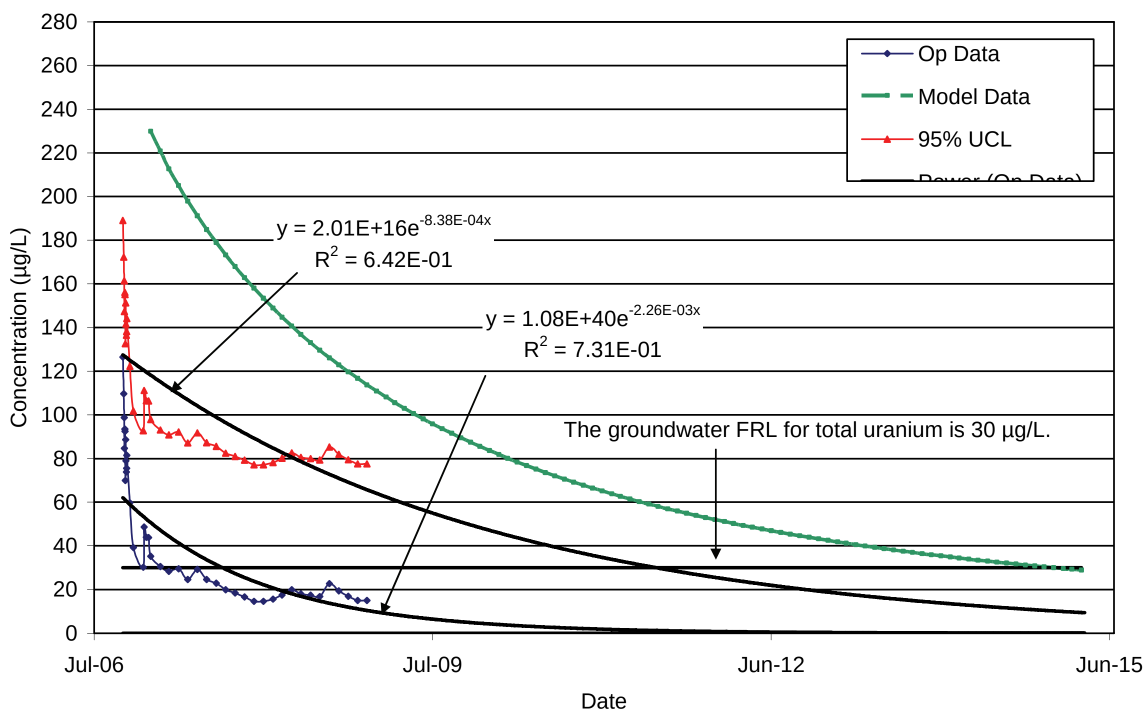

FIGURE A.1-29. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 33347 (EW-33a) WITH REGRESSION ANALYSIS

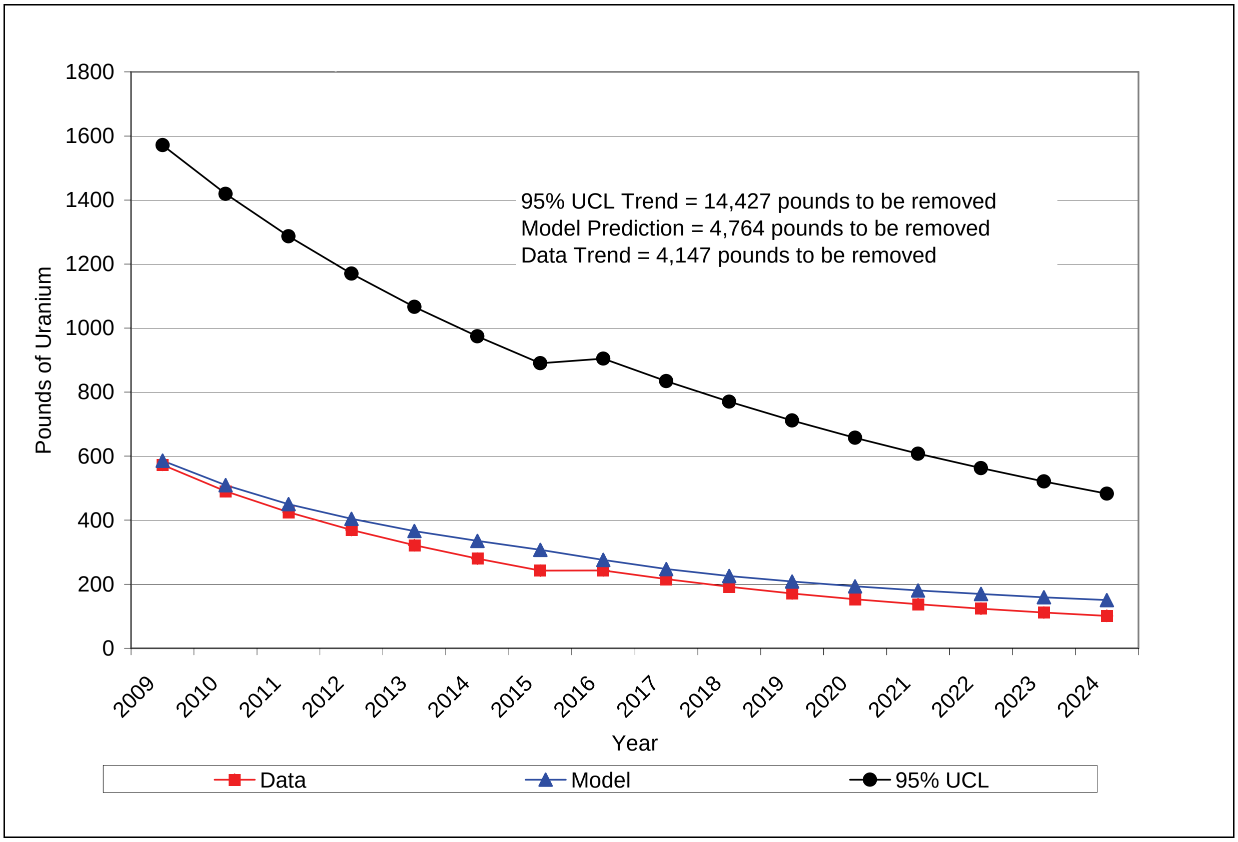

Figure A.1−30. Estimate of Yearly Pounds of Uranium to be Pumped from Aquifer (Model Predictions versus Measured Concentration Trends Data Collected Through 2008)

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Attachment A.2

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A.2.0 Assessment of Total Uranium Results

This attachment discusses groundwater monitoring total uranium results, through 2008. The groundwater total uranium sampling requirements are discussed in the Integrated Environmental Monitoring Plan (IEMP), which is Attachment D of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2008). The monitoring well locations that are sampled for total uranium are listed in Table A.2−1. IEMP groundwater monitoring and extraction well locations are shown in Figure A.2−1. For integration purposes, the on-site disposal facility (OSDF) monitoring well locations are also shown on Figure A.2−1 and Table A.2−1. In addition to the routine well monitoring specified in the IEMP, 19 locations were sampled using a direct-push sampling tool (i.e., Geoprobe®) in 2008.

Figures A.2−2A, A.2−2B and A.2−3A, A.2−3B show maximum total uranium plume maps for the first and second halves of 2008, respectively. Figures A.2–2A and A.2–3A show direct-push data, Figures A.2–2B and A.2–3B show monitoring well and extraction well data. Data collected from the aquifer are used to progressively update the maximum total uranium plume maps in the following manner:

- Total uranium concentration data are posted on a map with the contours from the previous map. The highest representative total uranium value at a monitoring well location is posted. The highest concentration associated with each direct-push location is also posted.
- If a recently measured concentration from a well is greater than the previous concentration contour value at that location, then the plume is re-contoured to honor the higher value.
- If the most recent concentration measurement from a well is less than the previous contour for that location, then the new data are posted but the plume contours are not adjusted to honor the new data until confirmatory direct-push sampling can be conducted.
- If direct-push data are available and a complete vertical profile of an area indicates that concentrations have changed, then the map is re-contoured to honor the new direct-push data.

Table A.2−2 lists the monitoring wells where total uranium concentrations exceeded the 30 µg/L FRL during 2008. Included in the table are total uranium statistical summaries for each well, which include Mann Kendall trend analyses. Table A.2−3 provides total uranium statistical summaries for the extraction wells including Mann Kendall trend analyses. Figure A.2−4 illustrates the statistics presented in Table A.2−2 (e.g., where total uranium concentrations have, if any, an "up, significant," "down, significant," or a "no significant" trend). Figures A.2−5 through A.2−154 present total uranium concentration versus time plots for those wells listed in Table A.2−1. These plots also show the screen interval for Type 2 wells (if available) and water levels.

Attachment A.2 is subdivided into the following sections:

- A.2.1 Waste Storage Area
- A.2.2 Plant 6 Area
- A.2.3 South Field and Off-Property South Plume Area
- A.2.4 Flow Monitoring in the Storm Sewer Outfall Ditch (SSOD).

A.2.1 Waste Storage Area

Highlights for 2008 include the following:

- Direct-push sampling conducted at six locations in the former waste storage area in 2008 (Section A.2.1.1)
- Waste Storage Area Maximum Uranium Plume (Section A.2.1.2)
  - — The former waste storage area portion of the maximum uranium plume is 22.429 acres in size. An increase of 0.9 acres from 2007. Increase is in the northwest corner due to new data collected at Location 13374.
  - — A new high uranium concentration measured in Channel 1 at Monitoring Well 83337.
  - — Additional attempt to verify the extent of the uranium FRL exceedance measured at Monitoring Well 83341 in 2006.
  - — Verification of the western edge of the maximum uranium plume in the former waste storage area at Location 13375.
- Pilot Plant Drainage Ditch Maximum Uranium Plume (Section A.2.1.3)
  - — The Pilot Plant Ditch portion of the Maximum Uranium Plume is 26.240 acres in size. No change from 2007. The concentration of the plume though was reduced based on data collected in 2008 at Location 13376.

A.2.1.1 Direct-Push Sampling in the Waste Storage Area

In 2008 six locations were sampled in the former waste storage area using a direct-push sampling tool (13370A, 13374, 13375, 13378, 13379, and 13380). Direct-push sampling results are provided in Tables A.2−4 through A.2−22.

All of the direct-push sampling locations were sampled for total uranium. Locations 13370A, 13379, and 13380 were also sampled for Waste Storage Area Constituents. Locations 13379 and 13380 were selected to further define the western edge of the maximum manganese plume in the Waste Storage Area. Results of the manganese plume verification, as well as the other non-uranium results, are discussed in Attachment A.4.

A.2.1.2 Waste Storage Area Maximum Uranium Plume

2008 Plume Status

At the end of 2007 the need to conduct additional direct-push sampling in the northwest corner of the Waste Storage Area Maximum Uranium Plume was identified to further delineate the extent of the plume.

In 2008, additional direct-push sampling was conducted at two locations (13374 and 13378). Results were used to expand the northwest side of the maximum total uranium. The revised 30 μg/L maximum uranium plume measures approximately 22.429 acres (excluding the Pilot Plant Drainage Ditch Portion) and adds approximately 0.906 acres to the Waste Storage Area Maximum Uranium Plume, compared to the plume defined in 2007.

Tables A.2–6 and A.2–10 present direct-push sampling results for Locations 13374 and 13378, respectively. Location 13374 was sampled first. The area near the water table was targeted for sampling, and as the data indicates, a uranium concentration of 70 μg/L or greater was detected down to 20 ft below the water table where sampling ended. Based on results at Location 13374, deeper samples were collected at Location 13378. The data indicates that no groundwater uranium FRL exceedances were detected down to a depth of 30 ft below the water table.

The northwest corner of the maximum uranium plume in the former waste storage area is bounded by Paddys Run to the west, and the former waste pits to the east. Intermittent puddles of surface water collect in this area west of the former Waste Pit 3. Surface water samples are collected and analyzed from these small intermittent puddles. The uranium concentration of some of the collected samples exceeds groundwater FRL limits. Location 13374 (from 2008) and Location 13369 (from 2007) are situated near where the surface water collects and infiltrates into the ground. This infiltrating water has likely contributed to the groundwater uranium FRL exceedances measured in the northwest corner of the maximum uranium plume in the former waste storage area. It is also possible uranium contamination is sorbed to aquifer sediments in the vadose zone of the aquifer in this area. When water levels are high enough to saturate portions of the vadose zone, the sorbed contamination that is present can dissolve into the groundwater.

In addition to rising water levels, increased infiltration of surface water could also help to flush sorbed contamination from the aquifer sediment. Surface grading completed in 2006 in the former waste storage area directs surface water runoff to where the clear well and pit 3 were once located. The surface water is allowed to infiltrate into the ground and serve as a source of recharge to the aquifer. Increased infiltration will help flush sorbed contamination from the aquifer sediments.

New High Uranium FRL Exceedance Measured in Channel 1 at Monitoring Well 83337

As discussed in Appendix A.3, high precipitation levels in 2008, coupled with two planned well field shutdowns, resulted in achieving high water levels in the aquifer in 2008. Allowing the water level to rise is good in that it re-saturates portions of the vadose zone and works to dissolve contamination sorbed on the aquifer sediments there.

A new high uranium concentration for well 83337 (2,210 μg/L) was measured in July 2008 in Channel 1. This new high is attributed to the flushing of sorbed contamination from the vadose zone in this area due to the high water levels realized in 2008.

Additional Attempt to Verify the Extent of the Uranium FRL Exceedance Measured at Monitoring Well 83341 in 2006.

Monitoring well 83341, with three sampling channels, was installed in the former waste storage area in 2006 to monitor the aquifer off the northeast corner of former waste pit 3. The northeast corner was a low point in the pit, so if the pit had leaked prior to or during source removal, that would have been a logical location for the leak to have occurred.

Monitoring Well 83441 was sampled for the first time in July 2006. A uranium concentration-versus-time plot is provided in Figure A.2–153. A small total uranium plume has been mapped at this location since 2006. Uranium FRL exceedances have only been detected in Channel 1, the shallowest channel, which is situated at an elevation of approximately 518.25 ft amsl. Sampling results continue to support the observation that a uranium groundwater FRL exceedance exists in a thin zone of water near the water table at this location; when the water table is at or above an elevation of 518.25 ft amsl.

For the past 2 years, direct-push sampling has been conducted just south of Monitoring Well 83341 (Location 13370) to establish the extent of the uranium FRL exceedance. In both years, water levels were too low to be conclusive.

In 2007 the shallowest sample collected came from an elevation of approximately 514.3 ft amsl. No uranium FRL exceedance was measured. In 2008 the shallowest sample collected came from an elevation of approximately 515 ft amsl (Table A.2–5). Although the 2008 sample was collected from a slightly higher elevation, the elevation was still approximately 3.25 ft too low.

Additional direct-push sampling will be conducted, when water levels are at or higher than 518.25 ft amsl to determine if additional shallow FRL exceedances are present. Lack of additional shallow exceedances would indicate that the exceedance measured in Channel 1 at monitoring well 83341 is isolated and most likely was sourced from the northeast corner of former Waste Pit 3.

It is expected that the groundwater FRL exceedance for uranium at Monitoring Well 83341 will dissipate rather quickly on its own now that the source excavation activities in the former waste storage area are complete. Particle path modeling indicates that monitoring well 83341 is located within the model predicted capture based on the Waste Storage Area (Phase II) Design. A map displaying particle paths for the Waste Storage Area (Phase II) Model Design is provided in Attachment A.3 (Figure A.3−5).

Verification of the Western Edge of the Maximum Uranium Plume in the Waste Storage Area at Location 13375

A direct-push sample was collected at Location 13375 to re-verify that the western extent of the maximum uranium plume in the former waste storage area is properly defined. Results are presented in Table A.2–7. As the data indicates, no FRL exceedances were detected indicating that the western extent of the plume appears to be properly defined. Additional checks will be made in this area as the pump and treat portion of the aquifer remedy progresses.

A.2.1.3 Pilot Plant Drainage Ditch Maximum Uranium Plume

The acreage of the Pilot Plant Drainage Ditch total uranium plume in 2008 remains unchanged from 2007, at 26.24 acres. The concentration of the plume though was reduced based on data collected in 2008 at Location 13376.

Location 13376 is located right next to an old direct-push location (12708) which was probed in March 2000. The highest uranium concentration measured in March 2000 was 566 µg/L; at an elevation of 509.02 ft amsl. As shown in Table A.2–8, the highest uranium concentration measured in 2008 at Location 13376 was 218.4 µg/L at an elevation of 516 ft amsl. Based on the 2008 results, the 1000 µg/L contour was removed from the map, and the 500 µg/L and 400 µg/L contours slightly reduced.

This area will be targeted for sampling several more times during the pump-and-treat stage of the aquifer remedy, using a direct-push sampling tool to further assess how the remedy is progressing.

A.2.2 Plant 6 Area

Plans for a restoration module in the Plant 6 area were abandoned in 2001 based on the outcome of the Design for Remediation of the GMA in the Waste Storage and Plant 6 area. This design provided data that indicated that the total uranium plume in the Plant 6 area was no longer present. The EPA and OEPA concurred with this decision.

Monitoring well 2389 is the only groundwater monitoring well remaining in the area where Plant 6 was located. As indicated in Figure A.2−28, sporadic uranium FRL exceedances have been detected since 2002 at monitoring well 2389.

Direct-push sampling is conducted in the area to supplement monitoring well results. Previous direct-push sampling in the area indicates that the FRL exceedances are limited to a depth right at the water table. A small uranium plume is shown circling monitoring well 2389 on the maximum total uranium plume map (Figures A.2–2B and A.2–3B).

A.2.1.3 2008 Monitoring Update

Monitoring well 2389 was sampled twice during 2008. No uranium groundwater FRL exceedances were measured. The sample collected on March 26, 2008 had a uranium concentration of 15 µg/L. The sample collected on October 22, 2008 had a uranium concentration of 21.3 µg/L.

Another attempt at collecting a direct-push sample at an elevation comparable to the elevation of the exceedances detected in Monitoring Well 2389 was made in 2008 at Location 13360A. This attempt was successful. A comparison to last years result is provided below.

Year	Location	Uranium Concentration (µg/L)	Elevation (ft amsl)
2007	13360	< 1.0	512
2008	13360A	37.2	515

Location 13360 is located approximately 74 ft southwest of monitoring well 2389. It should be noted that Location 13360A is the same as Location 13360. The letter designates that it is a repeat sampling of the same location at a different time.

Location 13360 was selected to investigate the possibility that an abandoned steel-lined shaft that was located 87 ft southwest of monitoring well 2389 may have provided a pathway for contamination to reach the shallow portions of the aquifer. As reported in the 2005 SER (DOE 2006), a steel manhole covering a steel-lined shaft was identified in late 2005. The manhole and steel-lined shaft are believed to have been associated with the elevator piston mechanism of Plant 5. The shaft was pulled from the ground, and the remaining hole was plugged with bentonite pellets in April 2006. The abandoned steel lined shaft was deep enough to breach the aquifer and could have provided a potential contamination pathway to the aquifer providing an explanation for the thin layer of uranium contamination that has been detected in the upper 1 ft or so of the aquifer in the location of monitoring well 2389.

Results from 2008 appear to confirm that this former shaft could have served as a contaminate pathway. The 37.2 μg/L uranium concentration measured in 2008 at an elevation of 515 ft amsl is very close to the elevation of the exceedances measured in Monitoring Well 2389 (516 to 519 ft amsl).

This area will be targeted for additional direct-push sampling during the pump and treat stage of the aquifer remedy, when the water table elevation is at an elevation of 515 ft amsl or higher.

A.2.3 South Field and Off-Property South Plume Uranium Plumes

Highlights for 2008 include:

- Direct-push sampling conducted at 10 locations in the South Field/South Plume Area in 2008 (Section A.2.3.1).
- South Field/South Plume Maximum Uranium Plume (A.2.3.2).
  - — The South Field/South Maximum Uranium Plume is 137.946 acres in size. Unchanged from 2007.
  - — Decreased uranium concentrations measured in the former Flyash Area portion of the total uranium plume.
  - — Uranium concentration changes in the South Plume.
  - — Update of cross-sections along Willey Road.

A.2.3.1 Direct-Push Sampling

During 2008, direct-push sampling was conducted at 10 locations in the South Field and Off-Property South Plume Uranium Plumes:

- Three locations in the former Inactive Flyash Pile Area (Locations 12824A, 12826A, and 12837A).
- Two locations in the South Plume (13229B and 13230B).
- Five locations along Willey Road (12370J, 12369N, 12372N, 12368J, and 12373N).

All of the locations were sampled for total uranium, starting approximately 5 ft beneath the water table, and then at successive 10-ft-deep intervals. Direct-push sampling results are presented in Tables A.2−4 through A.2−22.

A.2.3.2 South Field/South Plume Maximum Uranium Plumes

Uranium Concentration Decrease Observed in the Former Flyash Area Portion of the Maximum Total Uranium Plume

Three previous direct-push locations in the Former Flyash Area were re-sampled in 2008 using a direct-push sampling tool. Locations 12824, 12826, and 12837 were originally sampled in 2001. Results for 2008 are provided in Figures A.2–13, A.2–14, and A.2–15 respectively. A comparison of the 2001 results to the 2008 results is provided below.

Results from 12824 and 12824A		
Midpoint Screen Elevation (ft amsl)	**Location 12824 Date: 2001 Midpoint of 2-ft screen**	**Location 12824A Date: 2008 Midpoint of 10-ft screen**
514		632.2
511	403	
504	30	124.4
494	20	18.6
484	34	15
474	29	
464	2.1	
545	1.0	

Comparison of results between 2001 and 2008 matches data collected from the midpoint of a 2-ft sampling screen to data collected from the midpoint of a 10-ft sampling screen. The higher concentration measured in 2008 is attributed to higher water levels in the aquifer in 2008 compared to 2001.

Results from 12826 and 12826A		
Midpoint Elevation (ft amsl)	**Location 12826 Date: 2001 Midpoint of 2-ft screen**	**Location 12826A Date: 2008 Midpoint of 10-ft screen**
513		54.9
510	424	
503	47	12.5
493	31	18.3
483	16	8.2
473	2.1	
463	2.3	
453	0.8	

Results from 2008 indicate that Location 12826A is responding very well to pumping from nearby Extraction Well 33262 (EW-15A), which is only 45 ft away. Data posted to the second half 2008 total uranium map indicates that the plume should be re-contoured in the area of Location 12826A. In 2007 Location 12839A (south of Location 12826A) had a maximum uranium concentration of 16.7 μg/L. Additional direct-push data will be obtained in 2009 between Locations 12826A and 12839A to adjust the plume in this location.

Results from 12837 and 12837A		
Midpoint Screen Elevation (ft amsl)	**Location 12837 Date: 2001 Midpoint of 2-ft screen**	**Location 12837A Date: 2008 Midpoint of 10-ft screen**
515		**407.1**
511	**463**	
505		**43.5**
502	**62**	
495		**22.8**
492	**18**	
485		**19.5**
482	**45**	
475		**12.9**
472	**31**	
462	3.8	
452	1.3	

Concentrations measured at Location 12837A in 2008, compared to those measured in 2001, indicate that the plume is thinner and lower in concentration. The maximum uranium concentration remains above 400 µg/L. This indicates that a revision to the maximum uranium plume map in this area is not warranted at this time.

Location 12407

Location 12407 was sampled in 1999. It is located along the eastern edge of the South Field Plume. A discrepancy in the data at this location has been found that indicates that the maximum uranium concentration at this location could be as high as 59 µg/L. The possible high of 59 µg/L is posted to the map, but the contours will not be changed to honor the possible higher uranium concentration until the area is re-sampled using a direct-push sampling tool. Sampling is scheduled for 2009.

Uranium Concentration Changes in the South Plume

Both locations 13229 and 13230 in the South Plume was first sampled in 2002 using a direct-push tool. The purpose of the re-sampling in 2008 was to assess remediation progress made in the areas since 2002. Both locations are in the South Plume, north of Recovery Wells 32308 (RW-6) and 32309 (RW-7).

Results from 13229 and 13229B		
Midpoint Screen Elevation (ft amsl)	**Location 13229 Date: 2002 Midpoint of 2-ft screen**	**Location 13229B Date: 2008 Midpoint of 10-ft screen**
517	58	
508	101	
504		72.7
498	47	
494		65.3
488	29	
484		42.2
478	19	
474		37.4
468	15	
464		17.8
458	3.2	
448	1	
438	0.7	

Results indicate that since 2002 the maximum uranium concentration has been reduced from 101 µg/L to 72.7 µg/L. It should be noted that these concentration measurements are not from samples collected at the exact same elevation. They are within 4 ft of each other, indicating that more uranium contamination may be present at elevations higher than the sample collected in 2008 at an elevation of 504 ft amsl. Also, the length of the sampling screen (2 ft in 2002 compared to 10 ft in 2008) impacts the comparison.

Results from 13230 and 13230B		
Midpoint Screen Elevation (ft amsl)	**Location 13230 Date: 2002 Midpoint of 2-ft screen**	**Location 13230B Date: 2008 Midpoint of 10-ft screen**
515	36	
509		68.8
506	116	
499		32.7
496	101	
489		48.9
486	66	
479		37.4
476	12	
469		4.2
466	11	
456	3.1	
446	1.8	
436	1.1	

Results indicate that since 2002 the maximum uranium concentration has been reduced from 116 µg/L to 68.8 µg/L. It should be noted that these concentration measurements are not from samples collected at the exact same elevation. They are within 7 ft of each other, indicating that more uranium contamination may be present at elevations higher than the sample collected in 2008 at an elevation of 509 ft amsl.

Update of Cross Sections along Willey Road

Since 1998 several locations along Willey Road have been sampled using a direct-push sampling tool: 12367, 12368, 12369, 12370, 12371, 12372, and 12373. These locations were originally sampled to track re-injection progress along Willey Road. Re-injection was discontinued in September 2004; however, yearly sampling at some of these locations has continued, and five of the seven locations (12368, 12369, 12370, 12371, and 12372). The results are used to prepare two cross sections: Figures A.2–155 and A.2–156.

Re-sampling these locations each year provides insight into how the remedy is progressing in this area now that re-injection is no longer taking place. This area is subject to pumping stresses from both the South Field extraction wells to the north and the South Plume extraction wells to the south, creating a stagnation zone. Re-injection (when it was occurring) helped to break up this stagnation zone. As the remedy progressed, two of the locations (12367 and 12371) were dropped from the routine sampling because they are now located outside the 30 µg/L total uranium plume.

Data collected at Location 12372N indicates that rebound continues to impact this location. The high water level in 2008 contributed to the measured rebound. Results for the last 4 years are provided in the following table.

Elevation	2005 12372K WL: 516.15 ft (amsl)	2006 12372L WL: 512.5 ft (amsl)	2007 12372M WL: 514.2 ft (amsl)	2008 12372N WL: 519.2 ft (amsl)
514				68
511	39.3			
509			34.3	
508		21.8		
506	10.9			
504				23.2
499			18.5	
498		7.9		
496	11.2			
489			11.4	
488		7.9		
486	19.4			
479			12.1	
478		< 1.0		
476	7.5			

Rebound at this location will be an ongoing issue. Efforts such as the annual well field shutdown will help to raise water levels each year, if only for a brief time period, to help flush out contamination from higher elevations within the aquifer.

In 2005 a maximum uranium concentration of 170.6 μg/L was measured at Location 12373 at an elevation of 515.3 ft amsl. In 2008, the maximum uranium concentration measured at Location 12373 was 69.5 μg/L at an elevation of 514 ft amsl. This comparison gives a good assessment that the uranium concentration at this elevation in the aquifer has decreased since 2005.

A.2.4 Flow Monitoring in the Storm Sewer Outfall Ditch

As reported in the *Groundwater Remedy Evaluation and Field Verification Plan* (DOE 2004a), a modeled infiltration rate of 500 gpm through the Storm Sewer Outfall Ditch (SSOD) decreased the model predicted cleanup time estimate by 1 year. A field study was conducted in 2005 to gauge seasonal flow of water in the SSOD and to determine if recharge to the GMA through the SSOD at a rate of 500 gpm was feasible (DOE 2005). Although the study concluded that the operation would not be cost effective, subsequent discussions in 2006 with EPA and OEPA led to an agreement to continue the infiltration operation.

As shown in Figure A.2−157, six Parshall flumes are installed in the SSOD. These flumes are used to measure flow into and out-of the SSOD. The natural flow into the SSOD is being supplemented (since 2006) with water supplied from a group of three water wells located on the east side of the site (42202, 42471, and 43309). The wells are pumped as necessary to maintain a flow of approximately 500 gpm into the SSOD. Water pumped from the wells is discharged into a ditch that empties into the former OSDF Borrow Area Sediment Basin. Water from this basin is allowed to overflow into the mouth of the SSOD. Flume 6 is the first flume located down stream of the former OSDF Borrow Area Sediment Basin. Flumes 2, 3, 4, 5, and 6 all measure flows into the SSOD. Flume 1 is the most southern flume. It measures flow emptying out of the SSOD and into Paddys Run.

<u>Pumping Operations</u>

In 2008, 119,256,249 gallons of clean groundwater (average rate of 227 gpm) were pumped into the Storm Sewer Outfall Ditch. Pumping of clean groundwater into the SSOD began on December 14, 2006. Since pumping began, flow metering indicates 266,311,549 gallons of clean groundwater water have been pumped from the aquifer and used to supplement flow in the SSOD.

Year	Total Gallons of Water Pumped	Average Pumping Rate (gpm)
2006 (Dec. 14 – Dec. 31)	8,154,900	334
2007	138,900,400	264
2008	119,256,249	227
Total	**266,311,549**	

<u>Infiltration Assessment</u>

As discussed in the 2007 SER, due to problems with Flume 2 and Flume 4, infiltration calculations in 2008 were not possible (more flow was measured leaving the SSOD than entering it). As discussed below, Flume 2 and Flume 4 were replaced and relocated in late 2008, so assessments will once again be possible in 2009.

During 2008, it was possible to measure how much water was entering the SSOD through the uppermost flume (Flume 6). In 2008, operations were successful in achieving the target flow rate of 500 gpm in the SSOD. The average annual flow rate in Flume 6 in 2008 was 603 gpm. This flow rate consisted of natural flow and supplemented pumping from the clean production wells located on the east side of the site.

Figure A.2−158 shows a monthly comparison of the flow amount entering into the SSOD from 2006 to 2008, as measured at Flume 6. With the exception of December 2006, the only flow entering Flume 6 in 2006 was natural, not supplemented by pumping. As shown in Figure A.2−158 supplemental pumping has helped to keep flow rates higher in the summer months when natural SSOD flow is lower. Monthly average flow rates at Flume 6 in 2008 in January, June, September, and October failed to achieve a rate of 500 gpm, but the annual average calculates to 603 gpm.

Flume Replacements in 2008

In 2008, Flume 2 and Flume 4 were moved farther upstream to locations where the flumes could be constructed in a manner that allow for the collection of better flow measurements. Flume 2 was replaced with a new, larger flume to better accommodate larger flows. Figure A.2–157 shows the new locations of the flumes. Pictures of the new flumes are provided in Figures A.2–159 and A.2–160, respectively.

The six Parshall flumes in the SSOD were originally designed to be temporary installations to support the test conducted in 2005. The design allowed movement of the flumes during the testing period, if circumstances required. Engineering controls (i.e., anchoring the frames with metal stakes and sandbags and incorporating bonding trenches into the wing-walled construction) were implemented to limit the potential of the flumes to develop leaks or dislodge during the test. Since these engineering controls worked well during the testing period, it was initially decided to continue using the flumes as designed for the longer term operation. As discussed below, the temporary designs did not hold up well at Flumes 1, 2, and 4.

In 2006 a large rain event damaged the wing walls of Flume 1. Temporary repairs to the flume were made and the flume was replaced with a new design in 2007. Another concern noted in the 2006 SER was that the measured outflow rate in 2006 exceeded the measured inflow rate for the later part of the year resulting in a negative infiltration calculation (i.e., subtracting outflow from inflow). This indicated that unmeasured flow was entering the SSOD. The most likely area for this to occur was in the ditch where Flume 4 was installed. The post-closure configuration of the ditch, in which Flume 4 was installed, is too large for the size and location of the original flume. Flow appeared to be going under and around the original flume. Large storm events also took their toll on Flume 2 over the years, damaging the wing walls of the original flume.

Flumes 1, 2, and 4 have a rigid wing-wall construction rather than a wing-wall composed of sand bags. The rigid wing-walls in the new design are constructed of treated plywood, and are covered with a vinyl-polyester fabric that is UV resistant and flexible to 50 degrees below zero.

Table A.2–1. List of IEMP Monitoring Wells

Well ID	Monitoring Activity
13	Total Uranium
14	Total Uranium
2002	Total Uranium
2008	Total Uranium
2009	Total Uranium
2010	Waste Storage Area
2014	Total Uranium
2016	Total Uranium
2017	Total Uranium
2045	South Field
2046	Total Uranium
2048	Total Uranium
2049	South Field
2060 (12)	Total Uranium
2093	Property/Plume Boundary for FRL Exceedances
2095	Total Uranium
2106	Total Uranium
2125	Total Uranium
2128	Property/Plume Boundary for Paddys Run Road Site
2166	Total Uranium
2385	Total Uranium
2386	Total Uranium
2387	Total Uranium
2389	Total Uranium
2390	Total Uranium
2396	Total Uranium
2397	Total Uranium
2398	Property/Plume Boundary for FRL Exceedances
2402	Total Uranium
2431	Property/Plume Boundary for FRL Exceedances
2432	Property/Plume Boundary for FRL Exceedances
2550	Total Uranium
2552	Total Uranium
2553	Total Uranium
2625	Property/Plume Boundary for Paddys Run Road Site
2636	Property/Plume Boundary for Paddys Run Road Site
2649	Waste Storage Area
2733	Property/Plume Boundary for FRL Exceedances
2821	Waste Storage Area
2880	Total Uranium
2897	Total Uranium
2898	Property/Plume Boundary for Paddys Run Road Site
2899	Property/Plume Boundary for Paddys Run Road Site
2900	Property/Plume Boundary for Paddys Run Road Site
3014	Total Uranium
3015	Total Uranium
3045	Total Uranium

Table A.2–1 (continued). List of IEMP Monitoring Wells

Well ID	Monitoring Activity
3046	Total Uranium
3049	Total Uranium
3069	Total Uranium
3070	Property/Plume Boundary for FRL Exceedances
3093	Property/Plume Boundary for FRL Exceedances
3095	Total Uranium
3106	Total Uranium
3125	Total Uranium
3128	Property/Plume Boundary for Paddys Run Road Site
3385	Total Uranium
3387	Total Uranium
3390	Total Uranium
3396	Total Uranium
3397	Total Uranium
3398	Property/Plume Boundary for FRL Exceedances
3402	Total Uranium
3424	Property/Plume Boundary for FRL Exceedances
3426	Property/Plume Boundary for FRL Exceedances
3429	Property/Plume Boundary for FRL Exceedances
3431	Property/Plume Boundary for FRL Exceedances
3432	Property/Plume Boundary for FRL Exceedances
3550	Total Uranium
3552	Total Uranium
3636	Property/Plume Boundary for Paddys Run Road Site
3733	Property/Plume Boundary for FRL Exceedances
3821	Waste Storage Area
3880	Total Uranium
3897	Total Uranium
3898	Property/Plume Boundary for Paddys Run Road Site
3899	Property/Plume Boundary for Paddys Run Road Site
3900	Property/Plume Boundary for Paddys Run Road Site
4125	Total Uranium
4398	Property/Plume Boundary for FRL Exceedances
6015	Total Uranium
6880	Total Uranium
6881	Total Uranium
21033	Total Uranium
21063	Property/Plume Boundary for FRL Exceedances
21192	Total Uranium
22198	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22199	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22200	OSDF[a]
22201	OSDF[a]
22203	OSDF[a]
22204	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22205	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22206	OSDF[a]

Table A.2–1 (continued). List of IEMP Monitoring Wells

Well ID	Monitoring Activity
22207	OSDF[a]
22208	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22209	OSDF[a]
22210	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22211	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22212	OSDF[a]
22213	OSDF[a]
22214	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22215	OSDF[a]
22217	OSDF[a]
23064	Total Uranium
23118	Total Uranium
23271	Total Uranium
23272	Total Uranium
23273	Total Uranium
23274	Total Uranium
23275	Total Uranium
23276	Total Uranium
23277	Total Uranium
23278	Total Uranium
23279	Total Uranium
23280	Total Uranium
23281	Total Uranium
23282	Total Uranium
31217	Property/Plume Boundary for FRL Exceedances
32766	Total Uranium
32768	Total Uranium
62408	Total Uranium
62433	Total Uranium
63116	Total Uranium
63119	Total Uranium
63283	Total Uranium
63284	Total Uranium
63285	Total Uranium
63286	Total Uranium
63287	Total Uranium
63288	Total Uranium
63289	Total Uranium
63290	Total Uranium
63291	Total Uranium
63292	Total Uranium
82433	Total Uranium
83117	Total Uranium
83124	Total Uranium
83293	Total Uranium
83294	Total Uranium
83295	Total Uranium

Table A.2–1 (continued). List of IEMP Monitoring Wells

Well ID	Monitoring Activity
83296	Total Uranium
83335	Total Uranium
83336	Total Uranium
83337	Waste Storage Area
83338	Waste Storage Area
83339	Waste Storage Area
83340	Waste Storage Area
83341	Waste Storage Area
83346	Waste Storage Area

[a]OSDF total uranium graphs are included in this attachment and all of the OSDF data are discussed in Attachment A.5

Table A.2–2. Summary Statistics and Trend Analysis of Monitoring Wells for Total Uranium With 2008 Results Above FRLs

Well	No. of Samples Since 1988[a,b,c,d]	Minimum (µg/L)[a,b,c,d]	Maximum (µg/L)[a,b,c,d]	Average (µg/L)[a,b,c,d,e]	Standard Deviation (µg/L)[a,b,c,d,e]	Trend[a,b,c,d,e,f]
2045	53	12.034	462	136	116	**Up, Significant**
2046	52	20	907	179	227	Down, Marginal
2049	43	3	177.893	83.9	44.5	Down, Significant
2060	71	8.4	332	82.7	63.0	No Significant Trend
2095	56	27	208	112	43.7	Down, Significant
2166	45	28.3	95.1	58.9	15.4	Down, Significant
23271	14	34.6	144.3	87.2	31.3	No Significant Trend
23273	14	172	421	286	77.1	Up, Marginal
23274	22	128.5	384.2	209	69.1	Down, Marginal
23275	13	119	175	141	16.6	No Significant Trend
23276	14	60.4	94	78.9	9.38	No Significant Trend
23278	14	78.9	201.4	119	41.6	Down, Significant
23280	14	67.3	700	218	166	Down, Significant
23281	14	41.5	366.6	170	85.5	Down, Significant
2385	37	76.648	592.164	252	113	No Significant Trend
2387	37	18.1	492	142	90.5	**Up, Significant**
2390	36	37.5	163	82.9	27.3	Down, Significant
2397	27	212	737	399	125	No Significant Trend
2550	47	3.3	120	63.8	19.1	Down, Significant
2649	32	6.01	634	61.7	150	**Up, Significant**
2880	38	0.4	61.7	102	16.0	**Up, Significant**
3069	63	0.5	398.33	133	99.5	Down, Significant
3095	57	2	94	23.7	16.9	No Significant Trend
32766	15	31.8	79.9	50.2	14.0	Down, Significant
62408	25	42.1	157	93.9	41.2	Down, Significant
62433	26	145	844.991	420	158	Down, Significant
63285	14	74.9	256	196	51.1	**Up, Significant**
63287	14	157	315.7	204	40.8	Down, Significant
63288	14	34.3	267	113	71.0	Down, Marginal
63291	14	31.8	96.7	51.2	17.2	Down, Significant
6880	24	62.8	145	93.2	23.5	Down, Significant
82433_C2	9	55.8	214	124	62.8	Down, Significant
82433_C3	17	154	506	273	125	Down, Significant
83117_C1	16	655	1620	969	279	**Up, Significant**
83117_C2	8	71	330	196	113	Down, Significant
83117_C3	8	56.6	128	95.0	28.5	Down, Significant
83117_C4	8	71.3	111	86.1	13.9	**Up, Significant**
83124_C1	24	185	1070	515	204	No Significant Trend
83124_C2	10	27.8	103	60.9	23.5	Down, Significant
83124_C4	8	25.4	43	35.0	7.51	**Up, Significant**
83124_C5	8	24.4	61.4	50.9	11.6	Up, Marginal

Table A.2–2 (continued). Summary Statistics and Trend Analysis of Monitoring Wells for Total Uranium With 2008 Results Above Final Remediation Levels

Well	No. of Samples Since 1988[a,b,c,d]	Minimum (µg/L)[a,b,c,d]	Maximum (µg/L)[a,b,c,d]	Average (µg/L)[a,b,c,d,e]	Standard Deviation (µg/L)[a,b,c,d,e]	Trend[a,b,c,d,e,f]
83293_C2	9	7.3	80	24.3	22.2	No Significant Trend
83294_C1	13	98.5	195	166	31.7	**Up, Significant**
83294_C2	15	188.1	575	409	107	No Significant Trend
83294_C3	10	213	538.8	398	109	Down, Significant
83294_C4	8	48.3	298.6	170	102	Down, Significant
83295_C2	10	92.3	178	143	27.6	**Up, Significant**
83295_C3	11	111	175	150	20.6	No Significant Trend
83295_C4	9	77.2	199.1	131	54.1	Down, Significant
83295_C5	8	57.2	155	94.5	31.6	Down, Significant
83295_C6	8	3.4	54.4	19.6	17.1	**Up, Significant**
83296_C1	5	56.7	112	83.0	22.2	No Significant Trend
83296_C2	11	39.4	117	68.3	24.4	Down, Significant
83335_C2	5	4.54	49.5	27.9	21.0	No Significant Trend
83337_C1	8	877.2	2210	1420	405	**Up, Significant**
83337_C2	12	6.5	835.1	218	260	No Significant Trend
83338_C1	5	454.5	618	554	63.4	No Significant Trend
83338_C2	6	178	648	331	167	No Significant Trend
83339_C1	4	17.9	39.6	24.4	10.2	**Up, Significant**
83340_C1	4	13.2	32.7	21.8	8.08	No Significant Trend
83341_C1	4	28.8	39.4	35.7	4.73	No Significant Trend
83346_C1	4	42.1	70.7	51.8	12.9	No Significant Trend
83346_C2	5	9.5	36.4	20.8	12.1	No Significant Trend

[a]Summary statistics and Mann-Kendall test for trend are primarily based on unfiltered samples with some filtered samples from the Operable Unit 5 remedial investigation/feasibility study data set (1988 through 1993) and 1994 through 2008 groundwater data.
[b]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[c]Rejected data qualified with either an R or Z were not included in this count, the summary statistics, or Mann-Kendall test for trend.
[d]If the number of samples is greater than or equal to four, then all of the summary statistics and the Mann-Kendall test for trend are reported. If the total number of samples is equal to three, then the minimum, maximum, and average are reported. If the total number of samples is equal to two, then the minimum and maximum are reported. If the total number of samples is equal to one, then the data point is reported as the minimum.
[e]For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.
[f]Mann-Kendall test for trend is performed using data from third quarter 1998 through 2008.

Table A.2–3. Summary Statistics and Trend Analysis of Extraction Wells for Total Uranium

Well	Number of Samples Since 1988[a,b]	Minimum[a,b,c] (µg/L)	Maximum[a,b,c] (µg/L)	Average[a,b,c] (µg/L)	Standard Deviation[a,b,c] (µg/L)	Trend[a,b,c]
South Plume Module						
3924	516	1.8	180	32.0	15.1	Down, Significant
3925	517	0.5	84	25.4	7.73	Down, Significant
3926	511	1.5	42.4	25.5	8.67	**Up, Significant**
3927	516	1	17	2.56	1.16	Up, Significant
South Plume Optimization Module						
32308	447	18.4	100.1	57.0	14.2	Down, Significant
32309	451	32	122.8	58.5	17.9	Down, Significant
South Field Module						
31550	467	18.3	127.9	53.3	19.0	Down, Significant
31560	490	22.9	182.8	65.3	36.9	Down, Significant
31561	464	18.1	114[d]	42.1	10.1	Down, Significant
32276	509	36.6	290.2	111	60.9	Down, Significant
32446	364	37.9	168.1	64.2	19.3	Down, Significant
32447	383	49.8	302.3	119	50.6	Down, Significant
33061	269	29.4	98.5	49.8	12.9	Down, Significant
33262	220	30.9	109.7	51.8	12.1	Down, Significant
33264	218	19.5	364.1	96.6	37.0	Down, Significant
33265	219	8.8	96.5	23.7	7.32	Down, Significant
33266	215	6.5	105.1	18.6	10.5	Down, Significant
33298	178	36.6	76.2	54.9	7.03	**Up, Significant**
33326	121	21.5	62.2	29.8	5.19	Down, Significant
Waste Storage Area Module						
32761	261	31.5	161.2	69.9	31.3	Down, Significant
33062	269	37.9	236.4	79.6	45.3	Down, Significant
33334	88	10.9	50	21.3	6.23	Down, Significant
33347	78	9.3	126.5	35.7	25.7	Down, Significant

[a]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[b]Rejected data qualified with either an R or Z were not included in this count, the summary statistics, or Mann-Kendall test for trend.
[c]For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.
[d]This result (sampled August 31, 1998) appears to be an outlier. It is suspected that the sample for this well was switched with the sample for Extraction Well 31562.

Table A.2−4. Geoprobe Location 13360A

Easting '83:	**1349810**	Feet
Northing '83:	**480113.4**	Feet
Ground Elevation:	**574.08**	Feet AMSL
Depth to Water Table:	**54**	Feet bgs
Water Table Elevation:	**520.08**	Feet AMSL
Work Completed:	**4/29/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	515	59	0 feet - 10 feet	37.2	15.7	7.37	1.450	362	7.32
2	505.08	69	10 feet - 20 feet	5.3	14.1	7.59	1.063	> 999	8.70
3	505.08	69	10 feet - 20 feet	1.9	14.1	7.59	1.063	> 999	8.70
Rinsate				< 1.0					

Table A.2−5. Geoprobe Location 13370A

Easting '83:	1347192	Feet
Northing '83:	481599.7	Feet
Ground Elevation:	574.53	Feet AMSL
pth to Water Table:	54	Feet bgs
ter Table Elevation:	520.53	Feet AMSL
Work Completed:	5/6/2008	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval Feet	Uranium (ug/L) 5-micron (FRL=30)	Tech-99 (pCi/L) .45-micron (FRL=94)	Nitrate/Nitrite (mg/L) .45-micron (FRL=11)	Manganese (mgL) .45-micron (FRL=0.9)	Molybdenum (mgL) .45-micron (FRL=0.1)	Nickel (mgL) .45-micron (FRL=0.1)	Temp Celcius .45-micron	Cond mS/cm .45-micron	DO mg/L .45-micron	pH SU .45-micron	Turb NTU .45-micron
1	516	59	0 to 10	3.9	25.5	47.6	1.38	0.0753	0.0255	15.50	1.46	5.45	9.05	11.00
2	505.53	69	10 to 20	5.8	47.3	101	0.596	0.0779	0.0098	16.47	1.83	6.95	11.39	5.00
3	505.53	69	10 to 20	4.4	45.9	101	0.769	0.0794	0.0118	16.47	1.83	6.95	11.39	5.00
Rinsate				< 1.0										

Table A.2−6. Geoprobe Location 13374

Easting '83:	**1346351**	Feet
Northing '83:	**481508.2**	Feet
Ground Elevation:	**557.99**	Feet AMSL
Depth to Water Table:	**36**	Feet bgs
Water Table Elevation:	**521.99**	Feet AMSL
Work Completed:	**5/7/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron mS/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	517	41	0 feet - 10 feet	74.0	21.1	8.25	0.942	332	6.91
2	506.99	51	10 feet - 20 feet	70.1	17.7	8.05	0.903	563	7.50
3	506.99	51	10 feet - 20 feet	70.0	17.7	8.05	0.903	563	7.50
Rinsate				< 1.0					

Table A.2−7. Geoprobe Location 13375

Easting '83:	**1346645**	Feet
Northing '83:	**480707.6**	Feet
Ground Elevation:	**553.4**	Feet AMSL
Depth to Water Table:	**30**	Feet bgs
Water Table Elevation:	**523.4**	Feet AMSL
Work Completed:	**5/7/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron mS/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	518	35	0 feet - 10 feet	2.9	17.7	8.66	0.609	42	8.38
2	508.4	45	10 feet - 20 feet	5.0	14.6	8.69	0.560	965	9.65
3	508.4	45	10 feet - 20 feet	4.0	14.6	8.68	0.560	965	9.65
Rinsate				< 1.0					

Table A.2−8. Geoprobe Location 13376

Easting '83:	**1347264.98**	Feet
Northing '83:	**479926.66**	Feet
Ground Elevation:	**571.52**	Feet AMSL
Depth to Water Table:	**50.5**	Feet bgs
Water Table Elevation:	**521.02**	Feet AMSL
Work Completed:	**5/19/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	516	55.5	0 feet - 10 feet	218.4	17.6	8.76	0.960	766	8.32
2	506.02	65.5	10 feet - 20 feet	103.9	13.2	9.71	0.805	346	8.04
3	506.02	65.5	10 feet - 20 feet	117.5	13.2	9.71	0.805	346	8.04
4	496.02	75.5	20-feet - 30 feet	51.8	13.5	9.46	0.763	NR	8.81
5	486.02	85.5	30 feet - 40 feet	26.8	13.9	8.85	0.700	35	0.67
Rinsate				< 1.0					

NR = no result

Table A.2−9. Geoprobe Location 13377

Easting '83:	**1350280.72**	Feet
Northing '83:	**482388.19**	Feet
Ground Elevation:	**590.03**	Feet AMSL
Depth to Water Table:	**69.5**	Feet bgs
Water Table Elevation:	**520.53**	Feet AMSL
Work Completed:	**6/30/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Manganese .45-micron mg/L	Temp .45-micron Celcius	pH .45-micron SU	Cond .45-micron ms/cm	Turb .45 micron NTU	DO .45-micron mg/L
1	516	74.5	0 feet - 10 feet	1.8	0.225	27.1	7.34	0.985	26	6.86
2	505.53	84.5	10 feet - 20 feet	2.0	0.217	17.6	9.65	0.953	12	3.72
3	505.53	84.5	10 feet - 20 feet	1.6	0.219	17.6	9.65	0.953	12	3.72
4	495.53	94.5	20-feet - 30 feet	ND	0.205	14.8	8.58	0.959	7	3.98
5	485.53	104.5	30 feet - 40 feet	ND	0.206	16.5	7.89	1.050	14	5.60
6	475.53	114.5	40 feet - 50 feet	ND	0.204	15.6	7.23	1.100	1	4.80
7	465.53	124.5	50 feet - 60 feet	ND	0.275	16.5	7.16	1.250	28	7.26
Rinsate				< 1.0						

ND = not detected

Table A.2−10. Geoprobe Location 13378

Easting '83:	**1346366.11**	Feet
Northing '83:	**481600.4**	Feet
Ground Elevation:	**558.09**	Feet AMSL
Depth to Water Table:	**36**	Feet bgs
Water Table Elevation:	**522.09**	Feet AMSL
Work Completed:	**5/13/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron mS/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	517	41	0 feet - 10 feet	4.0	19.1	8.69	0.909	153	7.69
2	507.09	51	10 feet - 20 feet	3.2	16.0	9.06	0.743	557	8.55
3	507.09	51	10 feet - 20 feet	4.1	16.0	9.06	0.743	557	8.55
4	497.09	61	20-feet - 30 feet	4.5	14.6	8.60	0.410	845	10.25
Rinsate				< 1.0					

Table A.2−11. Geoprobe Location 13379

Easting '83:	**1348229.88**	Feet
Northing '83:	**481884.21**	Feet
Ground Elevation:	**584.69**	Feet AMSL
Depth to Water Table:	**64**	Feet bgs
Water Table Elevation:	**520.69**	Feet AMSL
Work Completed:	**7/22/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval Feet	Uranium (ug/L) 5-micron (FRL=30)	Tech-99 (pCi/L) 0.45-micron (FRL=94)	Nitrate/Nitrite (mg/L) 0.45-micron (FRL=11)	Manganese (mgL) 0.45-micron (FRL=0.9)	Molybdenum (mgL) 0.45-micron (FRL=0.1)	Nickel (mgL) 0.45-micron (FRL=0.1)	Temp Celcius 0.45-micron	Cond mS/cm 0.45-micron	DO mg/L 0.45-micron	pH SU 0.45-micron	Turb NTU 0.45-micron
1	516	69.0	0 to 10	5.5	ND	0.57	0.523	0.0121	0.0093	19.44	1.157	6.10	7.01	> 1000
2	505.69	79.0	10 to 20	7.6	12.50	29.2	0.922	0.0103	0.0174	17.08	1.196	5.70	7.27	> 1000
3	505.69	79.0	10 to 20	7.3	14.10	29.3	0.794	0.0107	0.0140	17.08	1.196	5.70	7.27	> 1000
4	495.69	89.0	20 to 30	7.2	89.20	13.2	0.717	0.0065	0.0100	17.51	1.020	6.08	7.33	139.0
5	485.69	99.0	30 to 40	3.4	ND	1.85	0.424	0.006	3.9	16.20	0.750	4.76	7.50	92.0
6	475.69	109.0	40 to 50	2.70	ND	0.13	0.241	0.0073	3.4	17.50	0.654	5.42	7.63	> 1000
7	465.69	119.0	50 to 60	1.4	ND	0.124	0.195	0.0134	0.0058	16.94	0.674	3.45	7.44	254.0
Rinsate				< 1.0										

ND = not detected

Table A.2−12. Geoprobe Location 13380

Easting '83:	**481884.21**	Feet
Northing '83:	**1348229.9**	Feet
Ground Elevation:	**585.21**	Feet AMSL
Depth to Water Table:	**64.5**	Feet bgs
Water Table Elevation:	**520.71**	Feet AMSL
Work Completed:	**7/16/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval Feet	Uranium (ug/L) 5-micron (FRL=30)	Tech-99 (pCi/L) 0.45-micron (FRL=94)	Nitrate/Nitrite (mg/L) 0.45-micron (FRL=11)	Manganese (mgL) 0.45-micron (FRL=0.9)	Molybdenum (mgL) 0.45-micron (FRL=0.1)	Nickel (mgL) 0.45-micron (FRL=0.1)	Temp Celcius 0.45-micron	Cond mS/cm 0.45-micron	DO mg/L 0.45-micron	pH SU 0.45-micron	Turb NTU 0.45-micron
1	516	69.5	0 to 10	ND	ND	0.193	0.265	0.0089	0.0066	16.94	1.017	5.60	7.25	17.2
2	505.71	79.5	10 to 20	19.3	ND	0.101	0.718	0.0031	0.0042	16.74	0.875	5.69	7.20	11.6
3	505.71	79.5	10 to 20	19.6	ND	0.116	0.701	0.0031	0.0043	16.74	0.875	5.69	7.20	11.6
4	495.71	89.5	20 to 30	22.4	ND	0.142	0.686	ND	0.0036	17.34	0.850	6.40	7.20	11.0
5	485.71	99.5	30 to 40	26.3	ND	0.198	0.753	ND	0.0042	17.89	0.912	4.55	7.43	10.7
6	475.71	109.5	40 to 50	2.50	ND	0.218	0.288	0.0041	0.0034	18.69	0.991	4.99	8.35	14.5
7	465.71	119.5	50 to 60	1.6	ND	1.070	0.288	0.0051	0.0053	18.22	1.273	4.85	7.38	28.2
Rinsate				< 1.0										

ND = not detected

Table A.2−13. Geoprobe Location 12824A

Easting '83:	**1348037.57**	Feet
Northing '83:	**477918.02**	Feet
Ground Elevation:	**566.09**	Feet AMSL
Depth to Water Table:	**47**	Feet bgs
Water Table Elevation:	**519.09**	Feet AMSL
Work Completed:	**6/23/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	514	52	0 feet - 10 feet	632.2	18.10	7.74	0.756	> 999	5.73
2	504.09	62	10 feet - 20 feet	115.7	14.60	8.33	0.699	> 999	9.32
3	504.09	62	10 feet - 20 feet	124.4	14.60	8.33	0.699	> 999	9.32
4	494.09	72	20-feet - 30 feet	18.6	14.40	8.59	0.574	> 999	8.44
5	484.09	82	30 feet - 40 feet	15.0	14.76	8.16	0.627	424	8.40
Rinsate				< 1.0					

Table A.2−14. Geoprobe Location 12826A

Easting '83:	**1348116.75**	Feet
Northing '83:	**477771.2**	Feet
Ground Elevation:	**568**	Feet AMSL
Depth to Water Table:	**50**	Feet bgs
Water Table Elevation:	**518**	Feet AMSL
Work Completed:	**6/11/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	513	55	0 feet - 10 feet	54.9	25.3	7.45	0.741	> 999	6.32
2	503	65	10 feet - 20 feet	12.5	19.7	7.73	0.630	579	7.27
3	503	65	10 feet - 20 feet	12.0	19.7	7.73	0.630	579	7.27
4	493	75	20-feet - 30 feet	18.3	12.27	7.93	0.651	820	9.03
5	483	85	30 feet - 40 feet	8.2	17.3	7.70	0.678	> 999	8.32
Rinsate				< 1.0					

Table A.2−15. Geoprobe Location 12837A

Easting '83:	**1348349.47**	Feet
Northing '83:	**478021.55**	Feet
Ground Elevation:	**573.99**	Feet AMSL
Depth to Water Table:	**54**	Feet bgs
Water Table Elevation:	**519.99**	Feet AMSL
Work Completed:	**6/16/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	515	59	0 feet - 10 feet	407.1	16.32	6.87	1.590	798	6.80
2	504.99	69	10 feet - 20 feet	41.9	15.50	7.98	0.772	636	8.07
3	504.99	69	10 feet - 20 feet	43.5	15.50	7.98	0.772	636	8.07
4	494.99	79	20-feet - 30 feet	22.8	16.02	8.76	0.681	176	6.58
5	484.99	89	30 feet - 40 feet	19.5	NR	NR	NR	> 999	NR
6	474.99	99	40 feet - 50 feet	12.9	17.87	8.54	0.669	> 999	6.93
Rinsate				< 1.0					

NR = no result

Table A.2−16. Geoprobe Location 13229B

Easting '83:	**1348249.46**	Feet
Northing '83:	**475528.075**	Feet
Ground Elevation:	**571.572**	Feet AMSL
Depth to Water Table:	**57.5**	Feet bgs
Water Table Elevation:	**514.072**	Feet AMSL
Work Completed:	**10/14/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron mS/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	509	62.5	0 feet - 10 feet	72.7	15.51	7.05	0.878	483	8.59
2	499.072	72.5	10 feet - 20 feet	65.3	16.21	7.14	0.875	> 1000	6.94
3	499.072	72.5	10 feet - 20 feet	62.1	16.21	7.14	0.875	> 1000	6.94
4	489.072	82.5	20-feet - 30 feet	42.2	15.25	7.64	0.788	12	5.71
5	479.072	92.5	30 feet - 40 feet	37.4	16.64	7.31	0.773	10	5.84
6	469.072	102.5	40 feet - 50 feet	17.8	15.11	7.55	0.846	83	7.20
Rinsate				< 1.0					

Table A.2−17. Geoprobe Location 13230B

Easting '83:	**1348648.74**	Feet
Northing '83:	**475594.69**	Feet
Ground Elevation:	**577.41**	Feet AMSL
Depth to Water Table:	**63**	Feet bgs
Water Table Elevation:	**514.41**	Feet AMSL
Work Completed:	**11/5/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron mS/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	509	68	0 feet - 10 feet	68.8	19.71	7.54	0.799	> 1000	8.88
2	499	78	10 feet - 20 feet	32.7	16.10	7.57	0.744	255	6.00
3	499	78	10 feet - 20 feet	30.0	16.10	7.57	0.744	255	6.00
4	489	88	20-feet - 30 feet	48.9	12.67	7.14	0.710	246	8.06
5	479	98	30 feet - 40 feet	37.4	13.56	7.38	0.690	> 1000	8.36
6	469	108	40 feet - 50 feet	4.2	13.75	7.31	0.697	870	8.59
Rinsate				< 1.0					

Table A.2−18. Geoprobe Location 12368J

Easting '83:	**1348.471**	Feet
Northing '83:	**476168**	Feet
Ground Elevation:	**576.51**	Feet AMSL
Depth to Water Table:	**57**	Feet bgs
Water Table Elevation:	**519.51**	Feet AMSL
Work Completed:	**5/21/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	514.51	62	0 feet - 10 feet	26.8	16.10	10.14	0.951	> 999	9.26
2	504.51	72	10 feet - 20 feet	5.3	16.37	10.24	0.776	339	4.73
3	504.51	72	10 feet - 20 feet	4.3	16.37	10.24	0.776	339	4.73
Rinsate				< 1.0					

Table A.2−19. Geoprobe Location 12369N

Easting '83:	**1348853.698**	Feet
Northing '83:	**476060.518**	Feet
Ground Elevation:	**575.58**	Feet AMSL
Depth to Water Table:	**60.5**	Feet bgs
Water Table Elevation:	**515.08**	Feet AMSL
Work Completed:	**9/23/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron mS/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	510	66	0 feet - 10 feet	122.5	14.72	6.48	0.868	7	5.00
2	500.08	76	10 feet - 20 feet	30.3	14.42	7.31	0.750	52	4.20
3	500.08	76	10 feet - 20 feet	30.3	14.42	7.31	0.750	52	4.20
4	490.08	86	20-feet - 30 feet	17.5	16.92	7.65	0.721	> 1000	8.49
Rinsate				< 1.0					

Table A.2−20. Geoprobe Location 12370J

Easting '83:	**1349422.63**	Feet
Northing '83:	**476213.041**	Feet
Ground Elevation:	**574.908**	Feet AMSL
Depth to Water Table:	**60.5**	Feet bgs
Water Table Elevation:	**514.408**	Feet AMSL
Work Completed:	**9/24/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron mS/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	509	66	0 feet - 10 feet	4.5	17.24	7.62	0.725	> 1000	7.51
2	499.408	76	10 feet - 20 feet	3.2	17.87	7.66	0.737	> 1000	7.50
3	499.408	76	10 feet - 20 feet	2.2	17.87	7.66	0.737	> 1000	7.50
Rinsate				< 1.0					

Table A.2−21. Geoprobe Location 12372N

Easting '83:	**1348559**	Feet
Northing '83:	**476215.58**	Feet
Ground Elevation:	**576.45**	Feet AMSL
Depth to Water Table:	**57**	Feet bgs
Water Table Elevation:	**519.45**	Feet AMSL
Work Completed:	**6/9/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	514	62	0 feet - 10 feet	68.0	21.3	7.26	0.914	1000	7.31
2	504.45	72	10 feet - 20 feet	23.2	20.1	7.58	0.762	907	5.93
3	504.45	72	10 feet - 20 feet	20.2	20.1	7.58	0.762	907	5.93
Rinsate				< 1.0					

Table A.2−22. Geoprobe Location 12373N

Easting '83:	**1349025**	Feet
Northing '83:	**476240**	Feet
Ground Elevation:	**563.87**	Feet AMSL
Depth to Water Table:	**45**	Feet bgs
Water Table Elevation:	**518.87**	Feet AMSL
Work Completed:	**6/19/2008**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron ms/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	514	50	0 feet - 10 feet	69.5	14.68	7.96	0.825	> 999	9.60
2	503.87	60	10 feet - 20 feet	2.5	15.42	8.64	0.719	> 999	8.40
3	503.87	60	10 feet - 20 feet	8.0	15.42	8.64	0.719	> 999	8.40
4	493.87	70	20-feet - 30 feet	4.9	16.90	7.70	0.749	> 999	9.57
Rinsate				< 1.0					

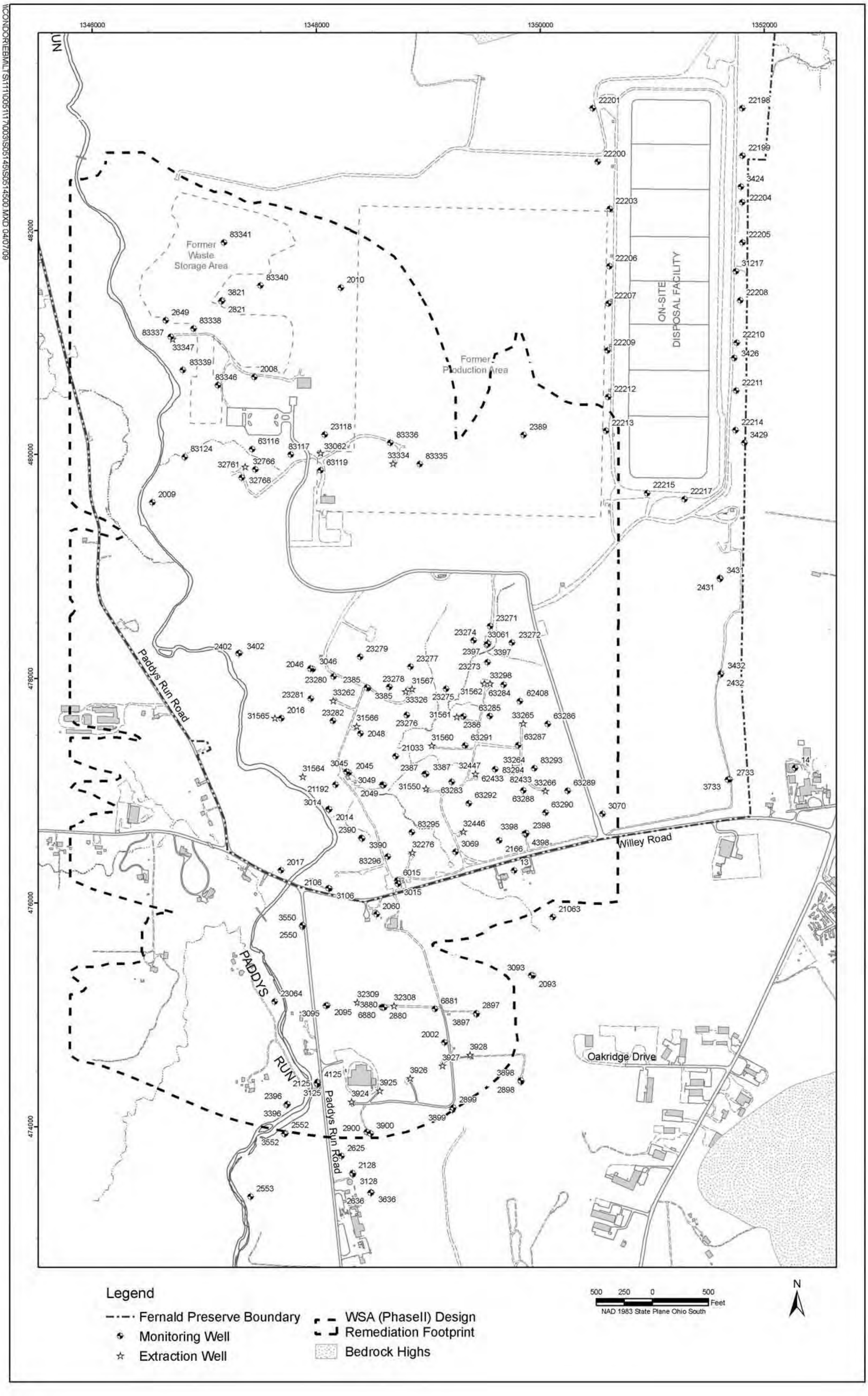


Figure A.2−1. IEMP Water Quality Monitoring Wells and Extraction Wells

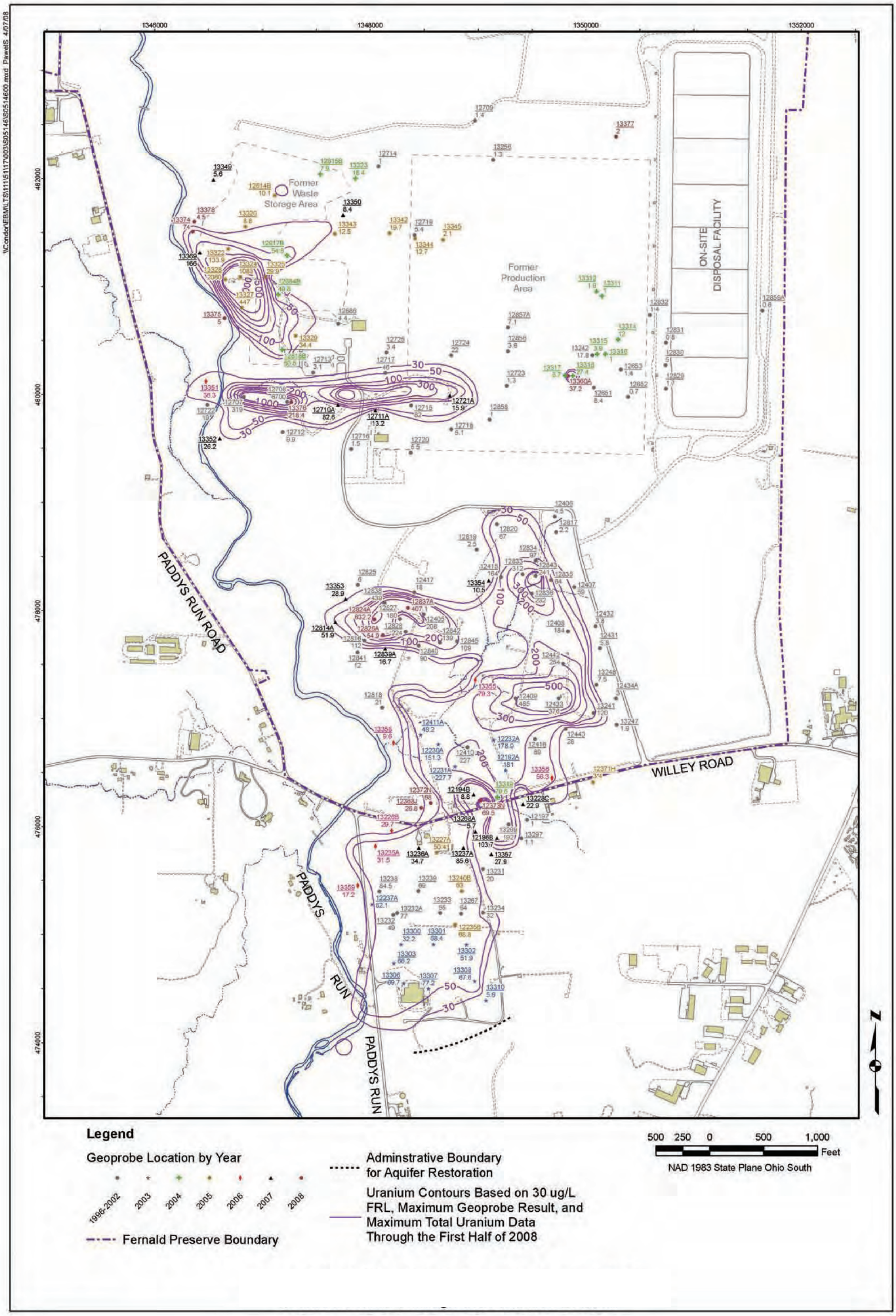
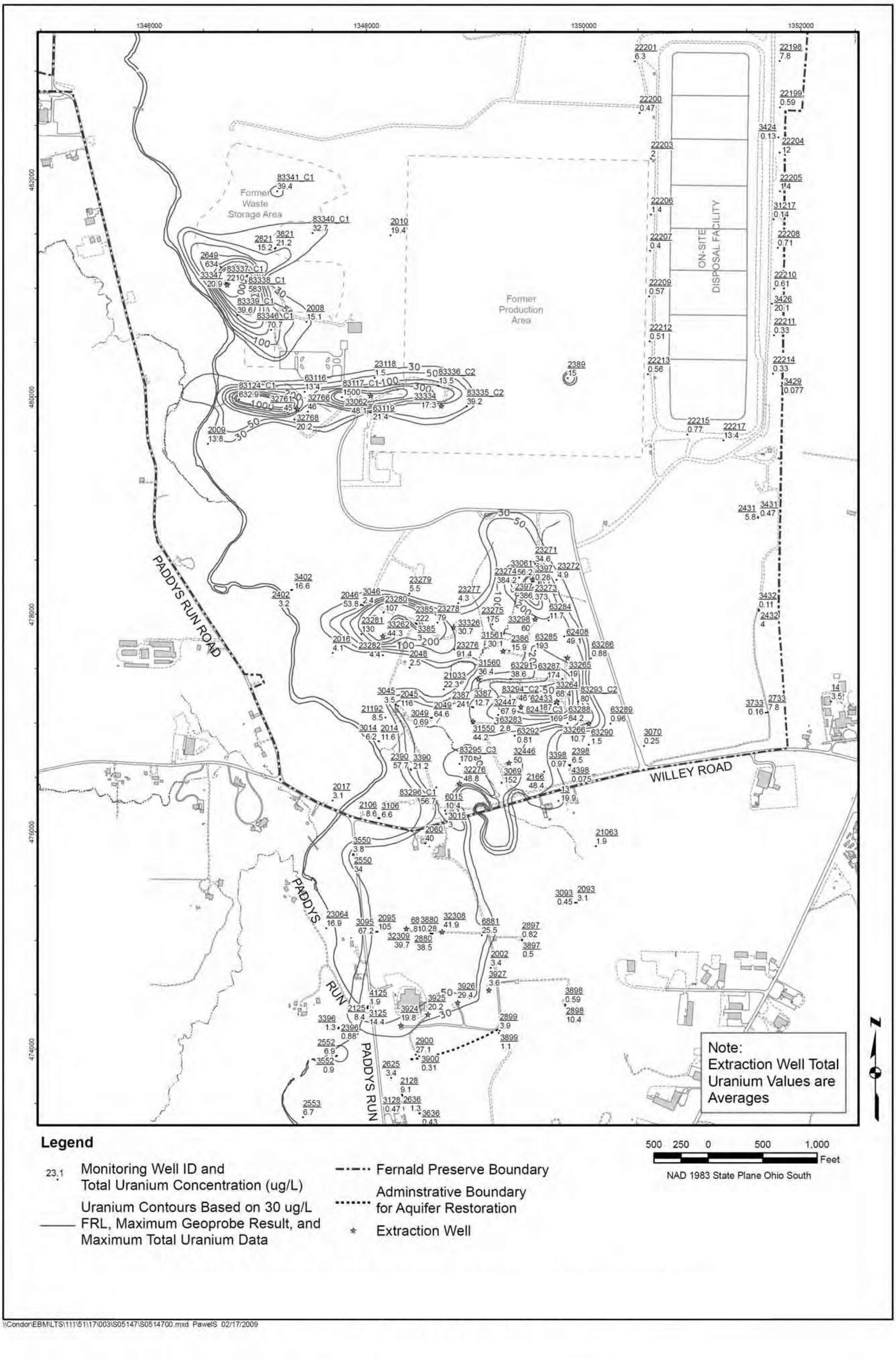


Figure A.2−2A. Direct-Push Data and Maximum Total Uranium Plume through the First Half of 2008



\\Condor\EBM\LTS\111\51\17\003\S05147\S0514700.mxd PawelS 02/17/2009

Figure A.2−2B. Monitoring Well Data and Maximum Total Uranium Plume through the First Half of 2008

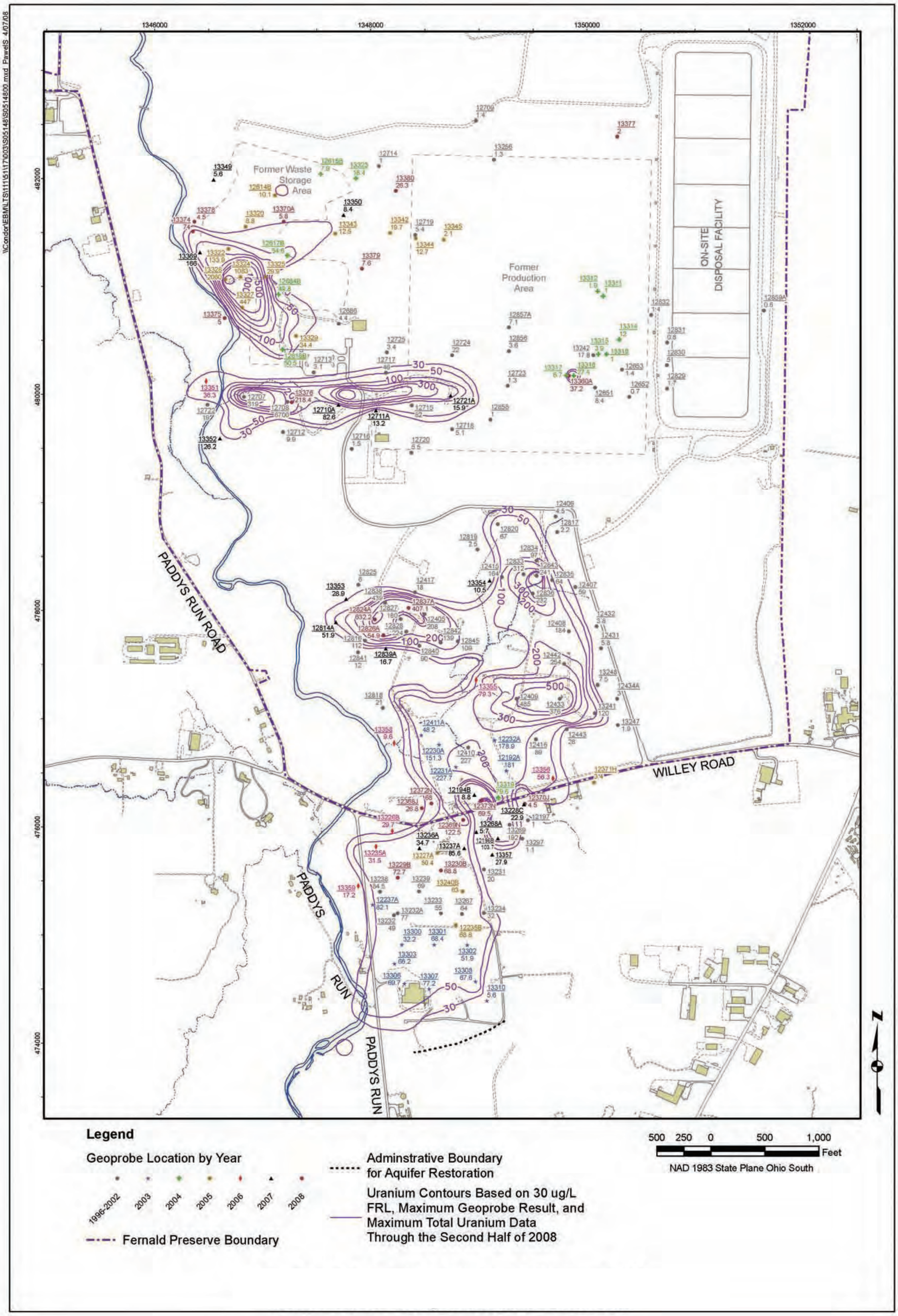
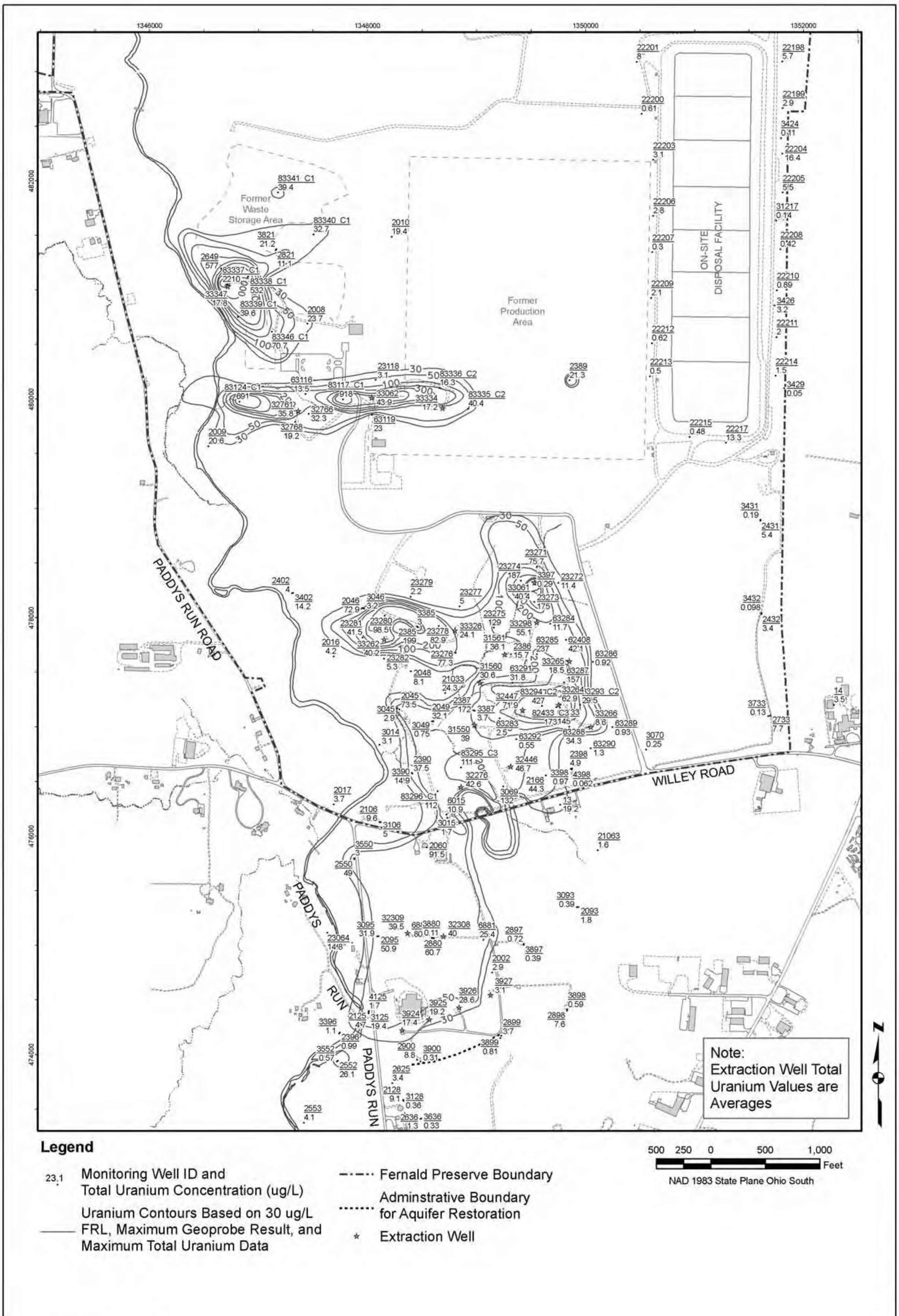


Figure A.2−3A. Direct-Push Data and Maximum Total Uranium Plume through the Second Half of 2008



\\Condor\EBM\LTS\111\51\17\003\S05149\S0514900.mxd PawelS 03/19/2009

Figure A.2−3B. Monitoring Well Data and Maximum Total Uranium Plume through the Second Half of 2008

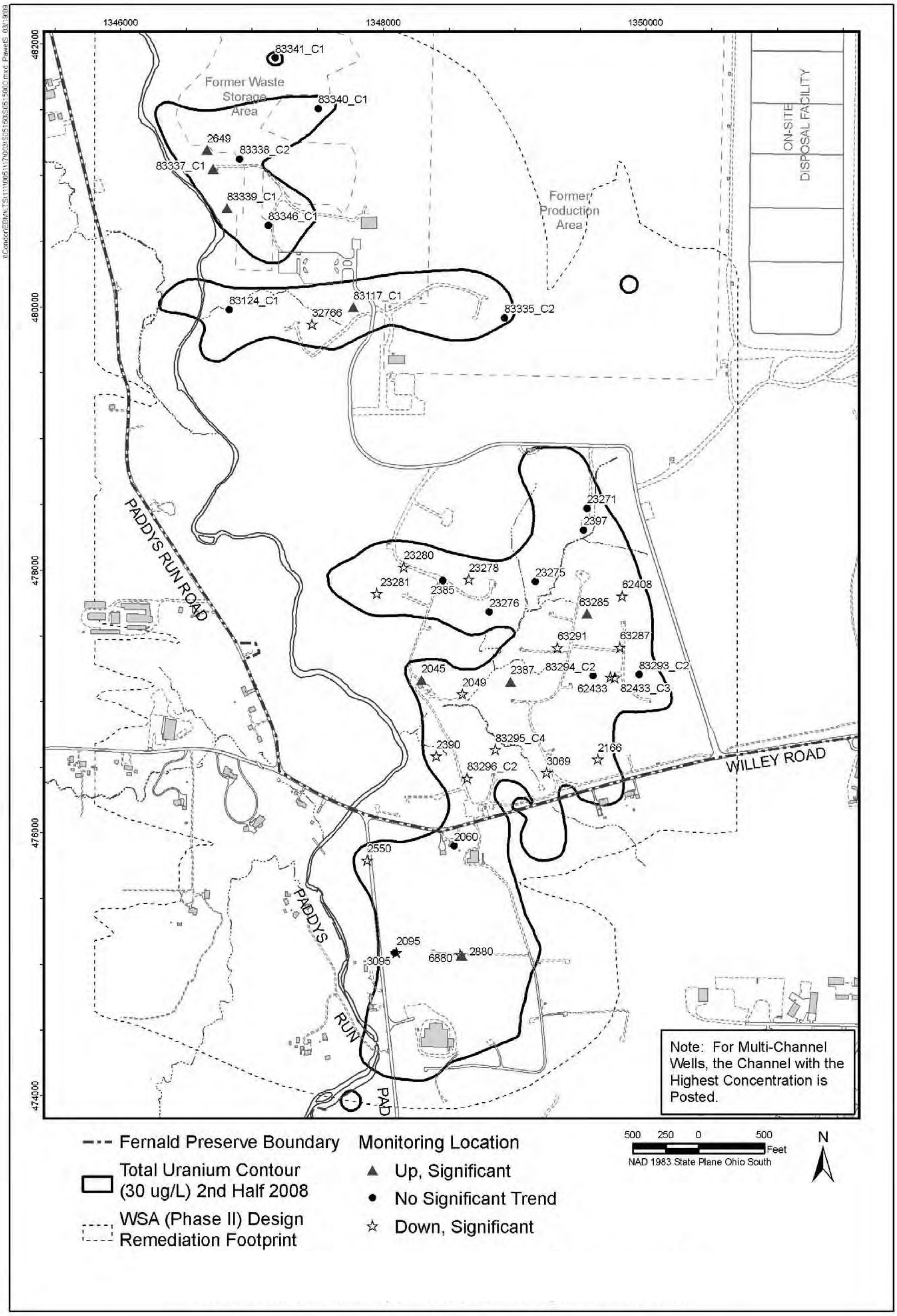


Figure A.2−4. Monitoring Wells with 2008 Exceedances for Total Uranium with Up, Down, or No Significant Trends

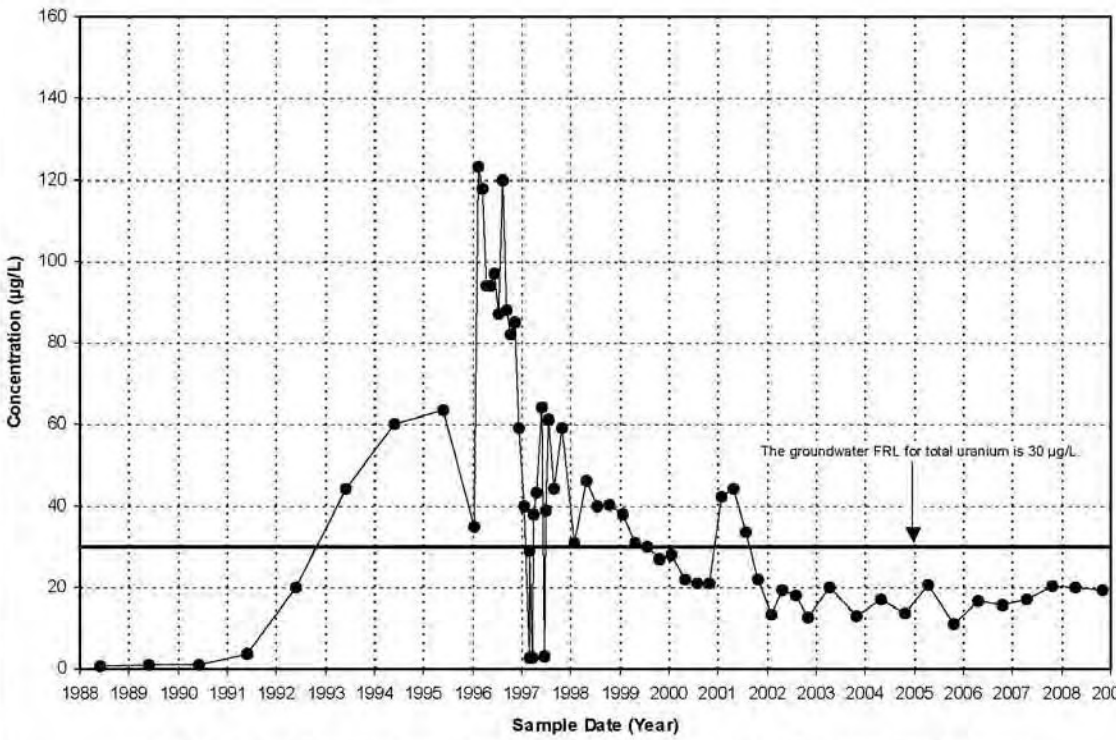


FIGURE A.2-5. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 13

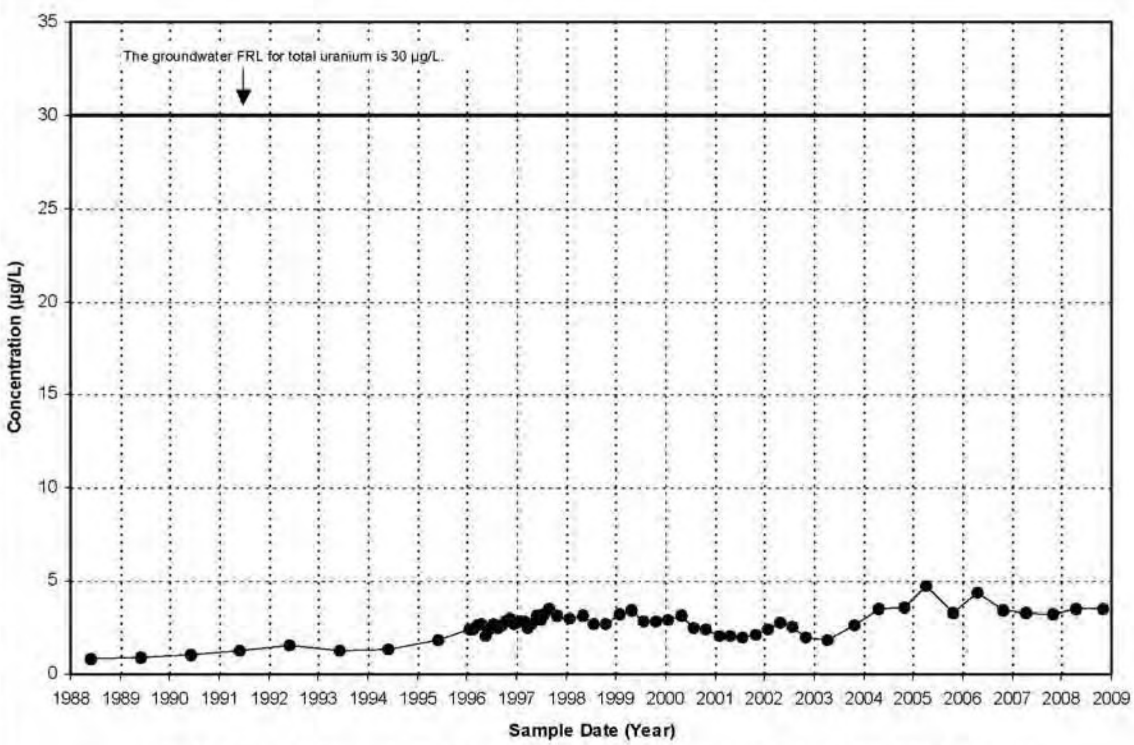


FIGURE A.2-6. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 14

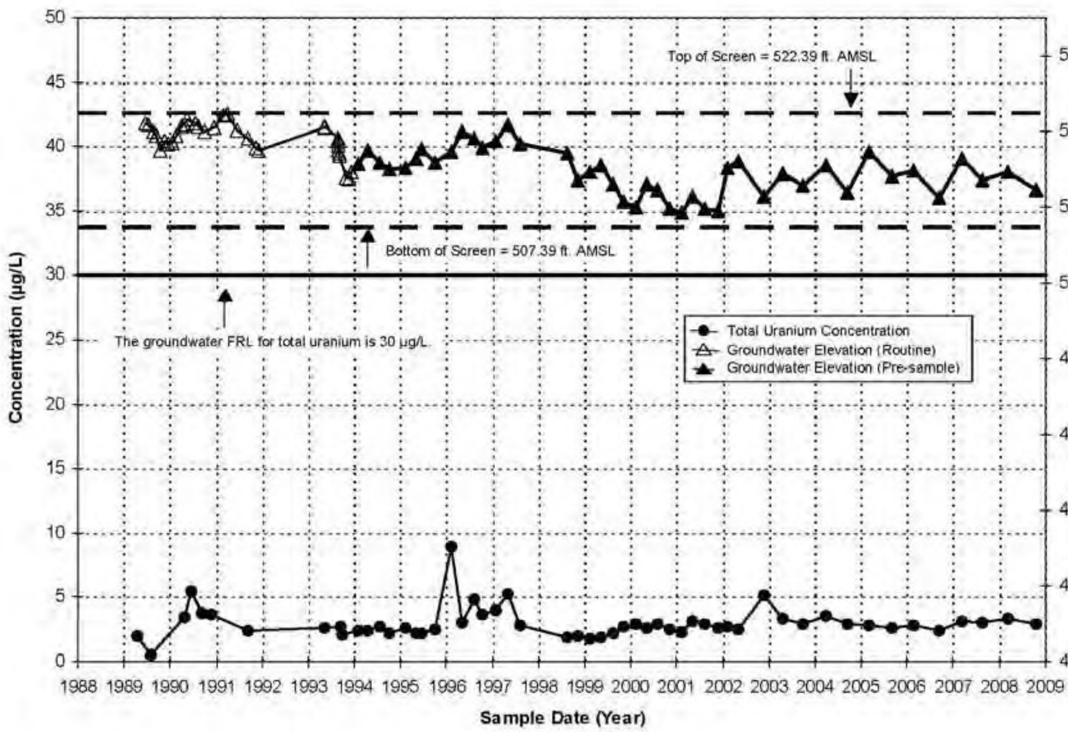


FIGURE A.2-7. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2002

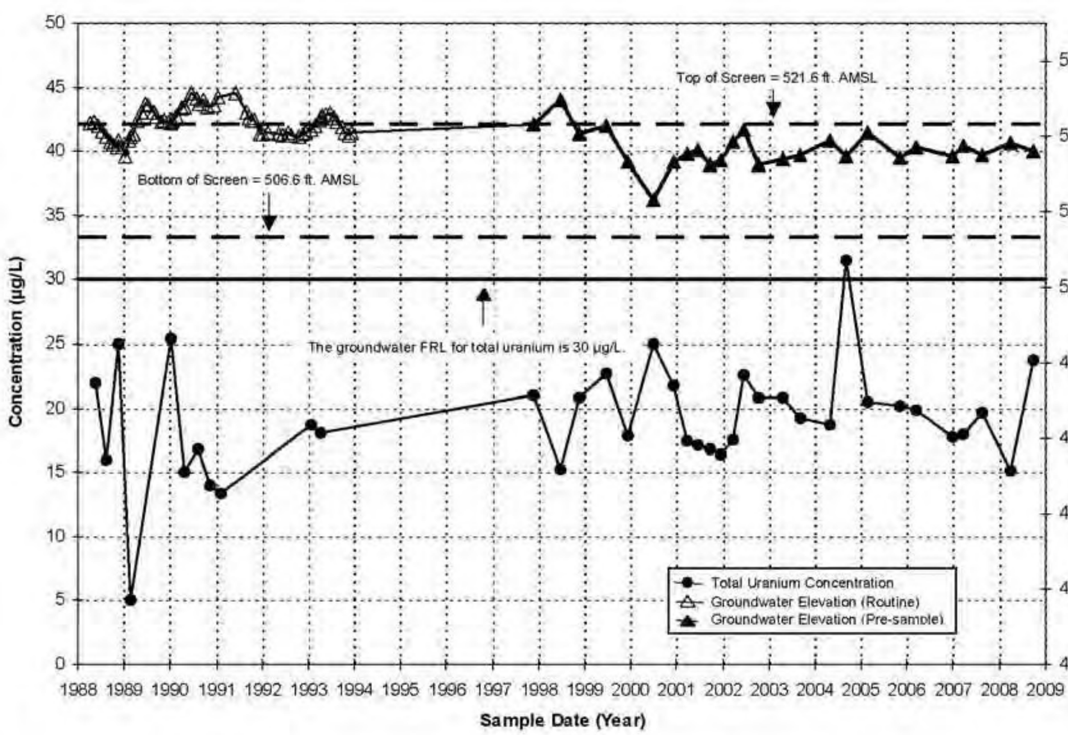


FIGURE A.2-8. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2008

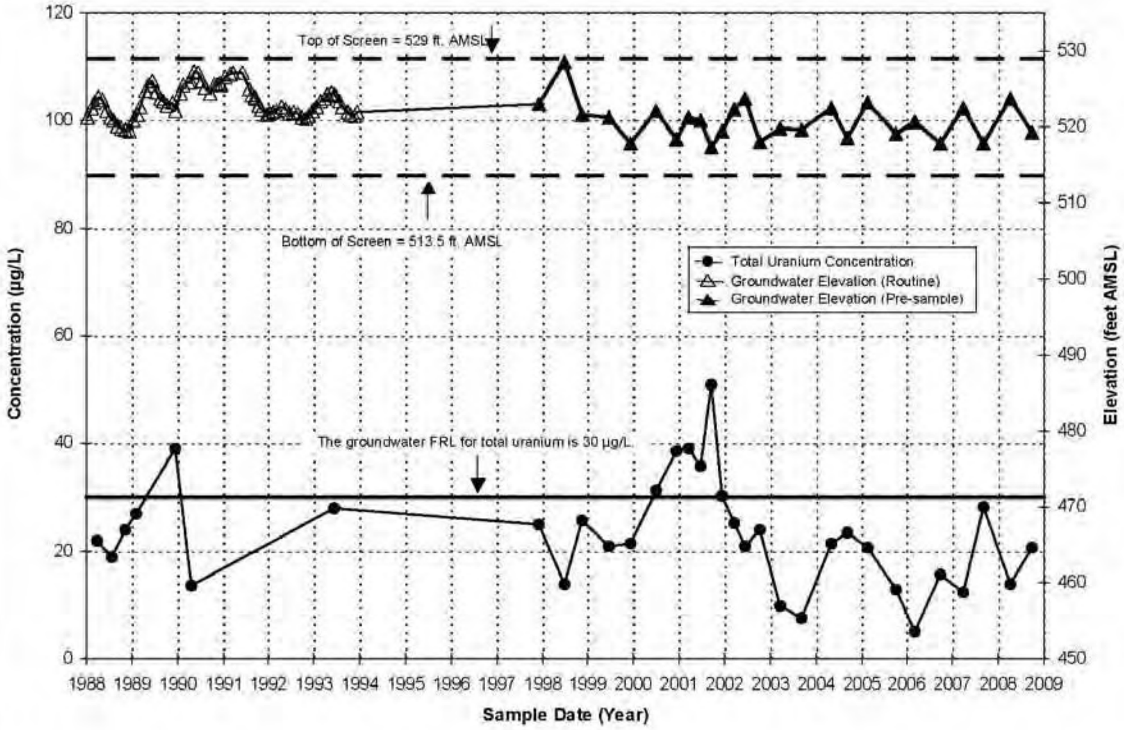


FIGURE A.2-9. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2009

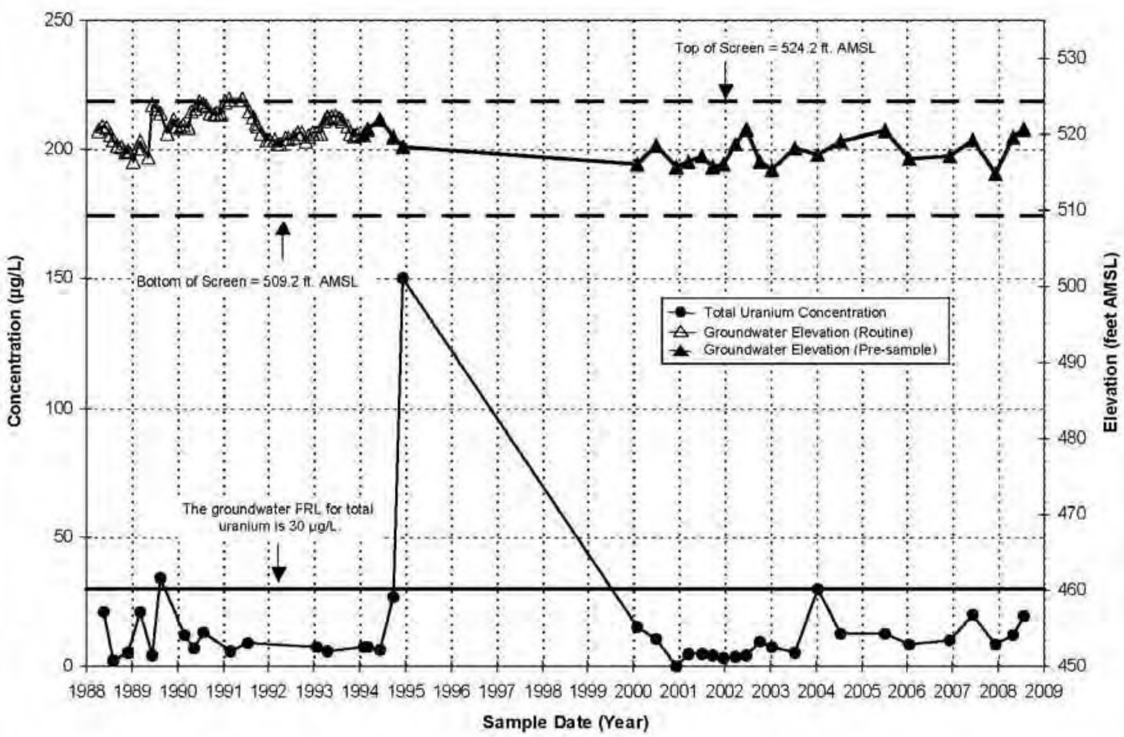


FIGURE A.2-10. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2010

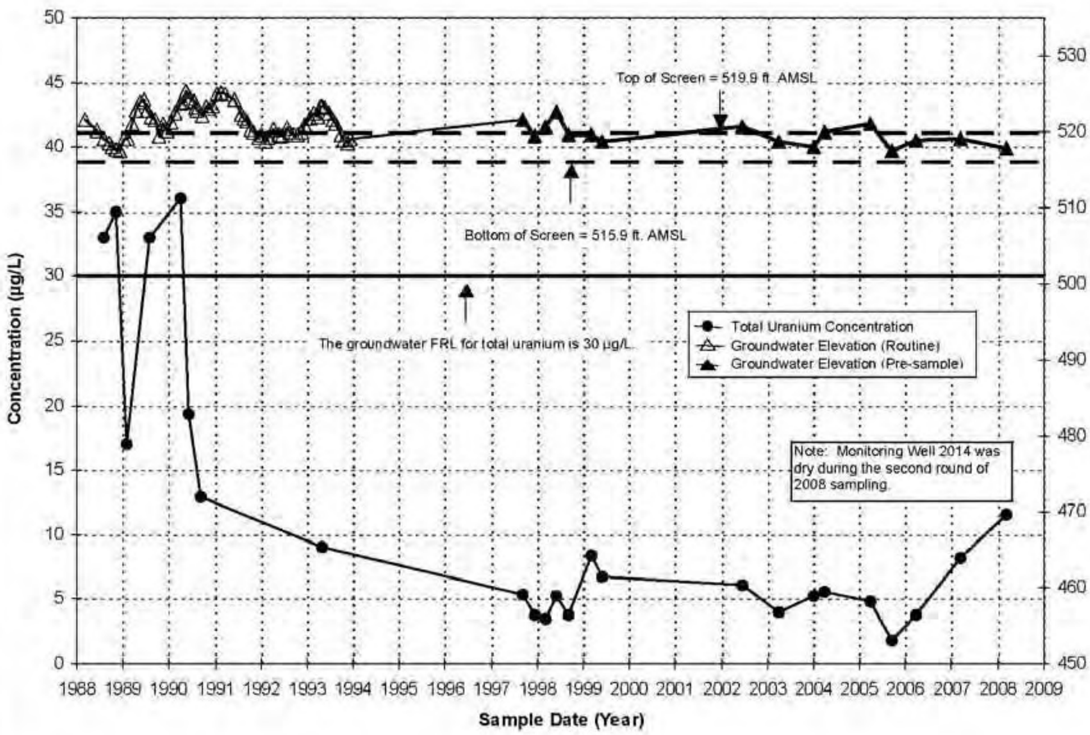


FIGURE A.2-11. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2014

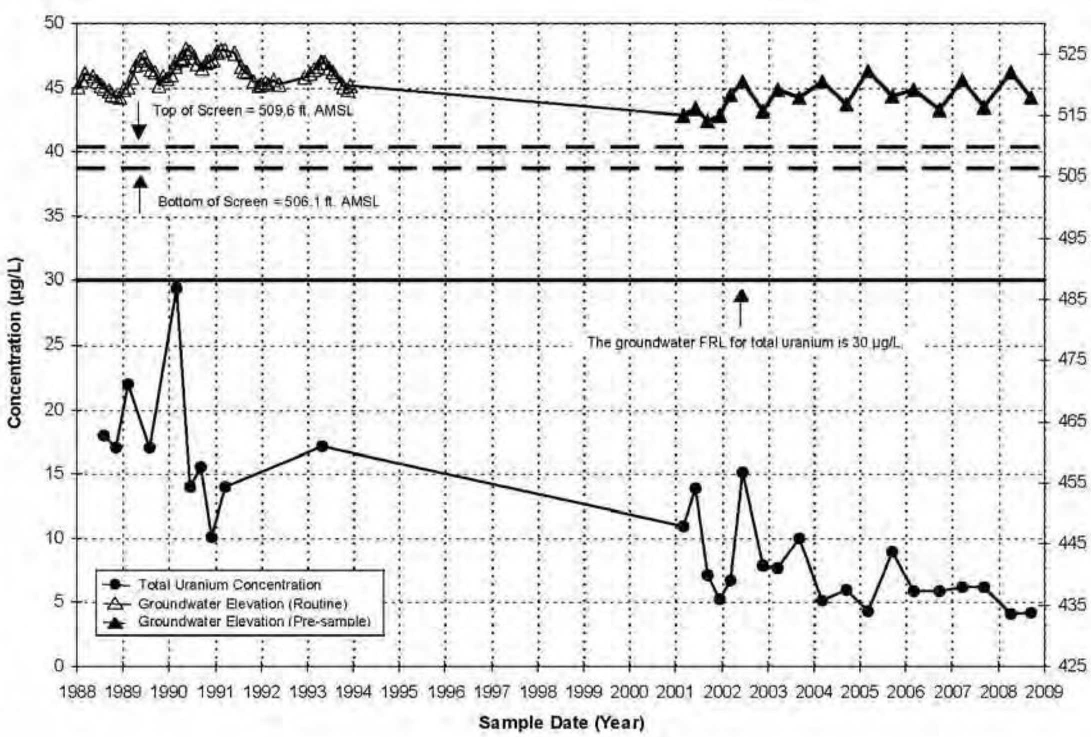


FIGURE A.2-12. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2016

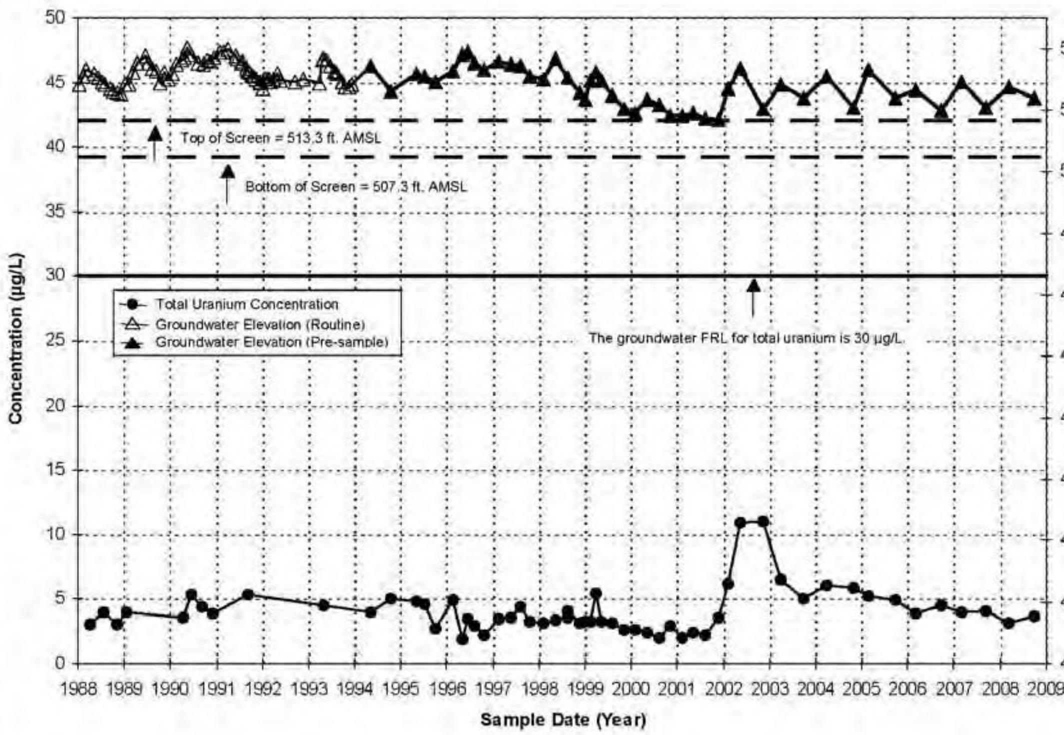


FIGURE A.2-13. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2017

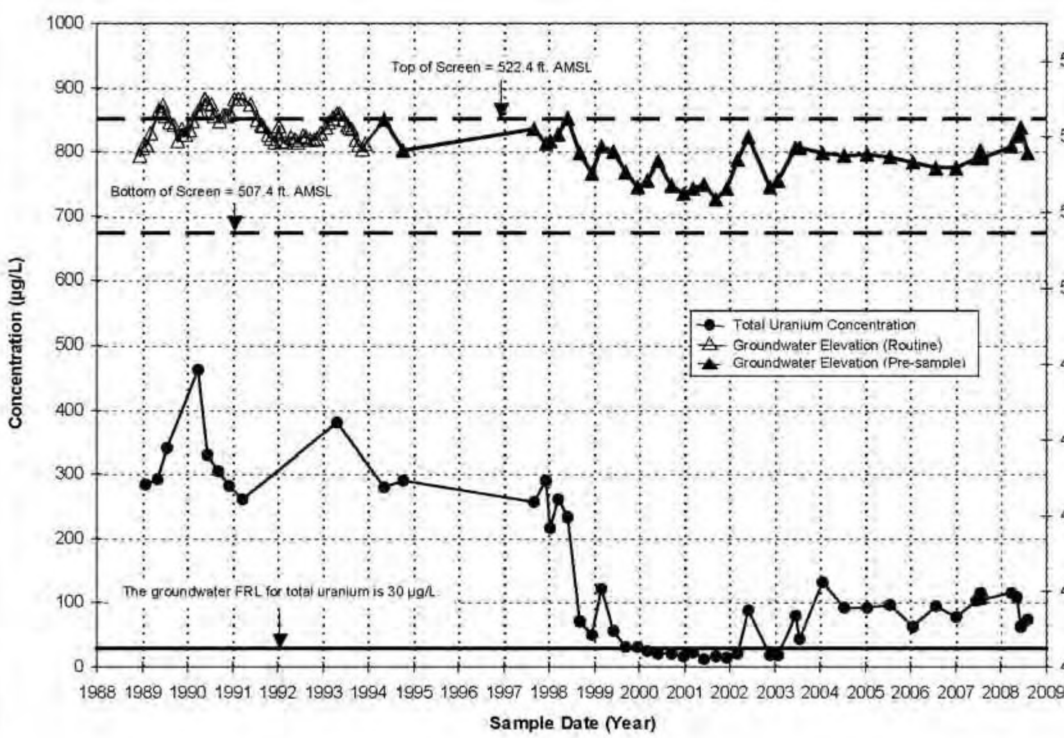


FIGURE A.2-14. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2045

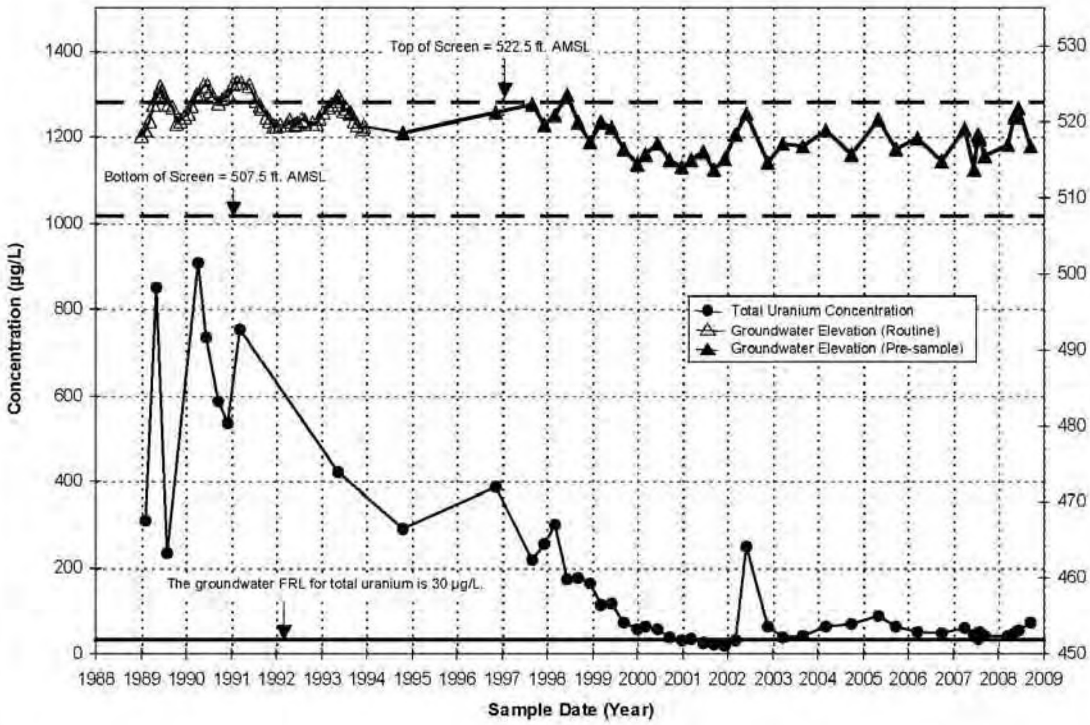


FIGURE A.2-15. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2046

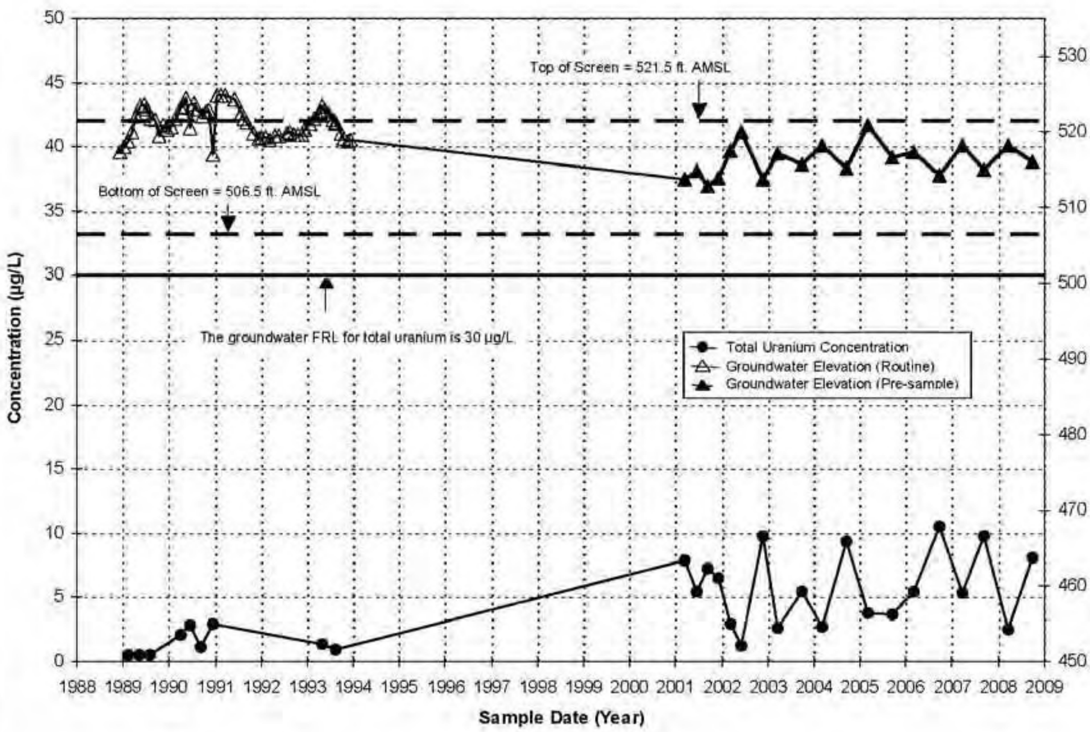


FIGURE A.2-16. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2048

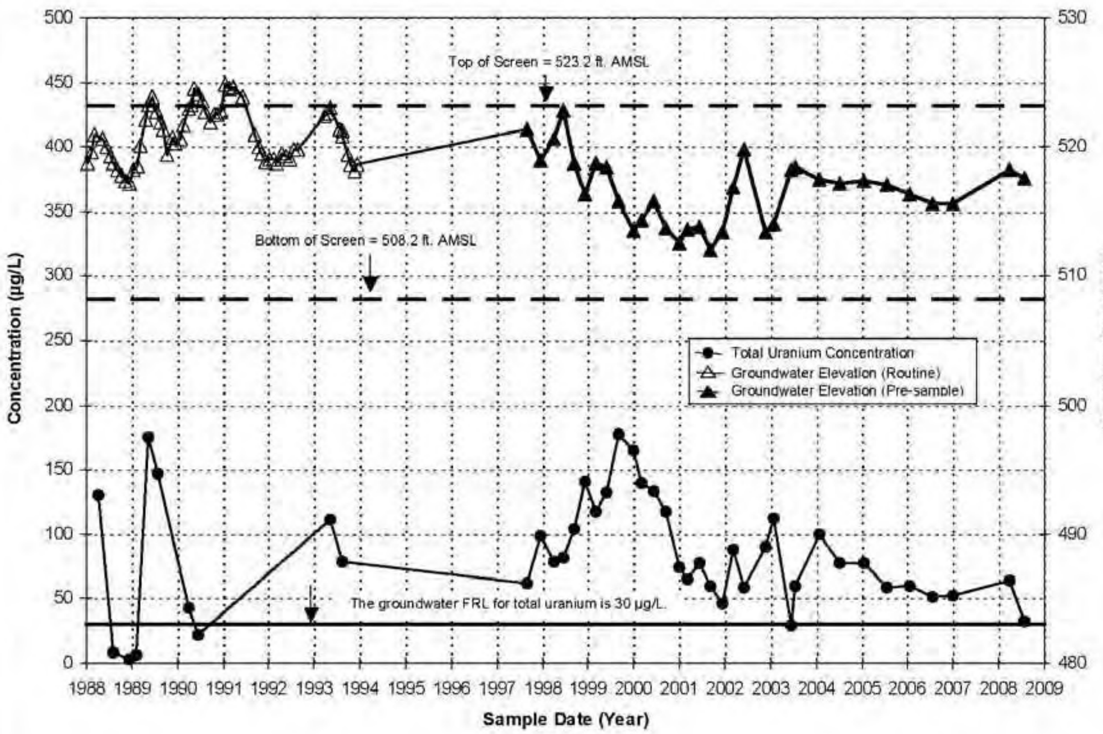


FIGURE A.2-17. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2049

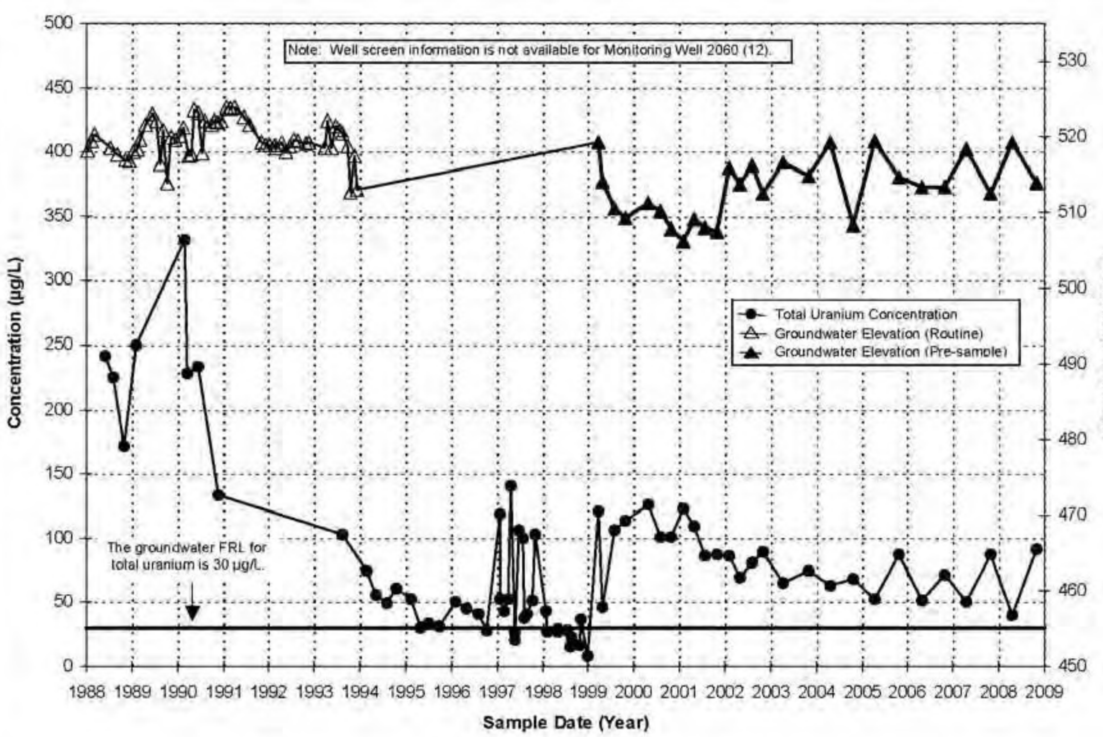


FIGURE A.2-18. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2060 (12)

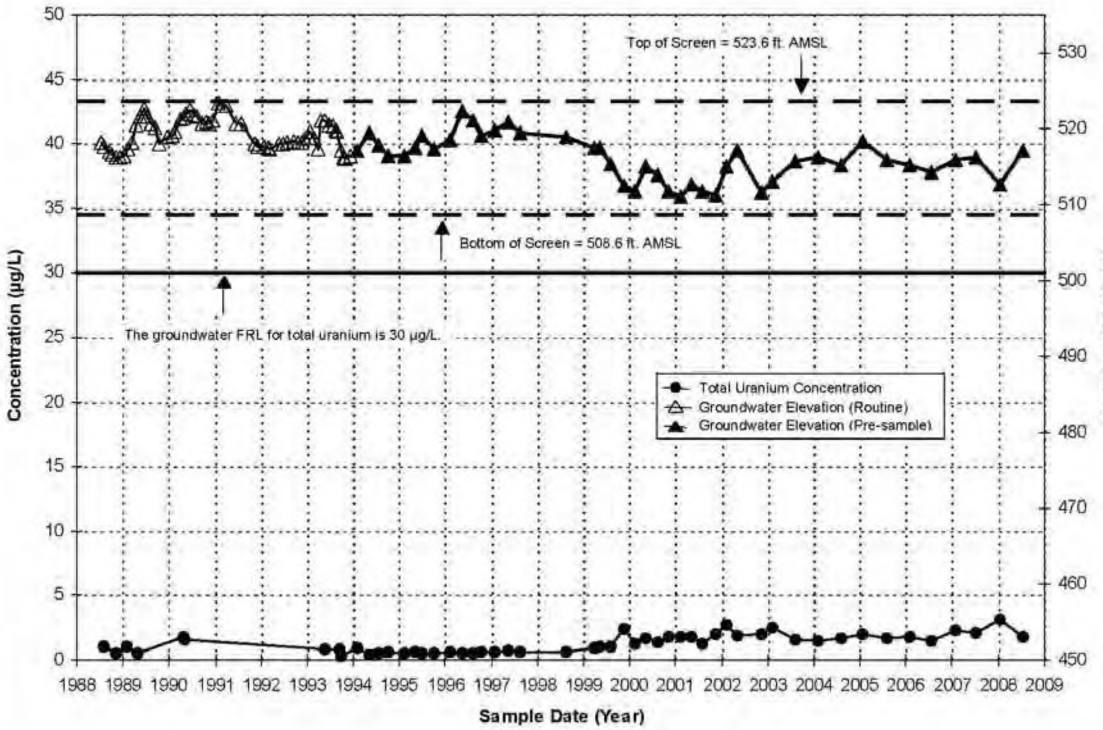


FIGURE A.2-19. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2093

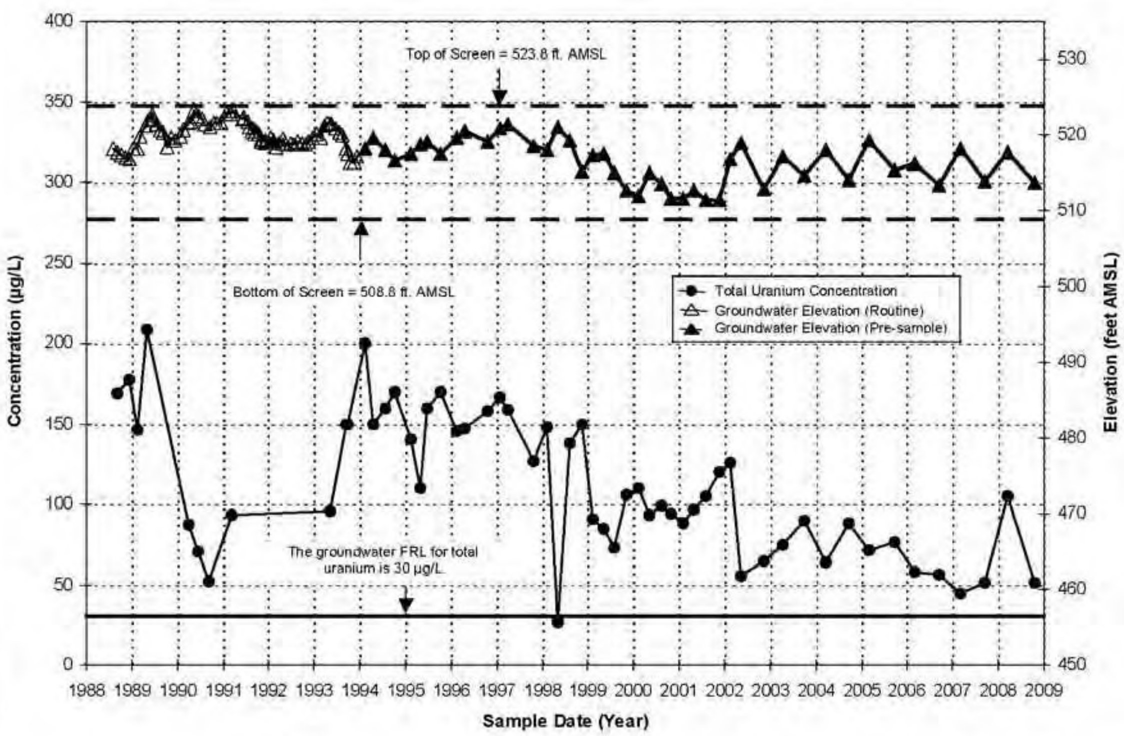


FIGURE A.2-20. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2095

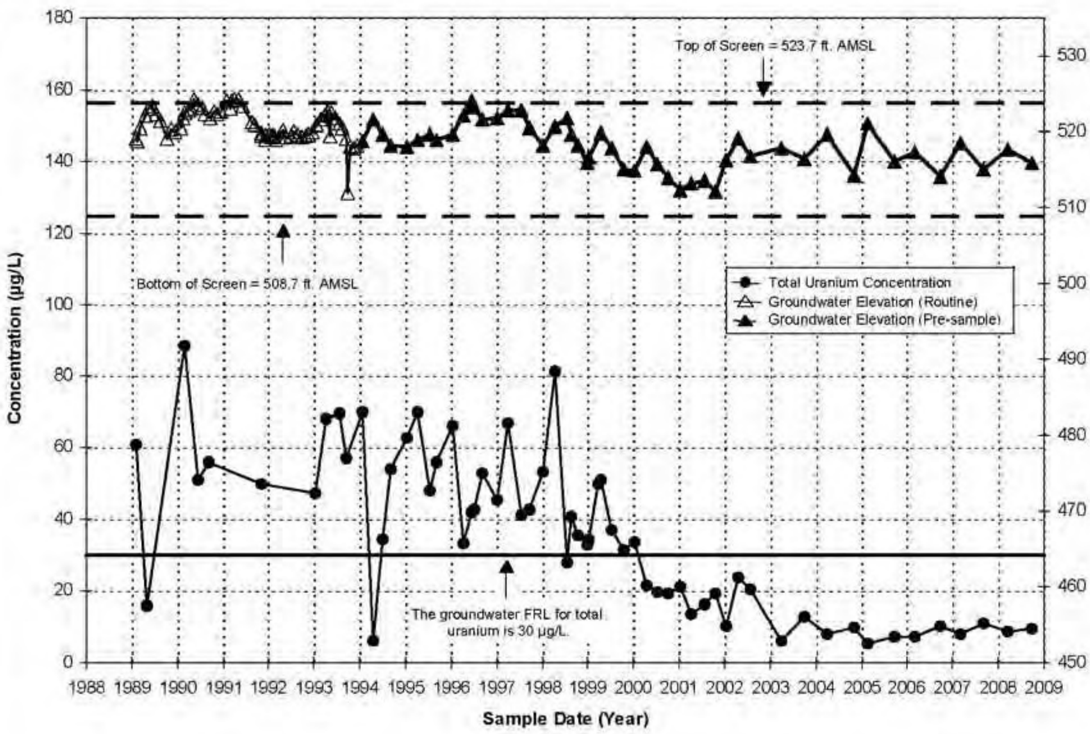


FIGURE A.2-21. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2106

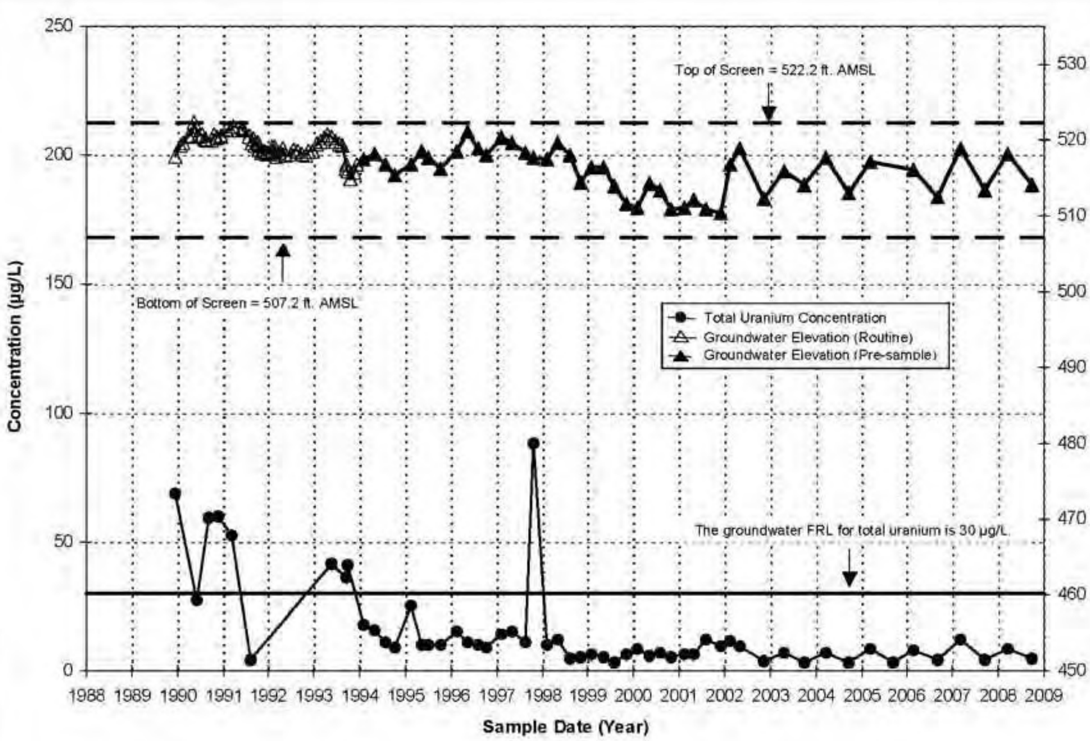


FIGURE A.2-22. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2125

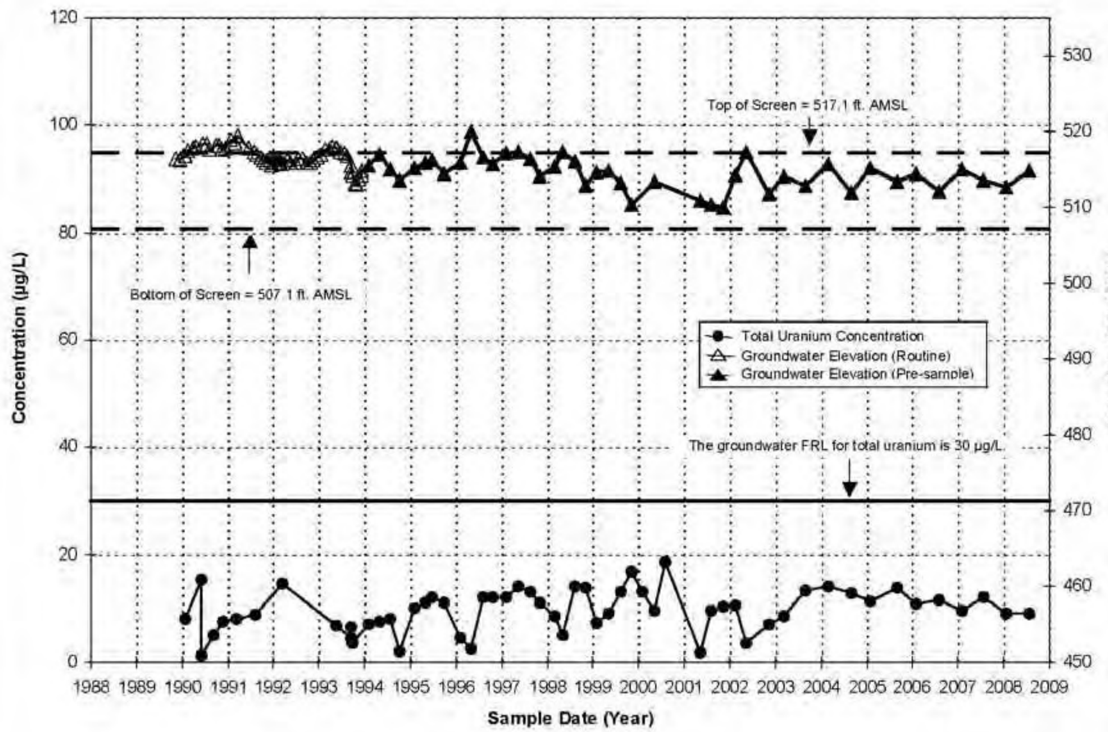


FIGURE A.2-23. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2128

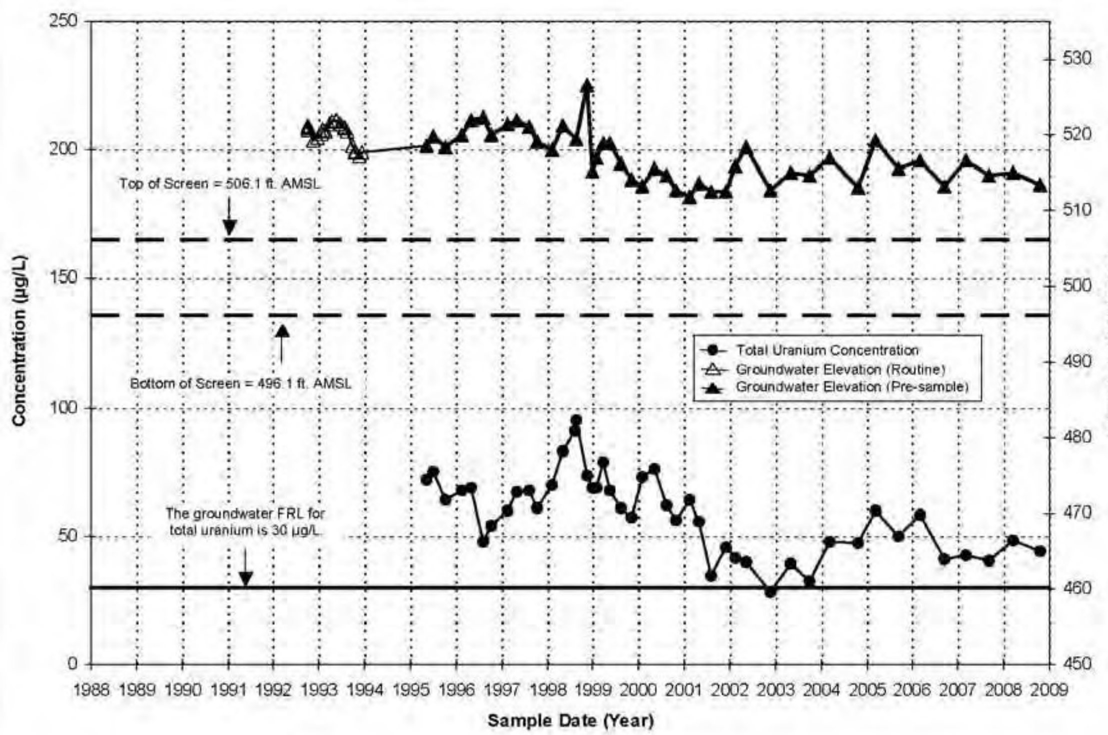


FIGURE A.2-24. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2166

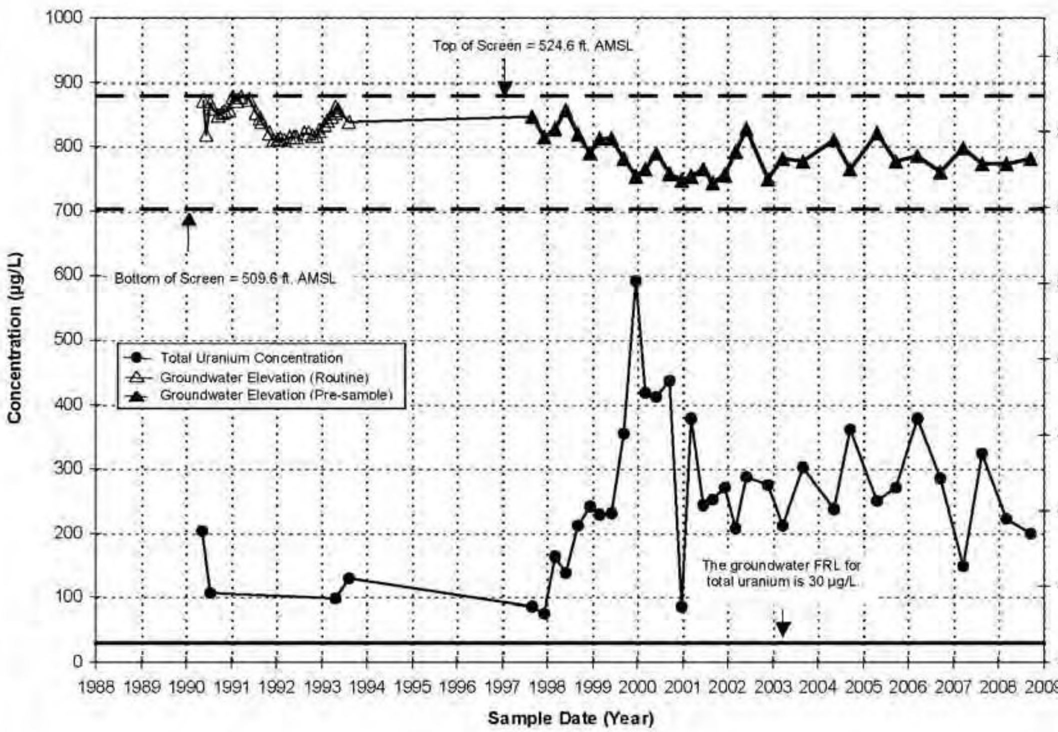


FIGURE A.2-25. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2385

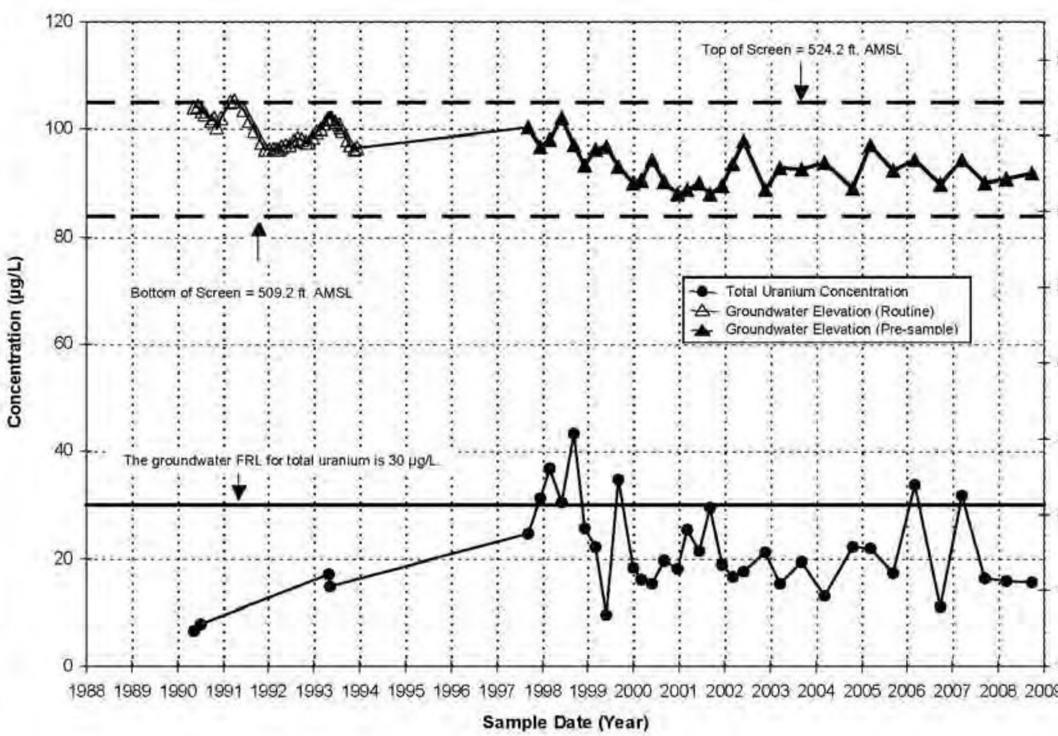


FIGURE A.2-26. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2386

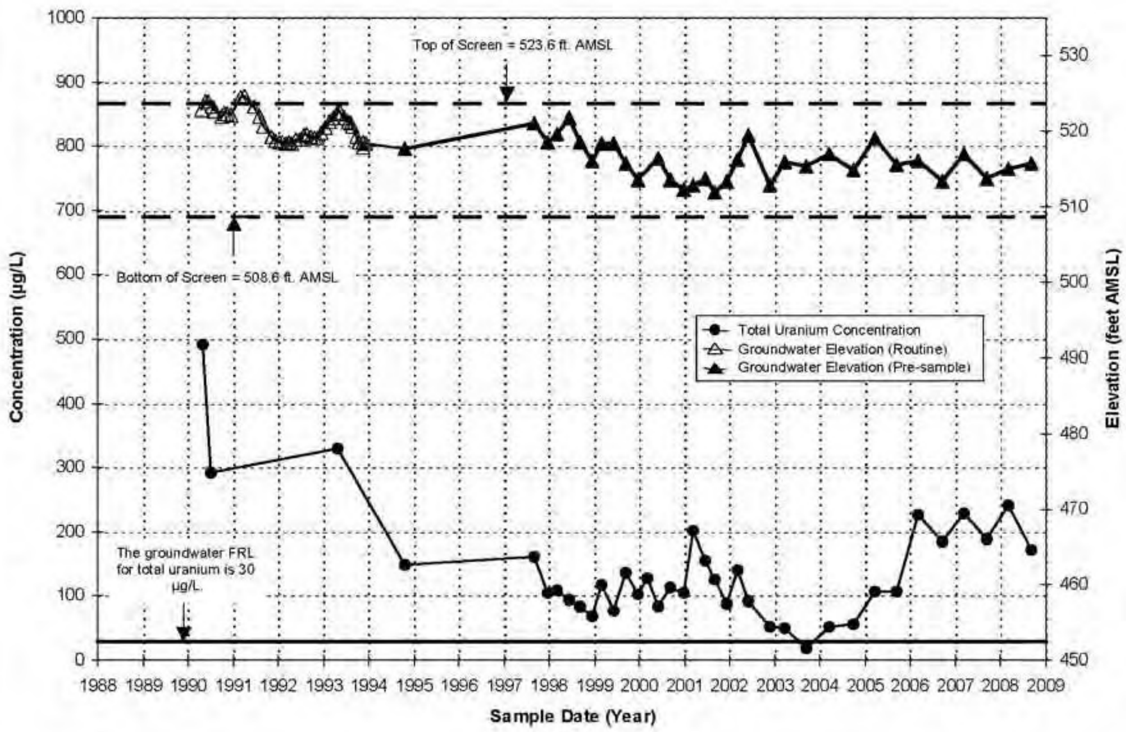


FIGURE A.2-27. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2387

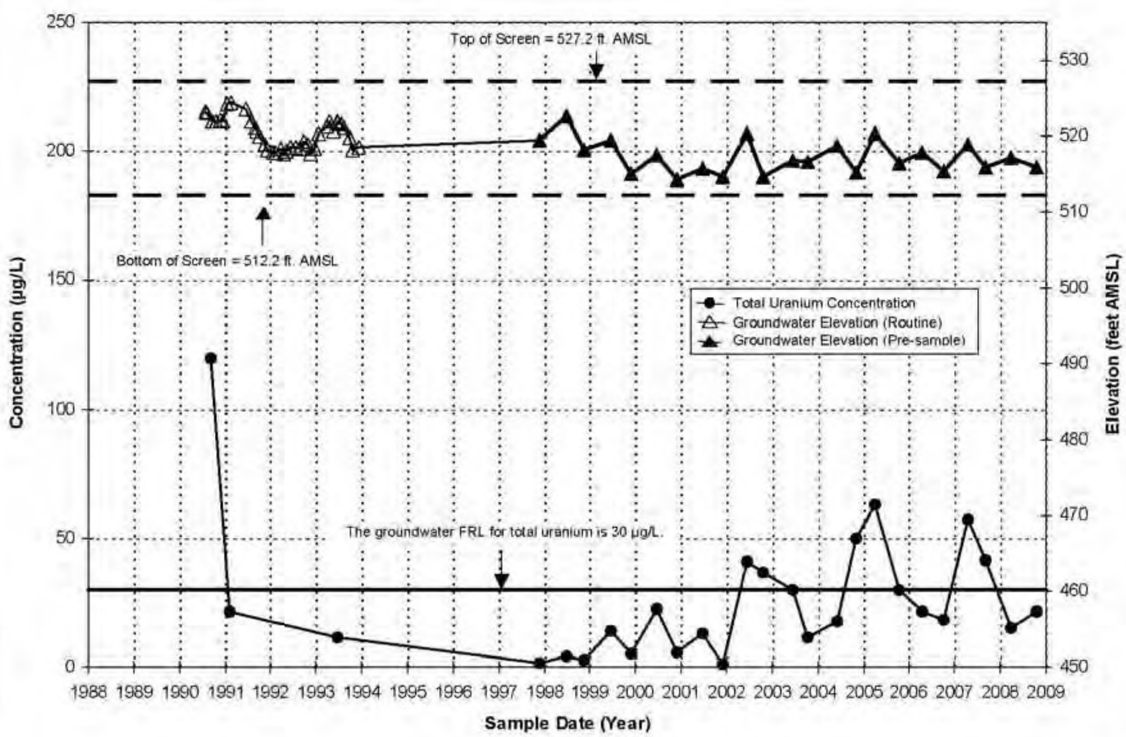


FIGURE A.2-28. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2389

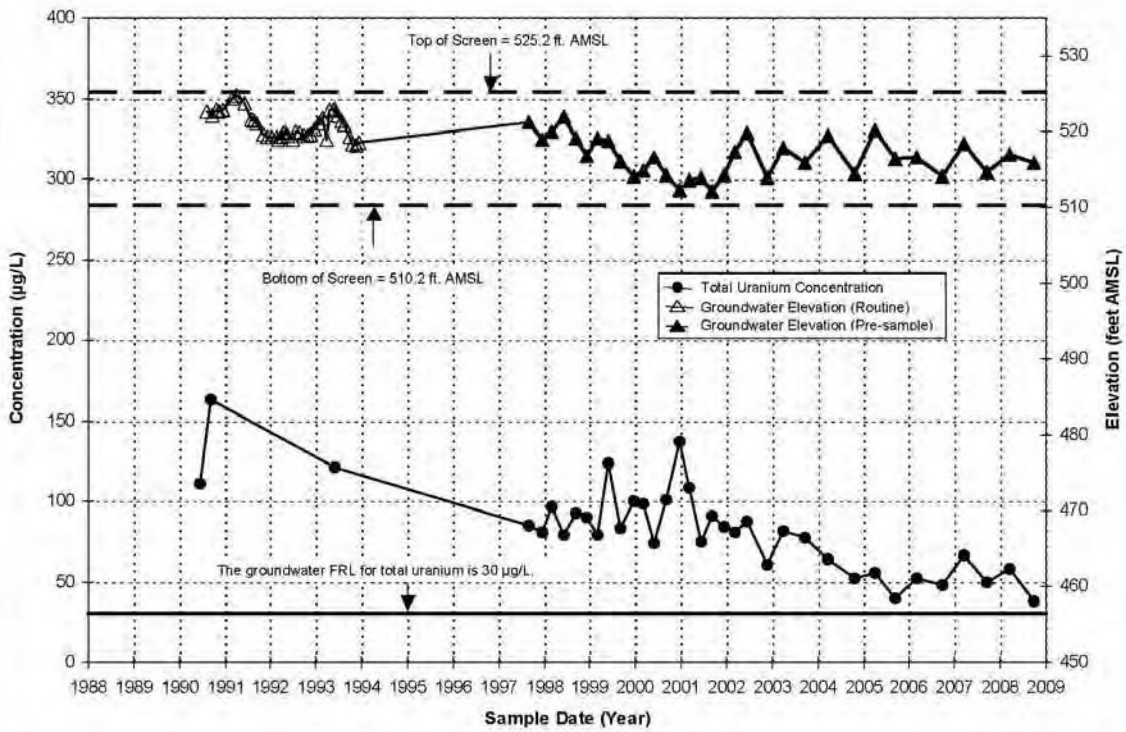


FIGURE A.2-29. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2390

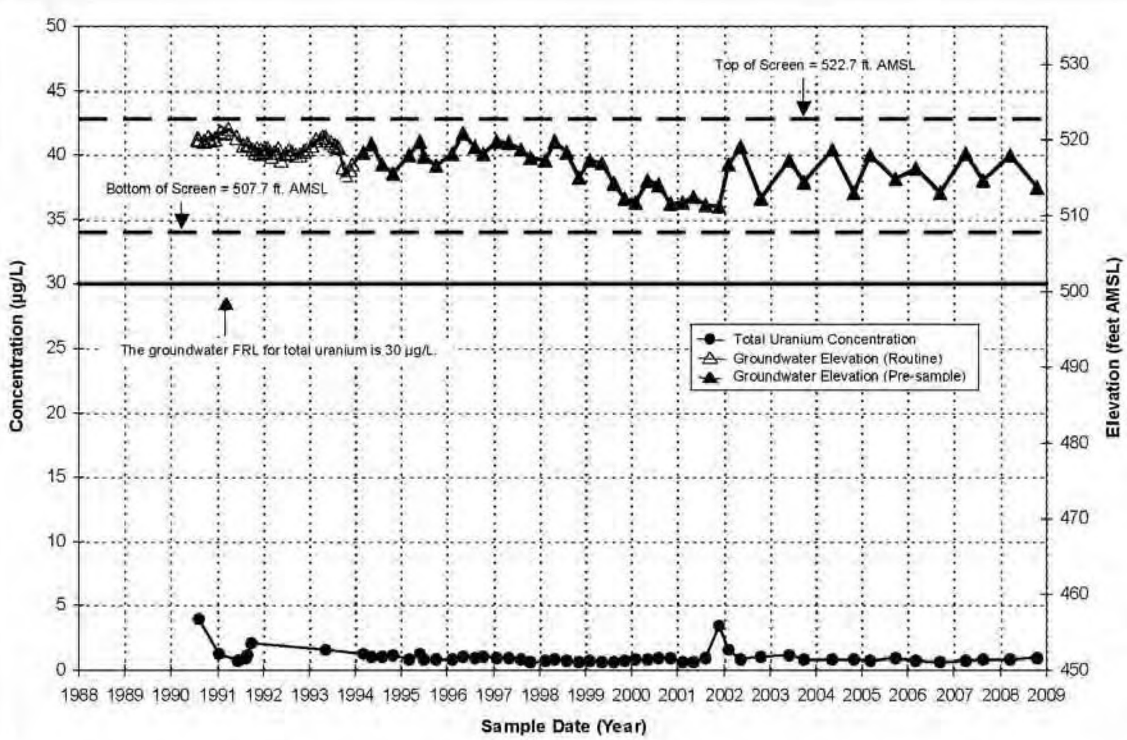


FIGURE A.2-30. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2396

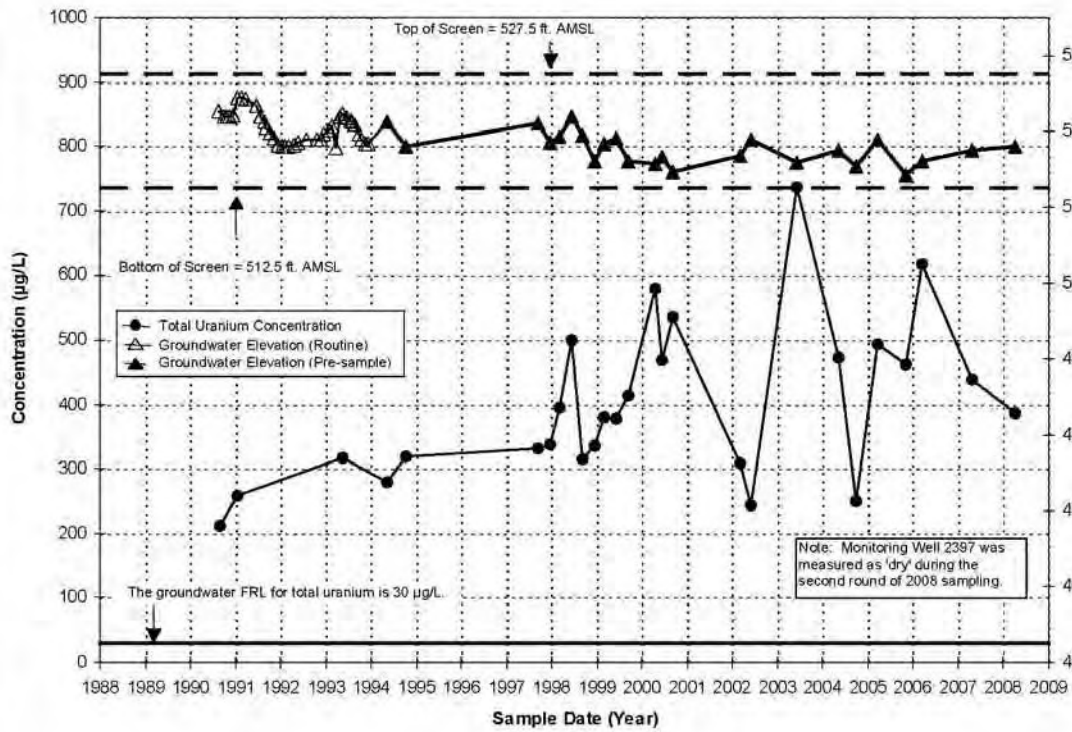


FIGURE A.2-31. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2397

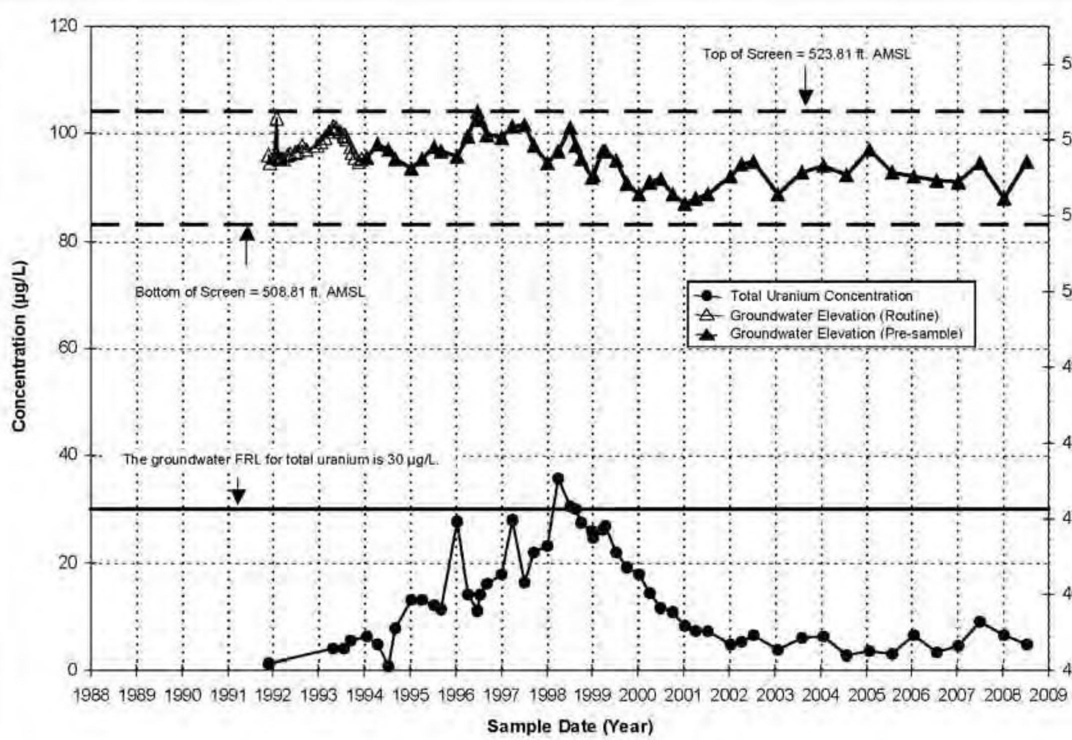


FIGURE A.2-32. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2398

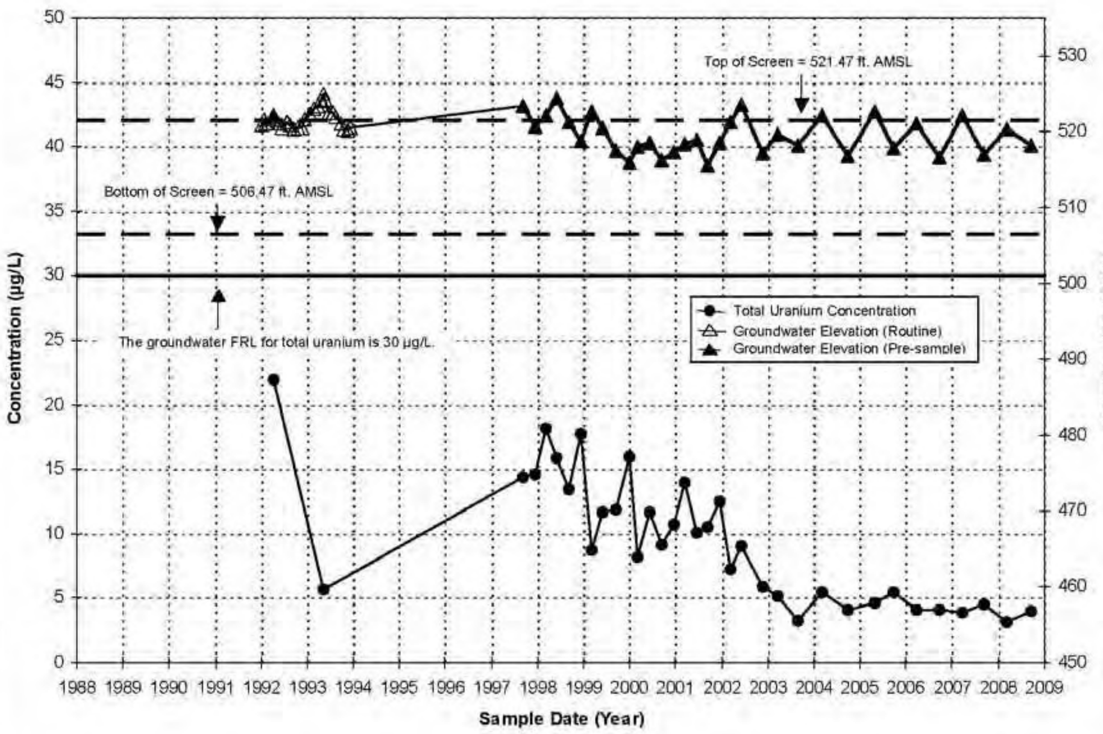


FIGURE A.2-33. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2402

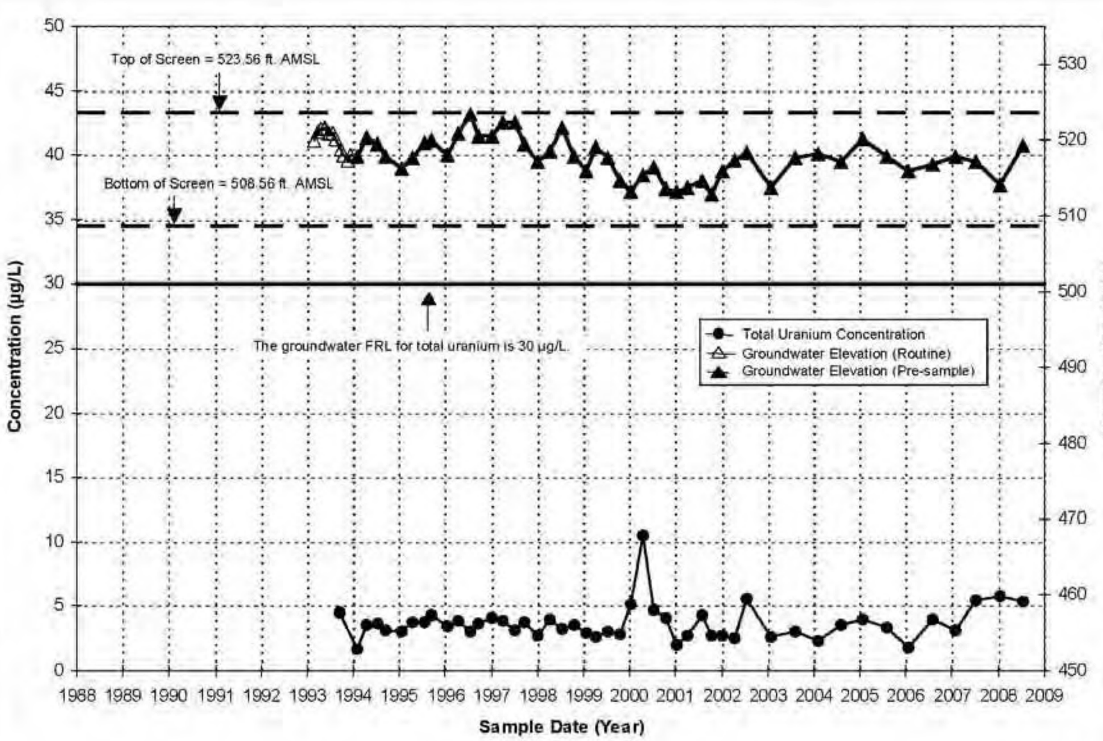


FIGURE A.2-34. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2431

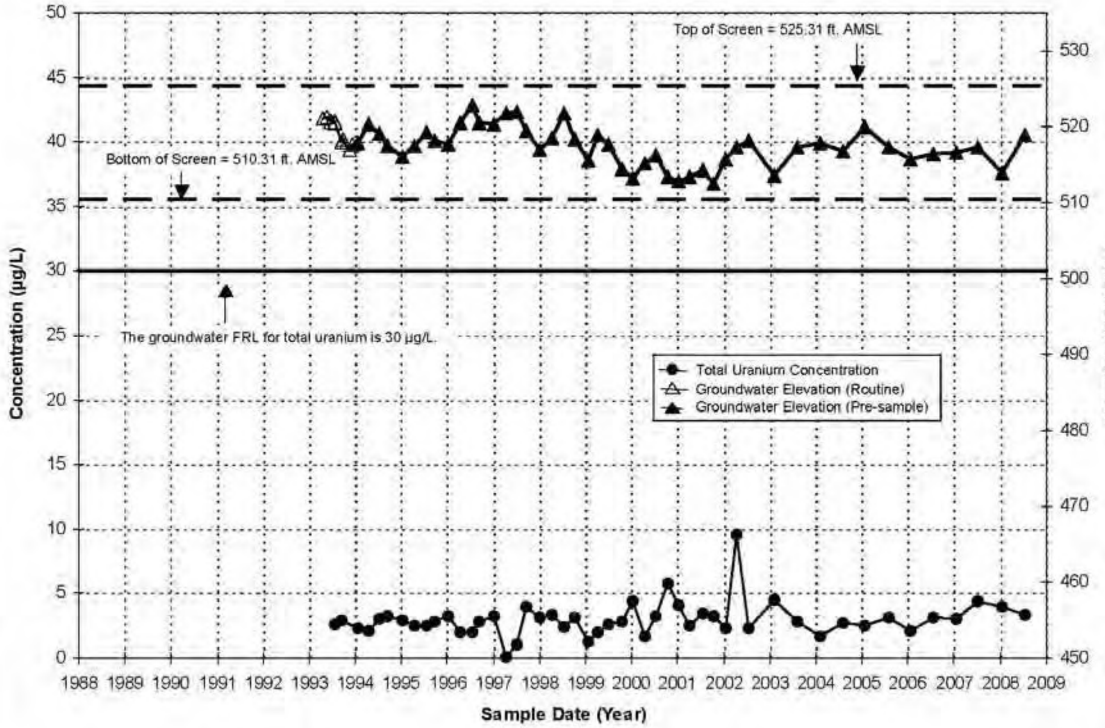


FIGURE A.2-35. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2432

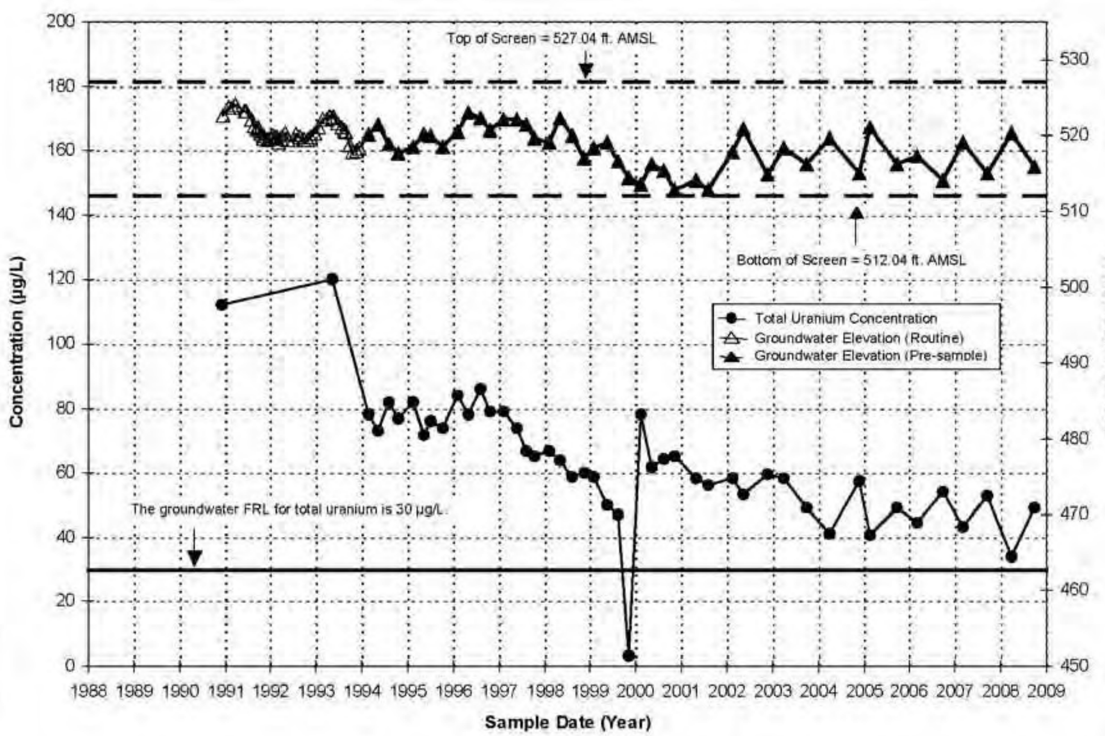


FIGURE A.2-36. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2550

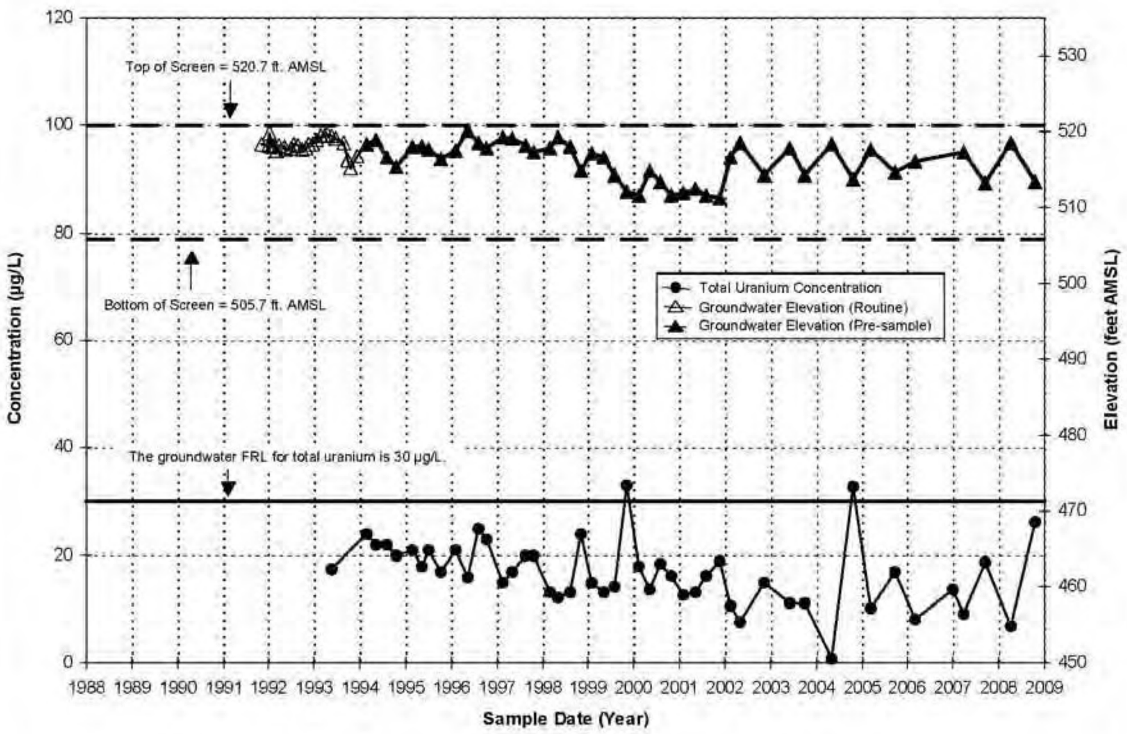


FIGURE A.2-37. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2552

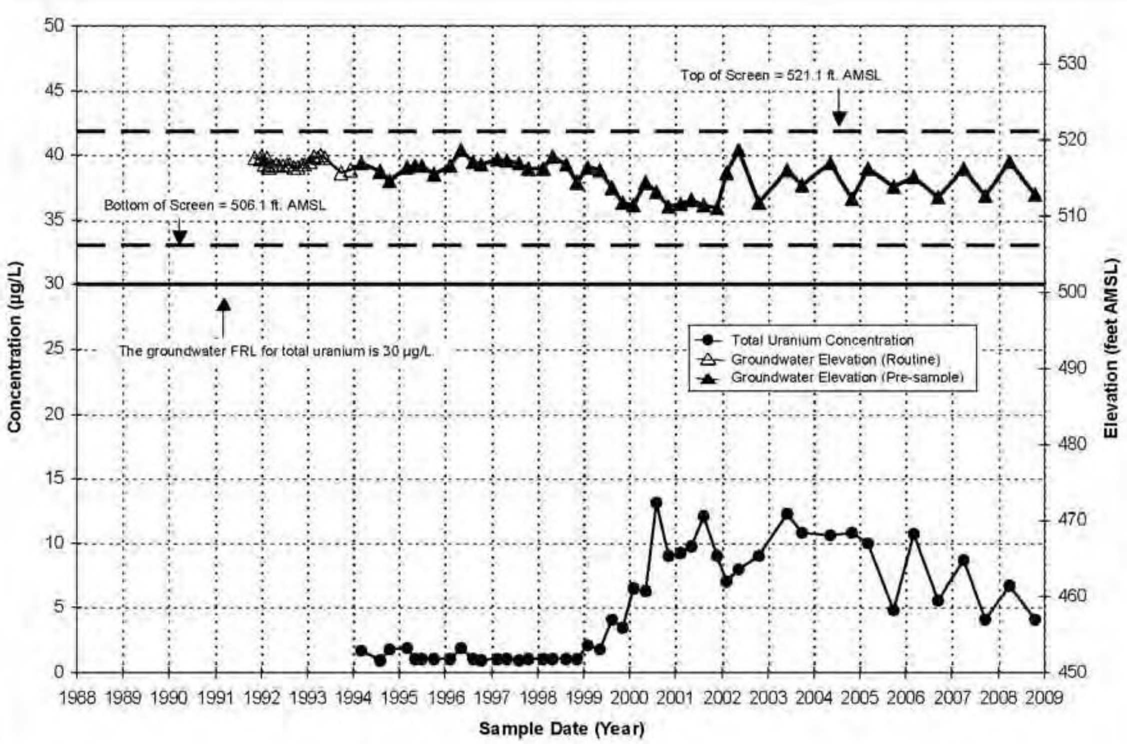


FIGURE A.2-38. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2553

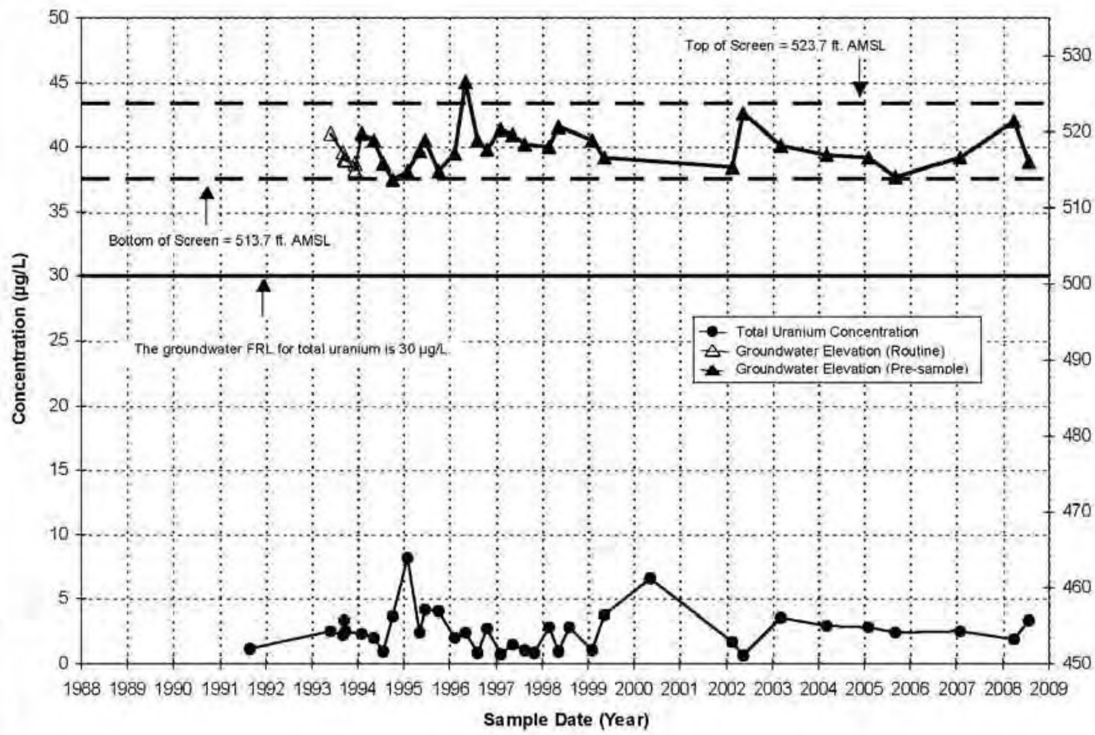


FIGURE A.2-39. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2625

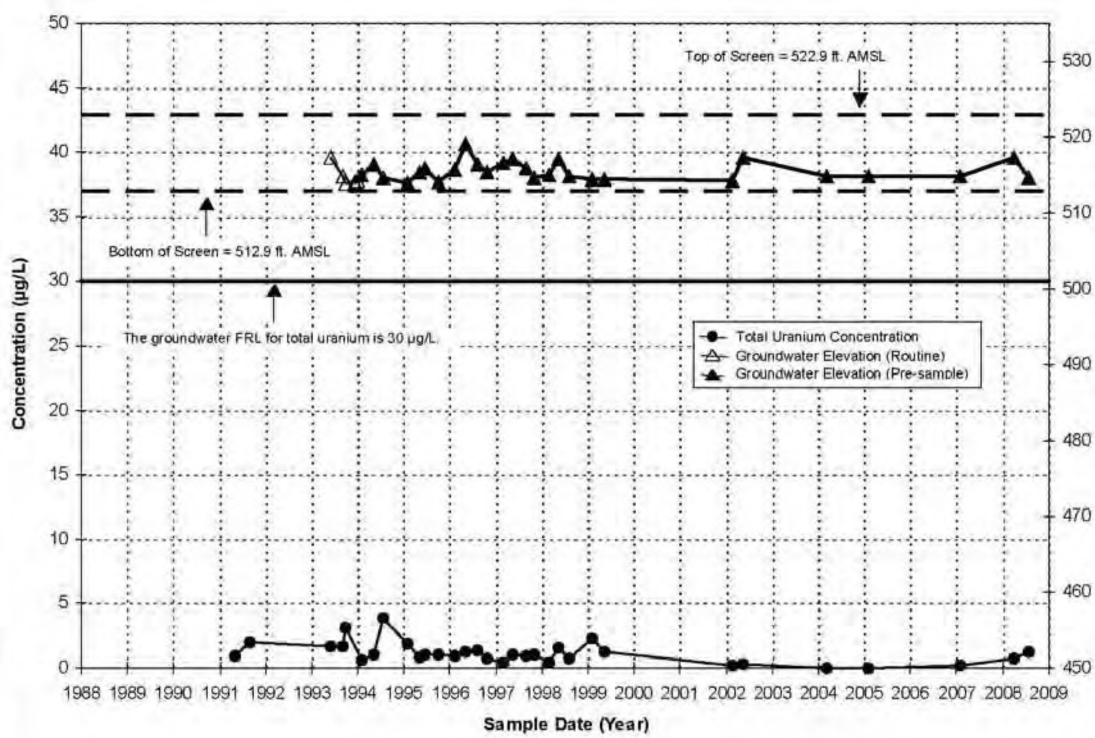


FIGURE A.2-40. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

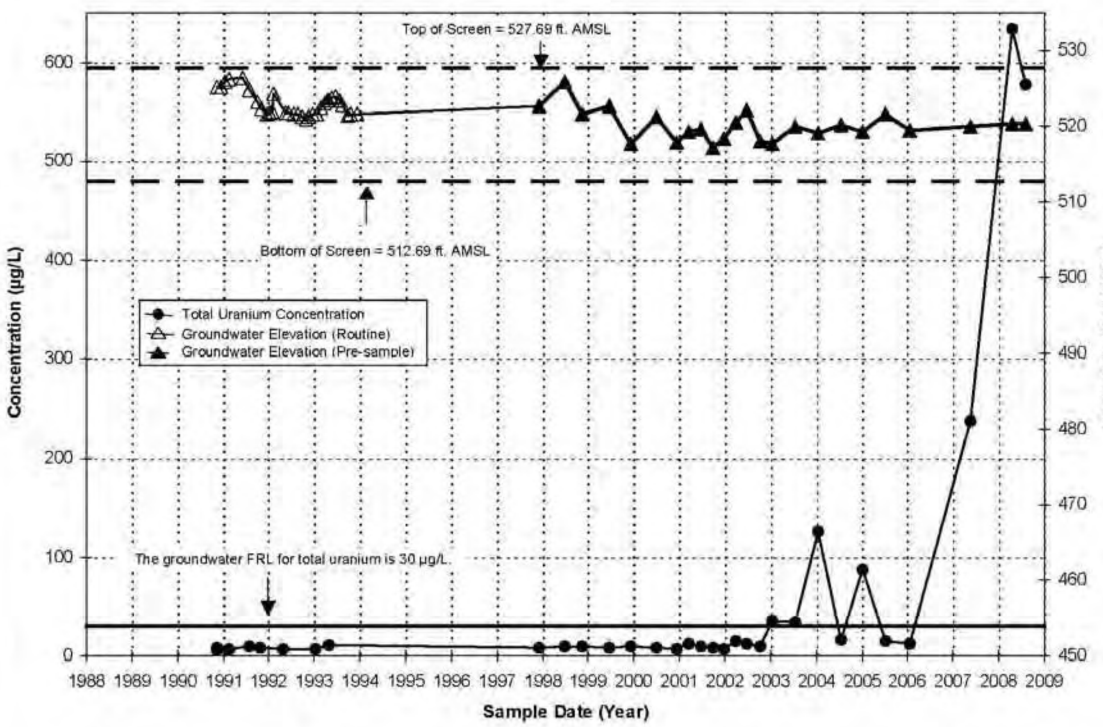


FIGURE A.2-41. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2649

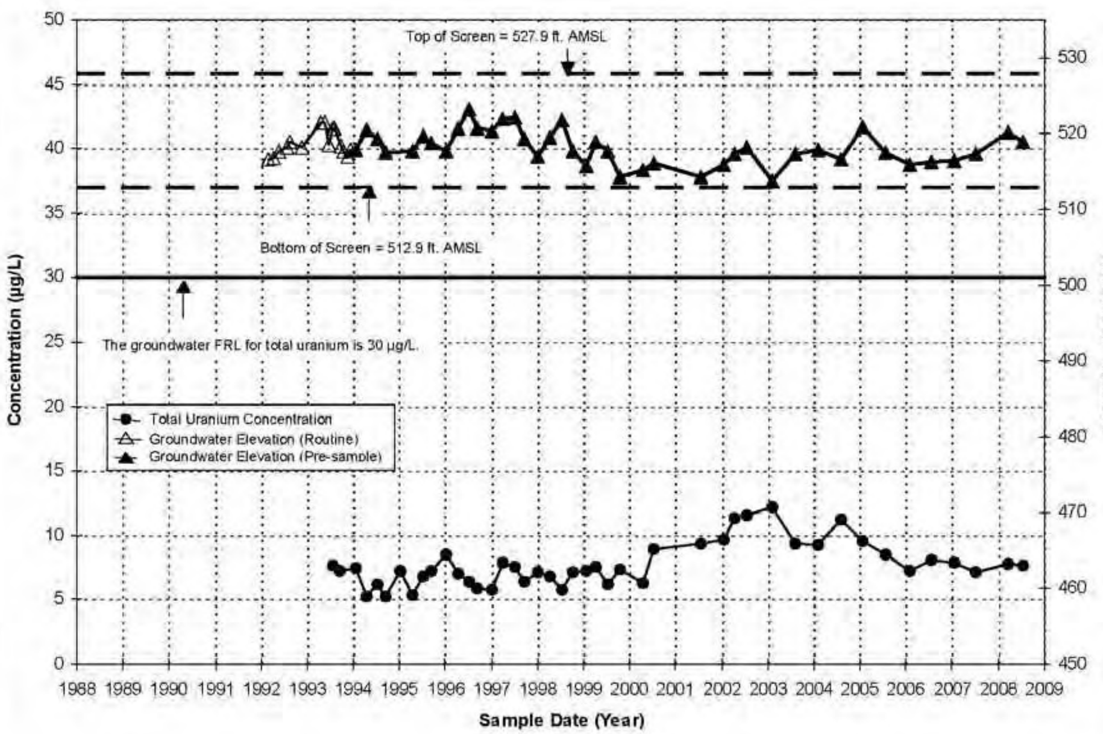


FIGURE A.2-42. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2733

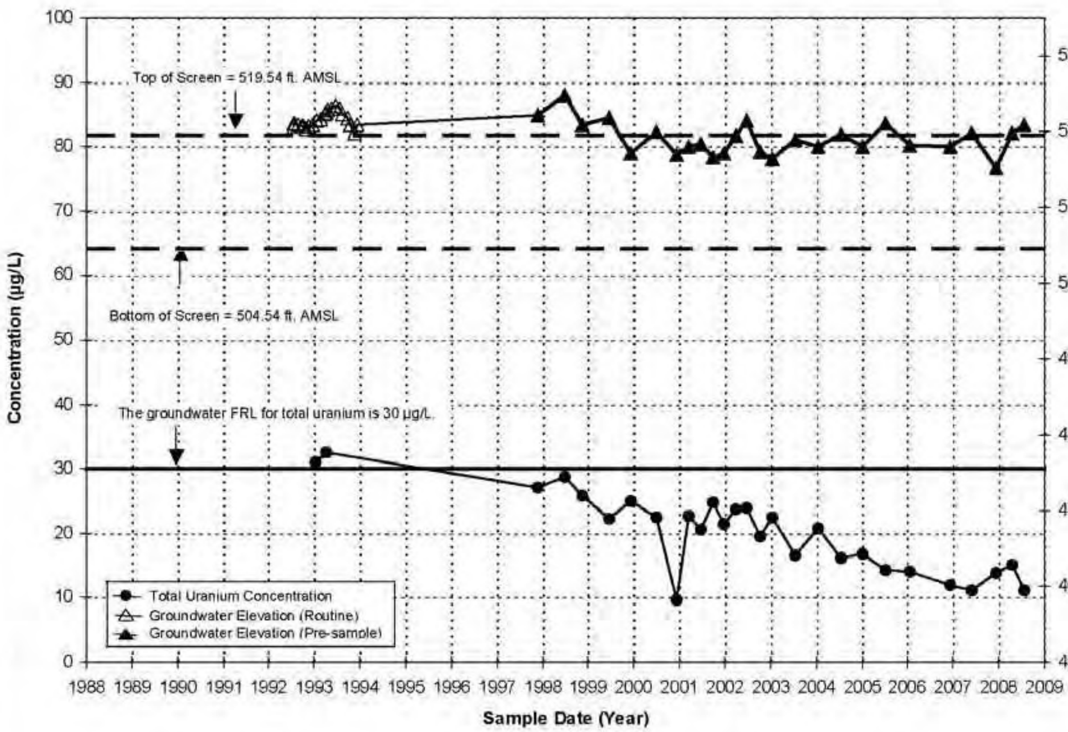


FIGURE A.2-43. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2821

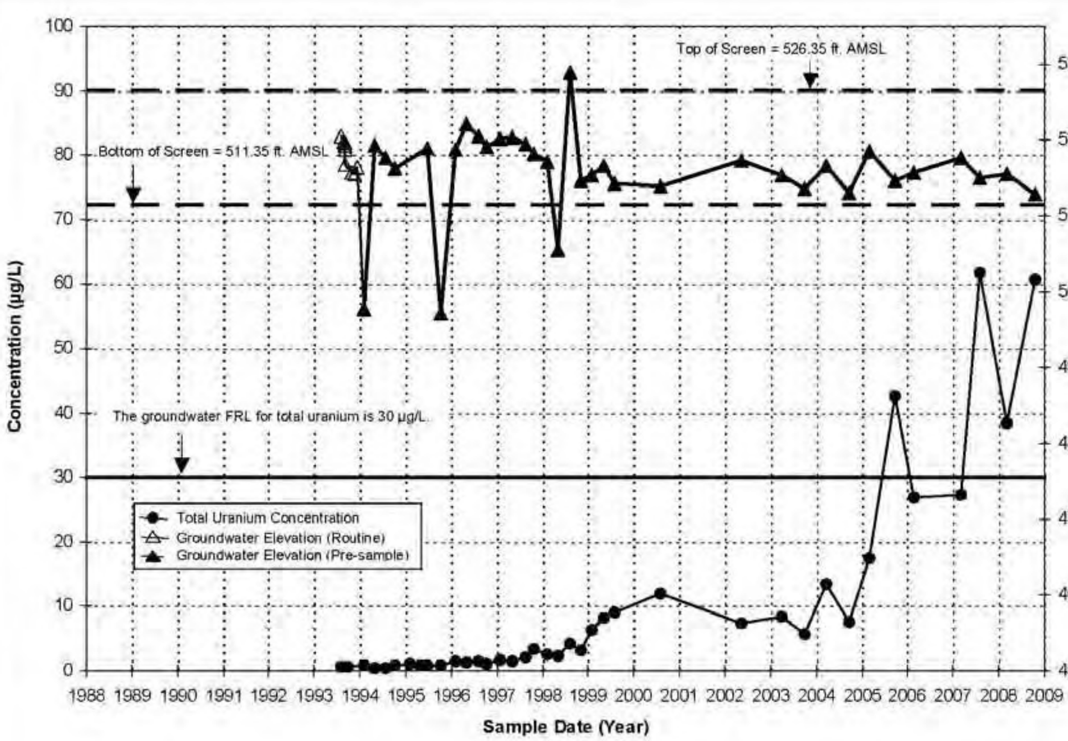


FIGURE A.2-44. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2880

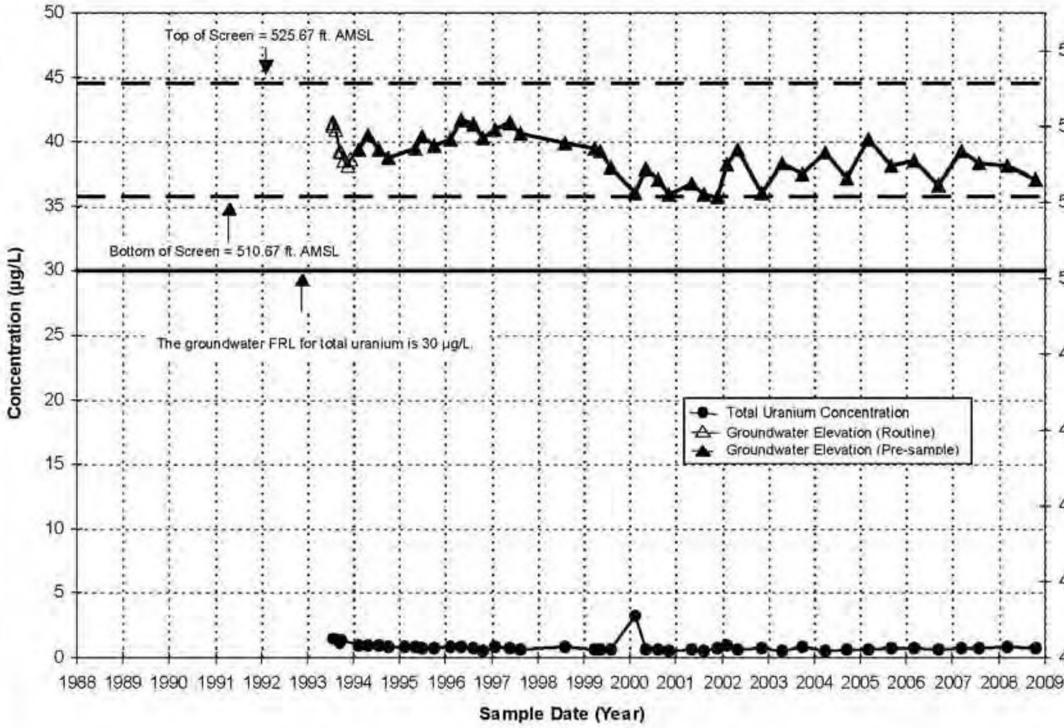


FIGURE A.2-45. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2897

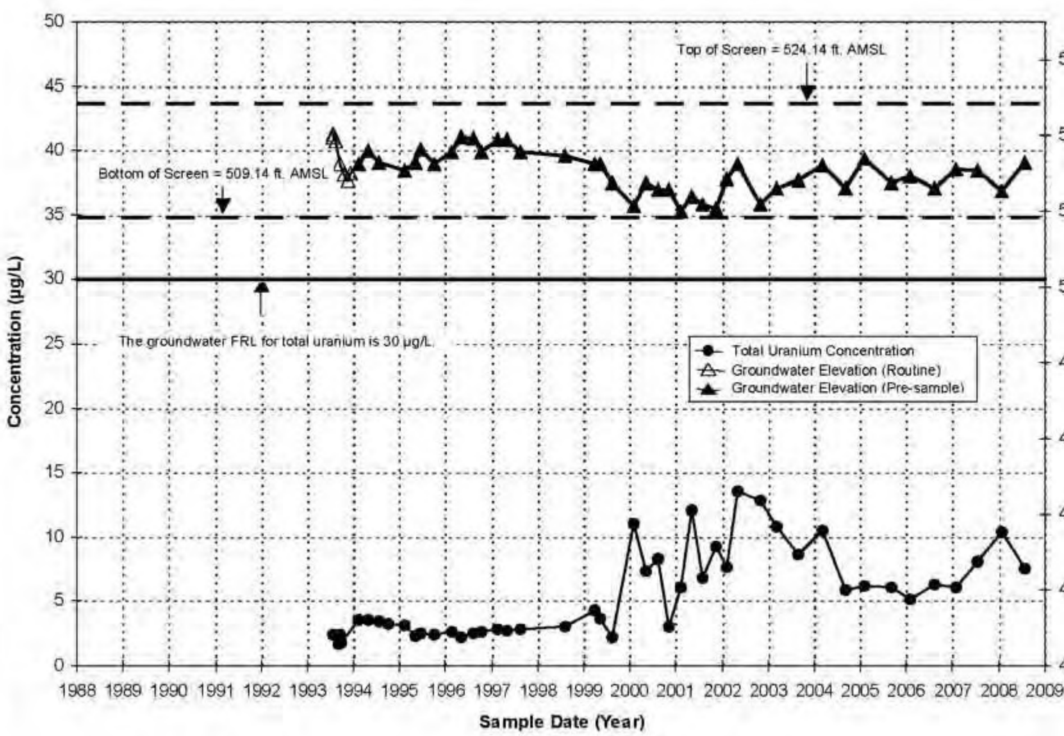


FIGURE A.2-46. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2898

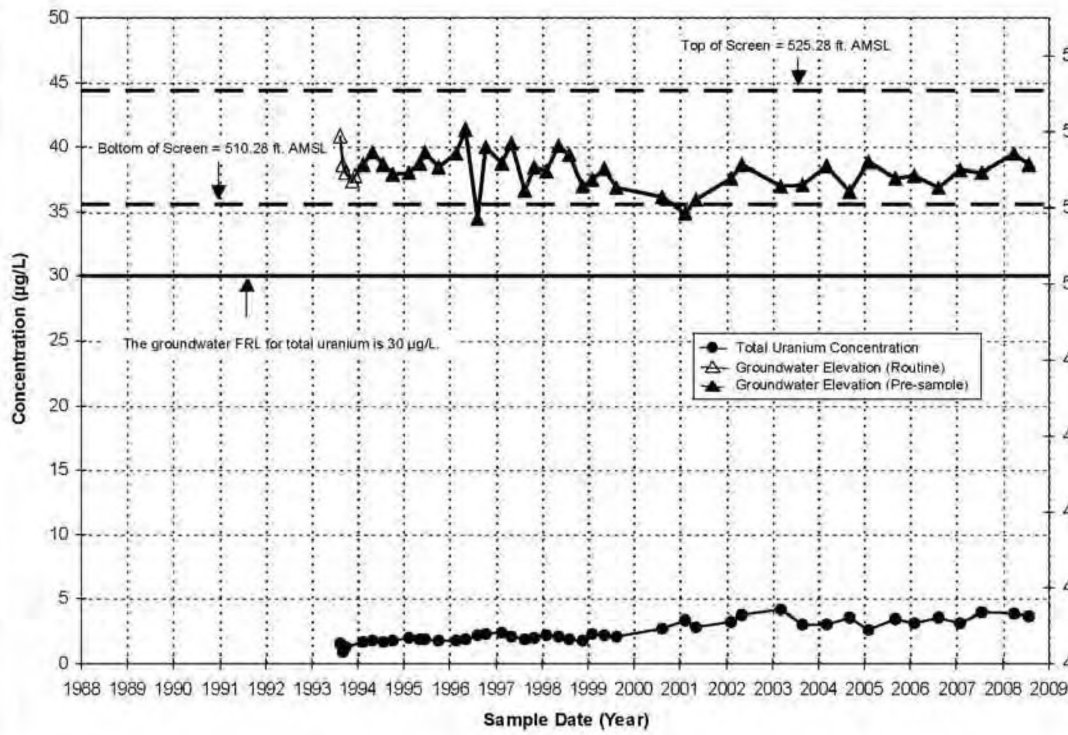


FIGURE A.2-47. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2899

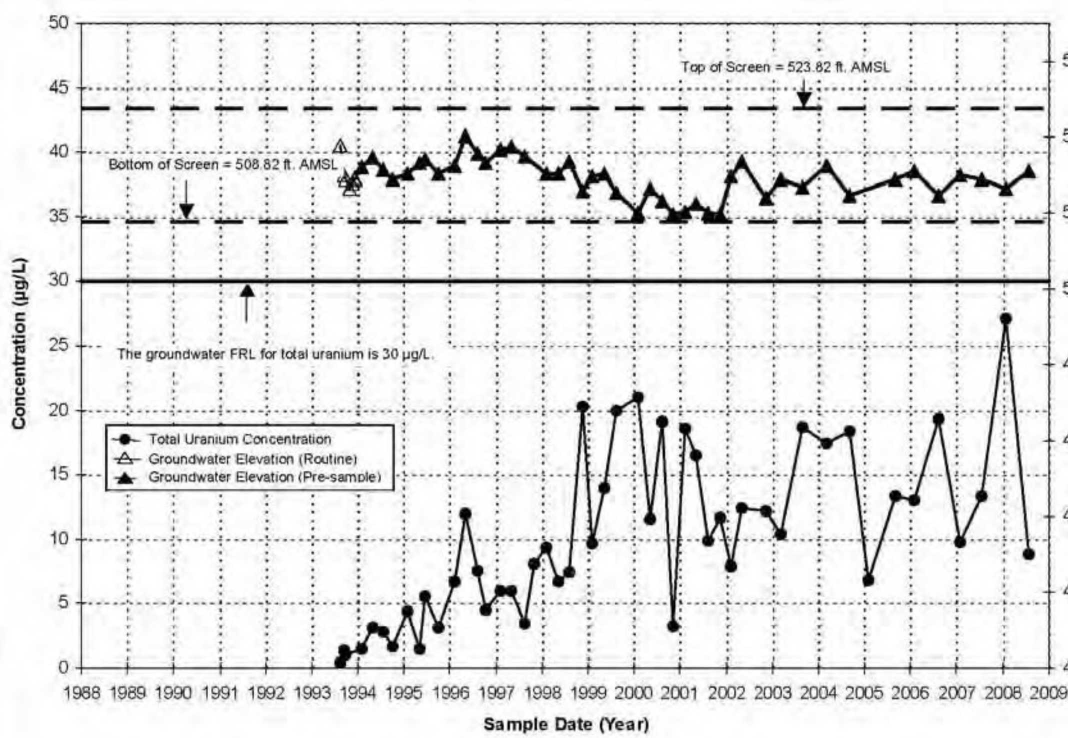


FIGURE A.2-48. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2900

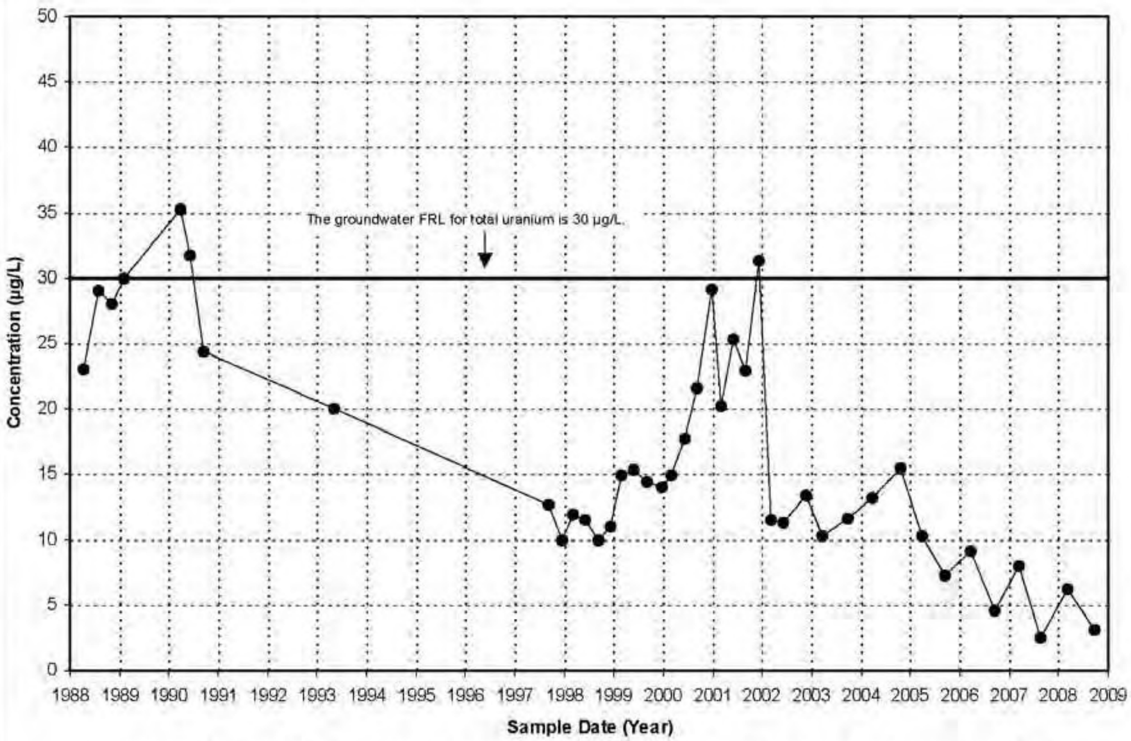


FIGURE A.2-49. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3014

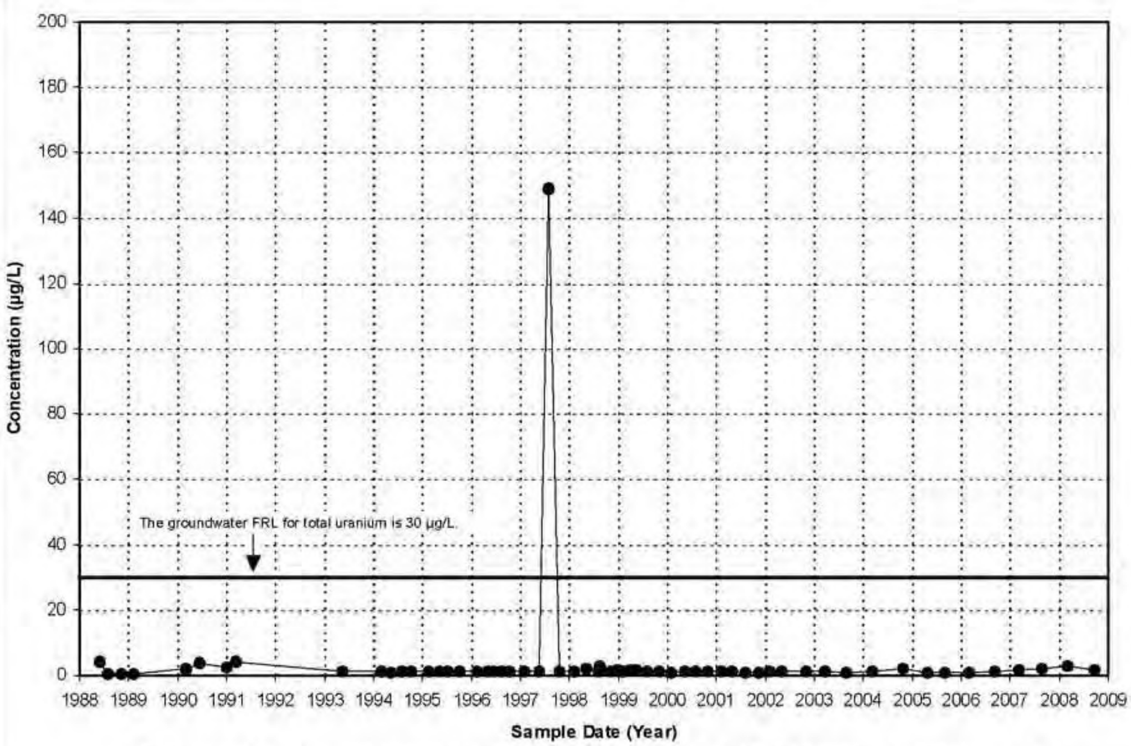


FIGURE A.2-50. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3015

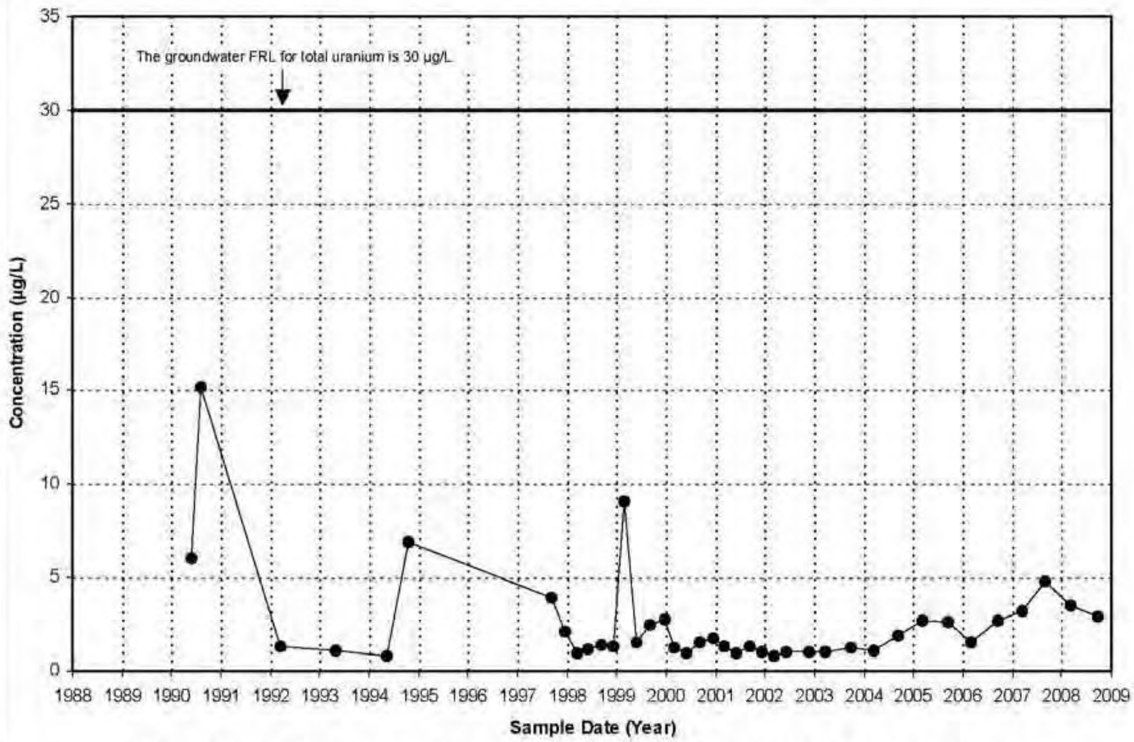


FIGURE A.2-51. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3045

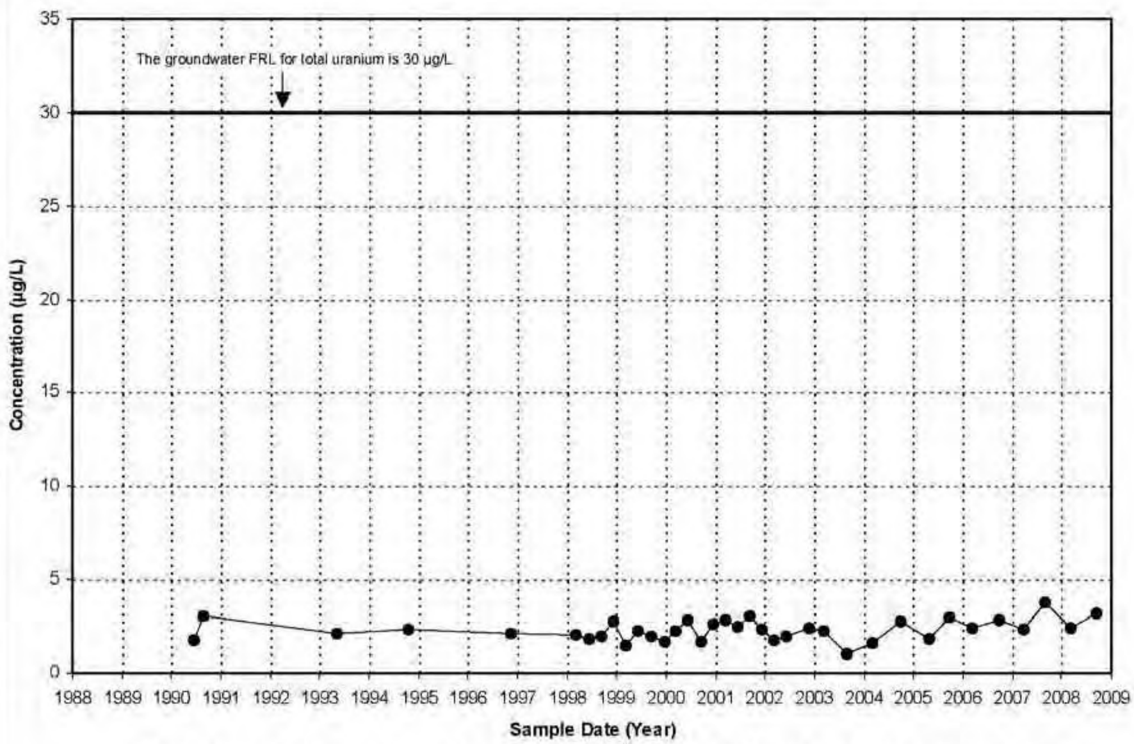


FIGURE A.2-52. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3046

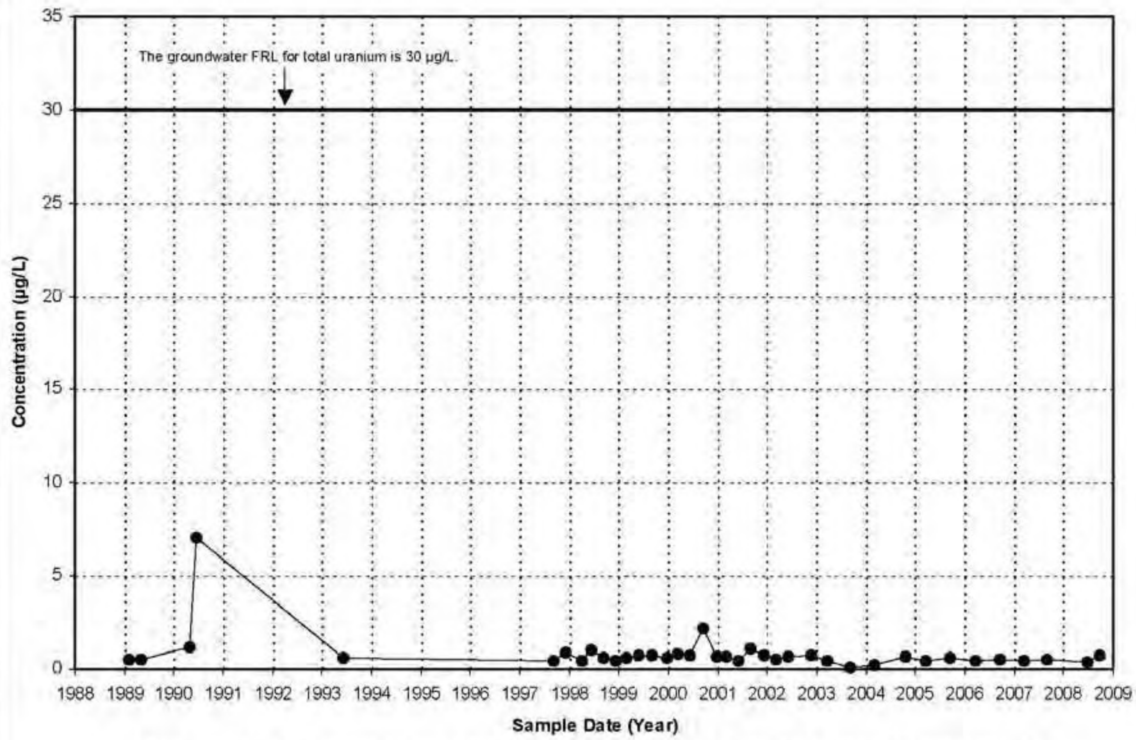


FIGURE A.2-53. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3049

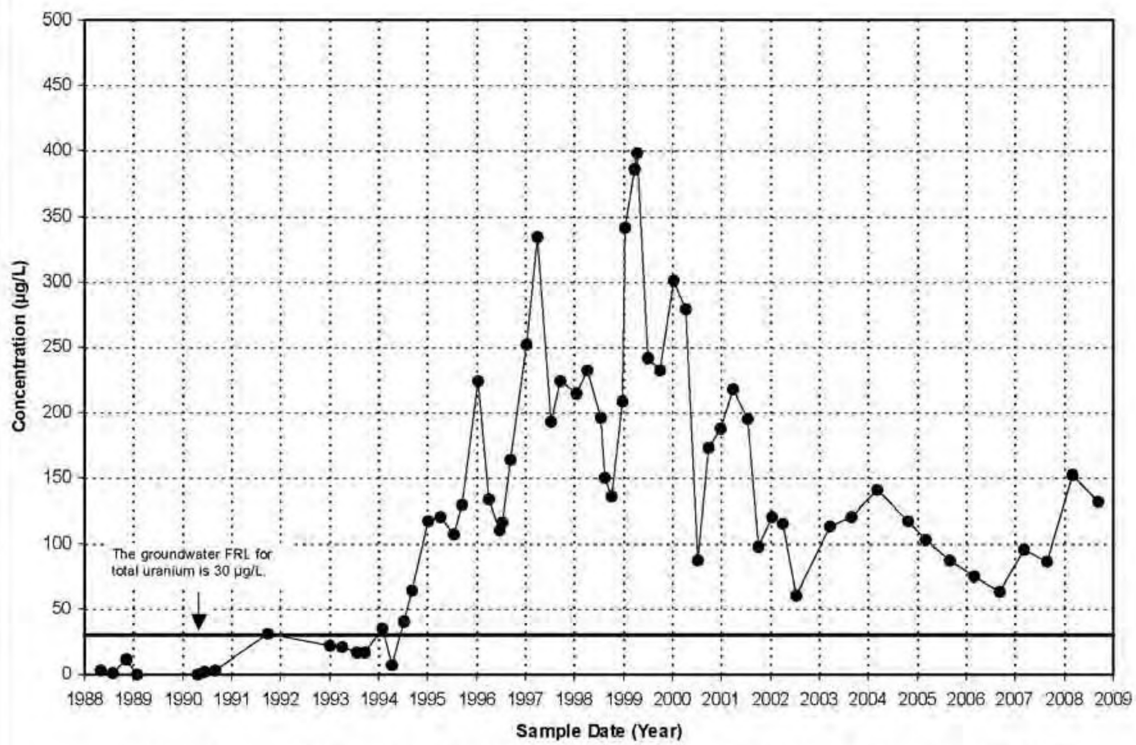


FIGURE A.2-54. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3069

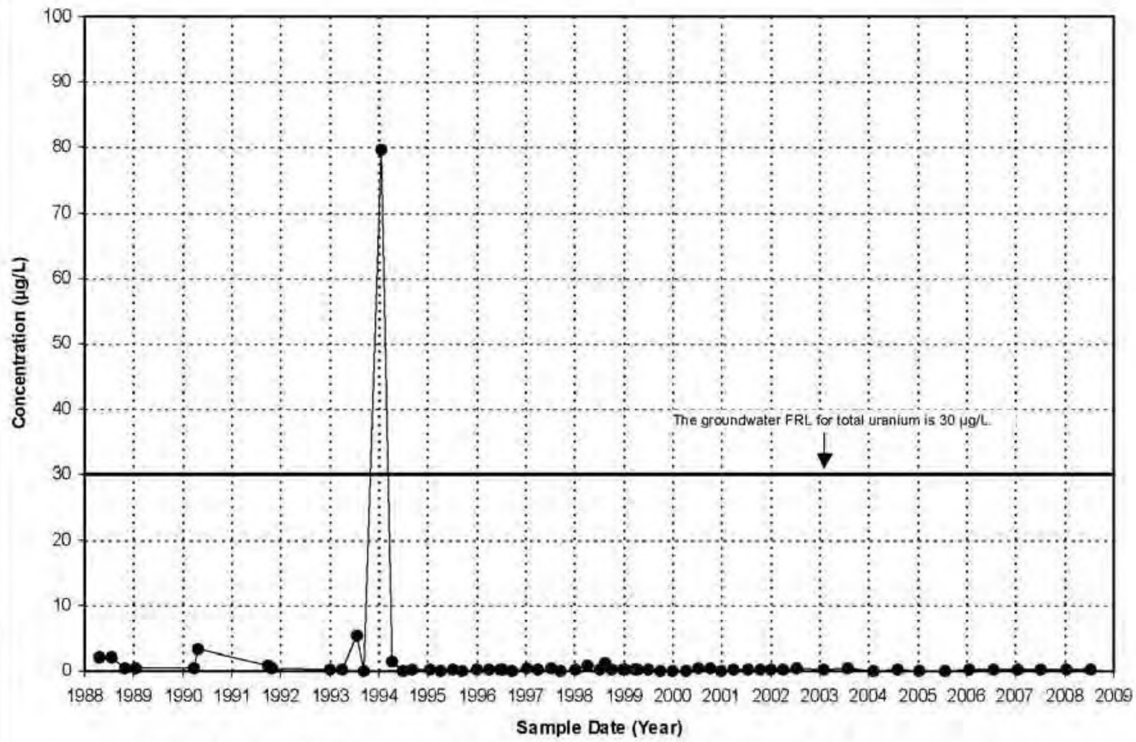


FIGURE A.2-55. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3070

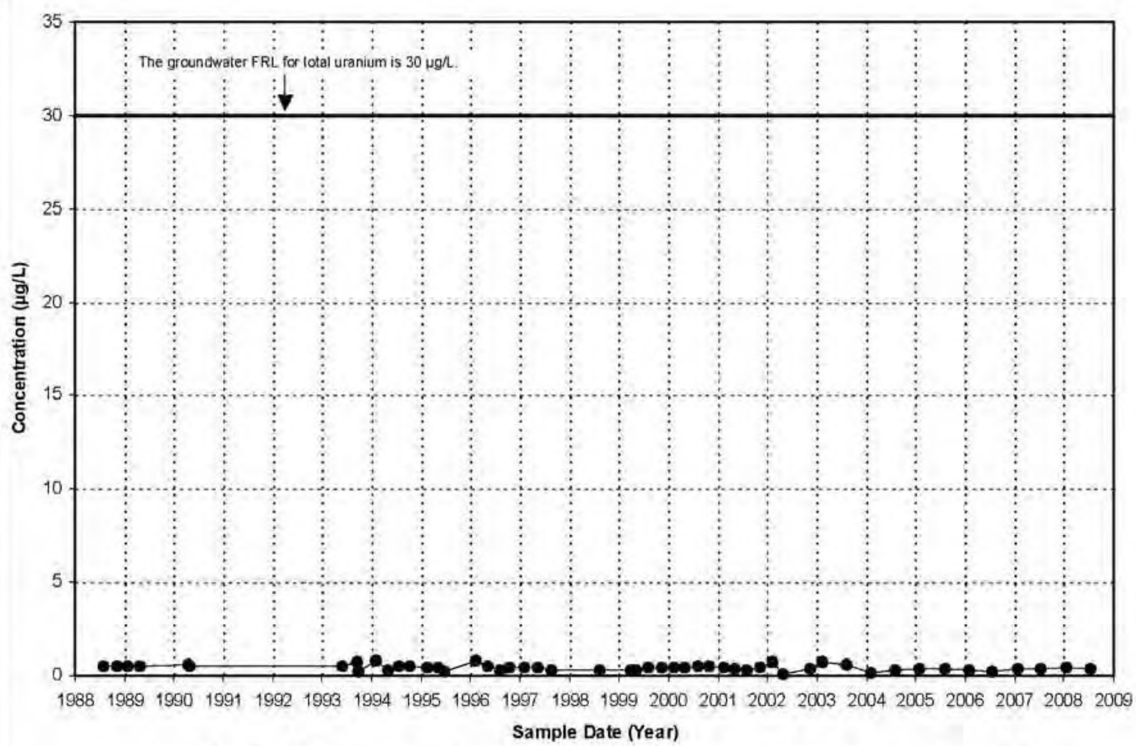


FIGURE A.2-56. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3093

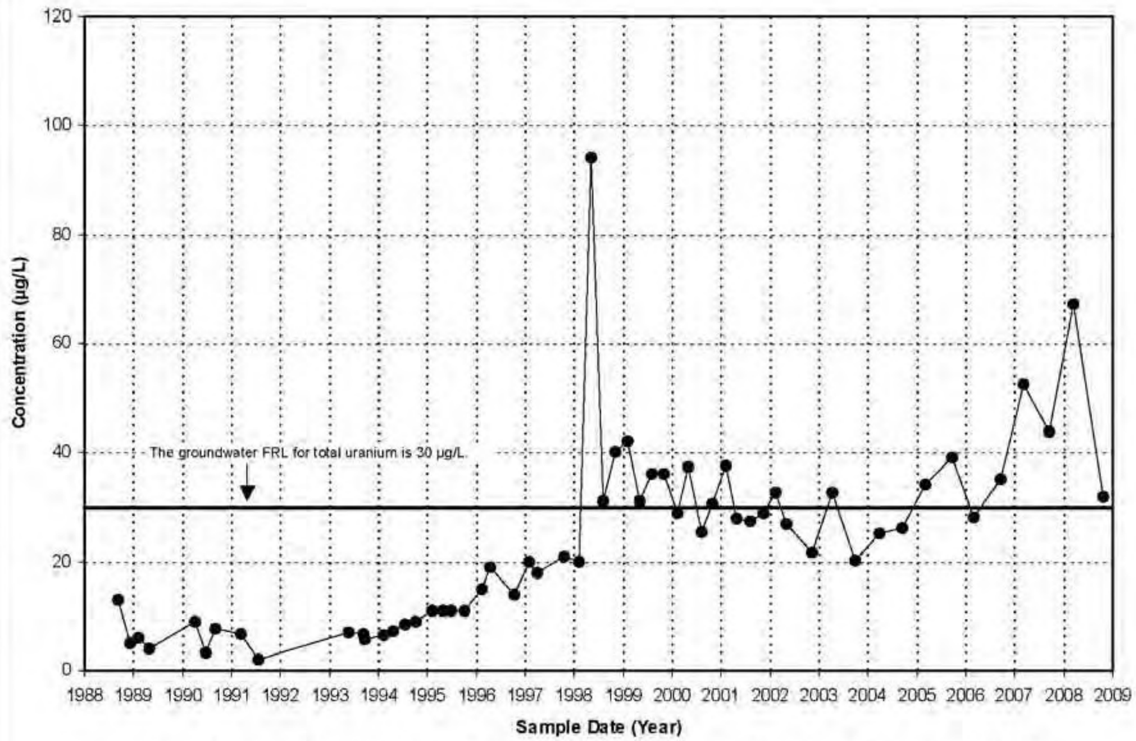


FIGURE A.2-57. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3095

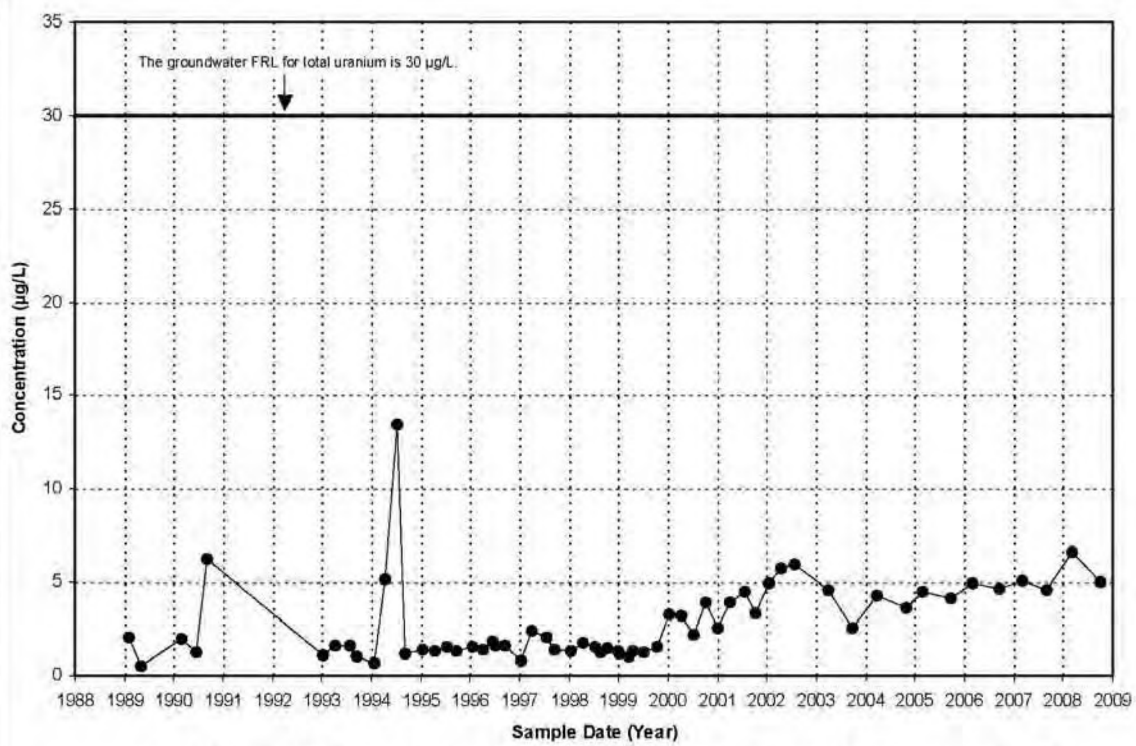


FIGURE A.2-58. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3106

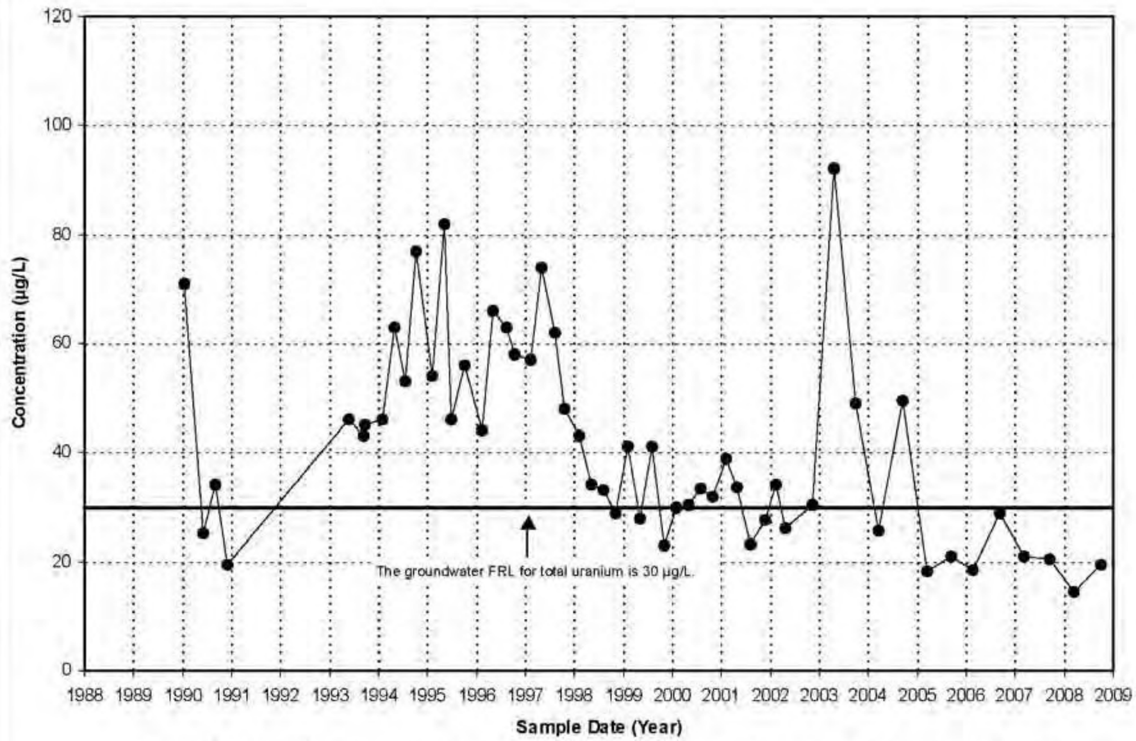


FIGURE A.2-59. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3125

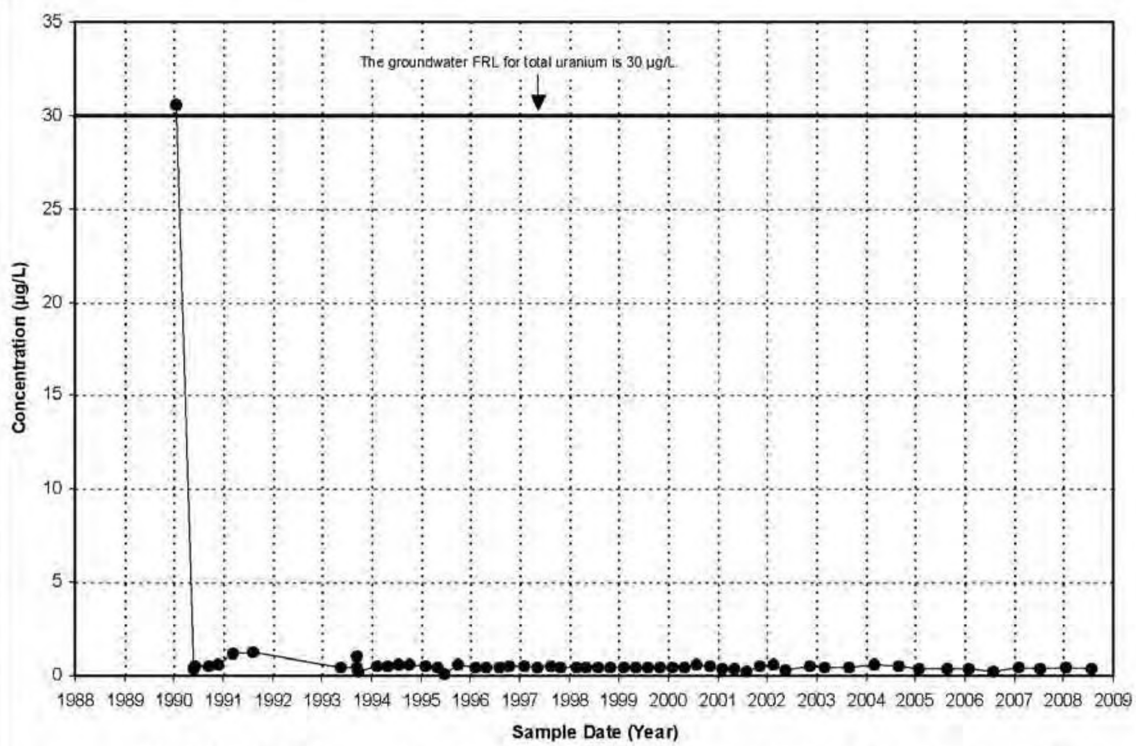


FIGURE A.2-60. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3128

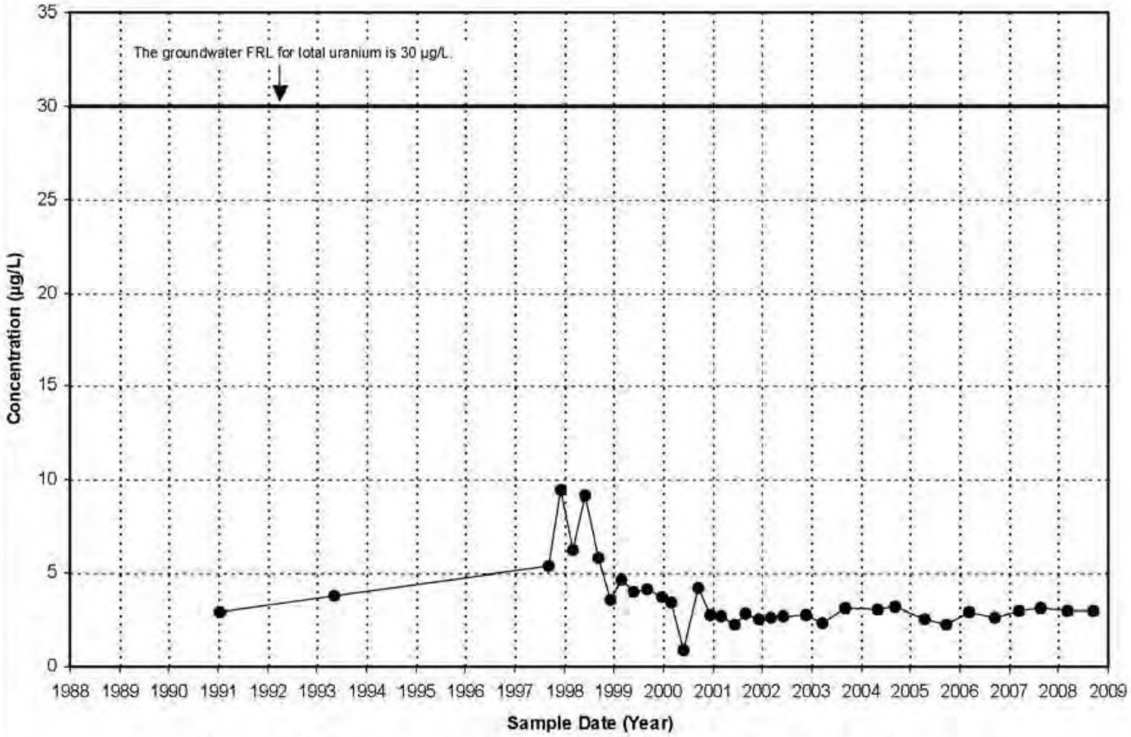


FIGURE A.2-61. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3385

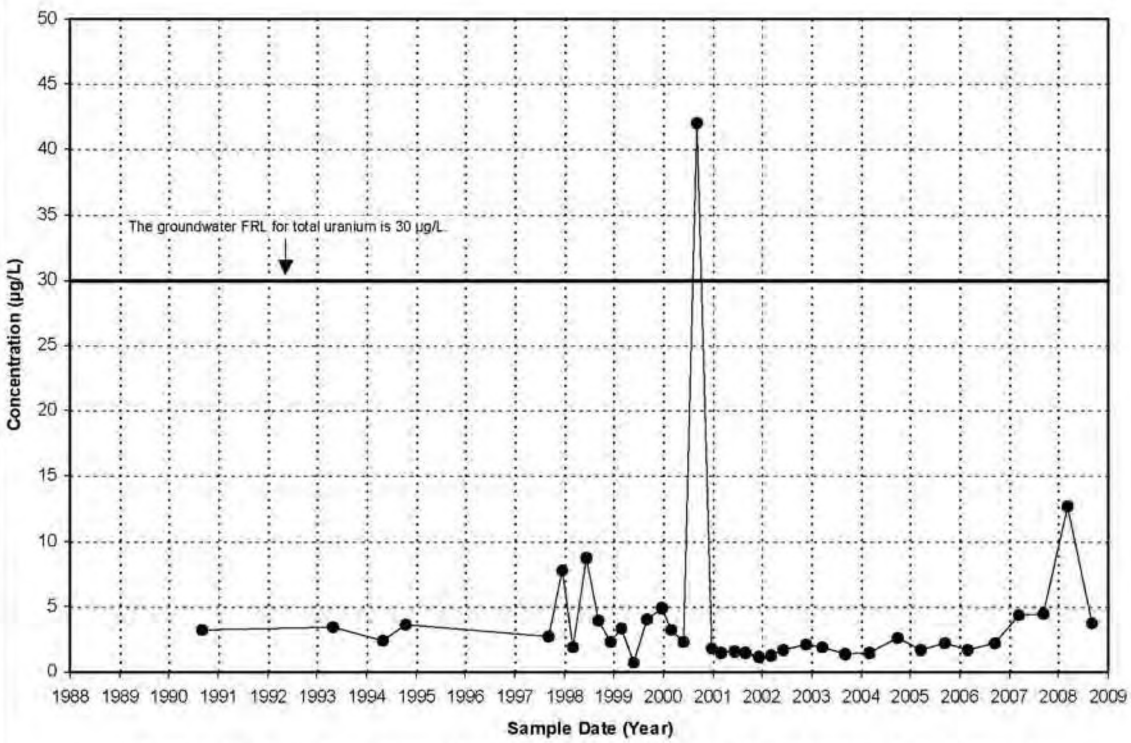


FIGURE A.2-62. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3387

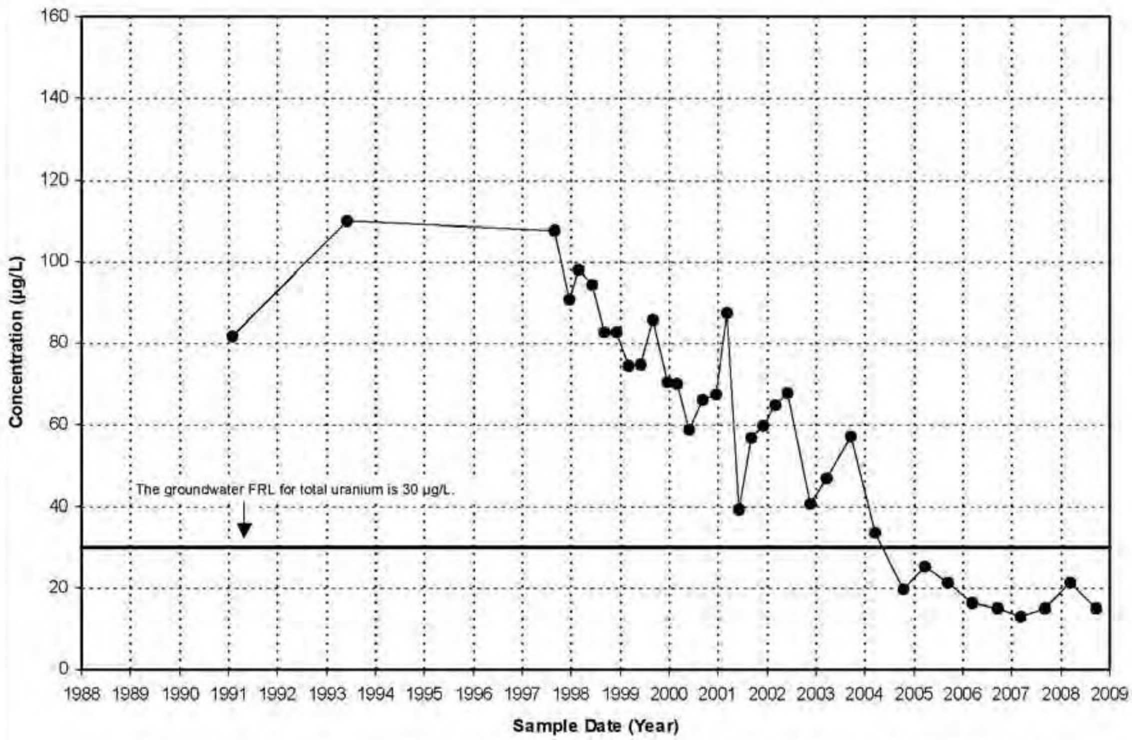


FIGURE A.2-63. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3390

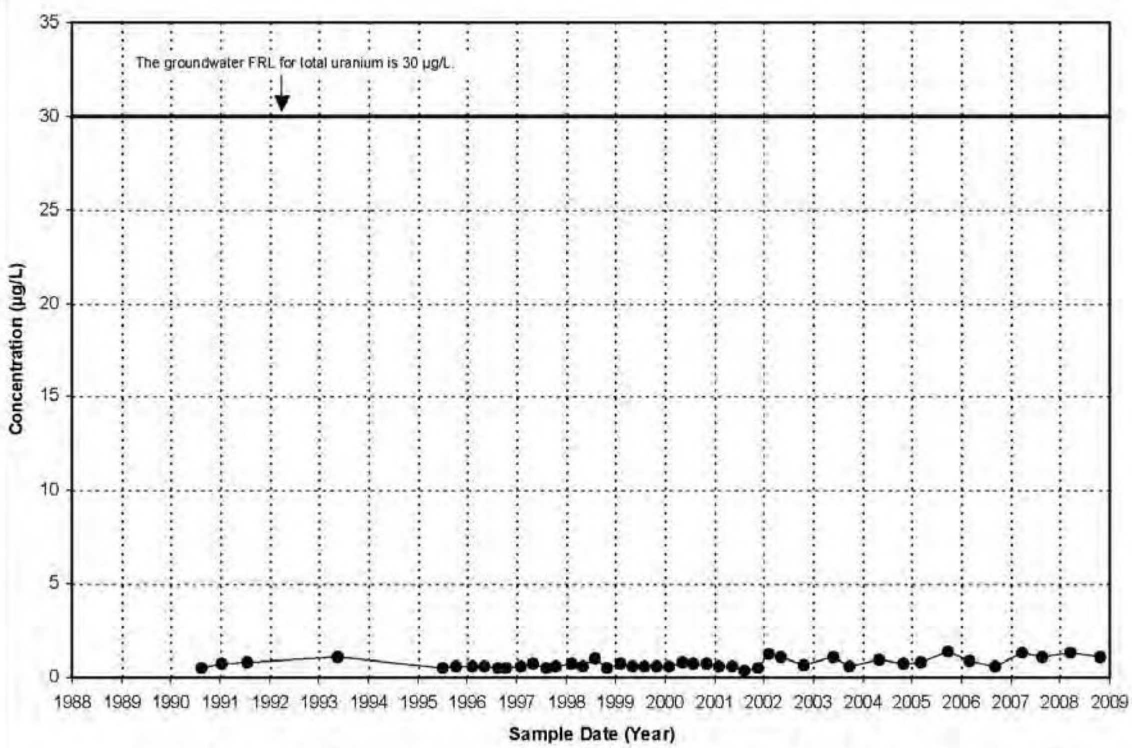


FIGURE A.2-64. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3396

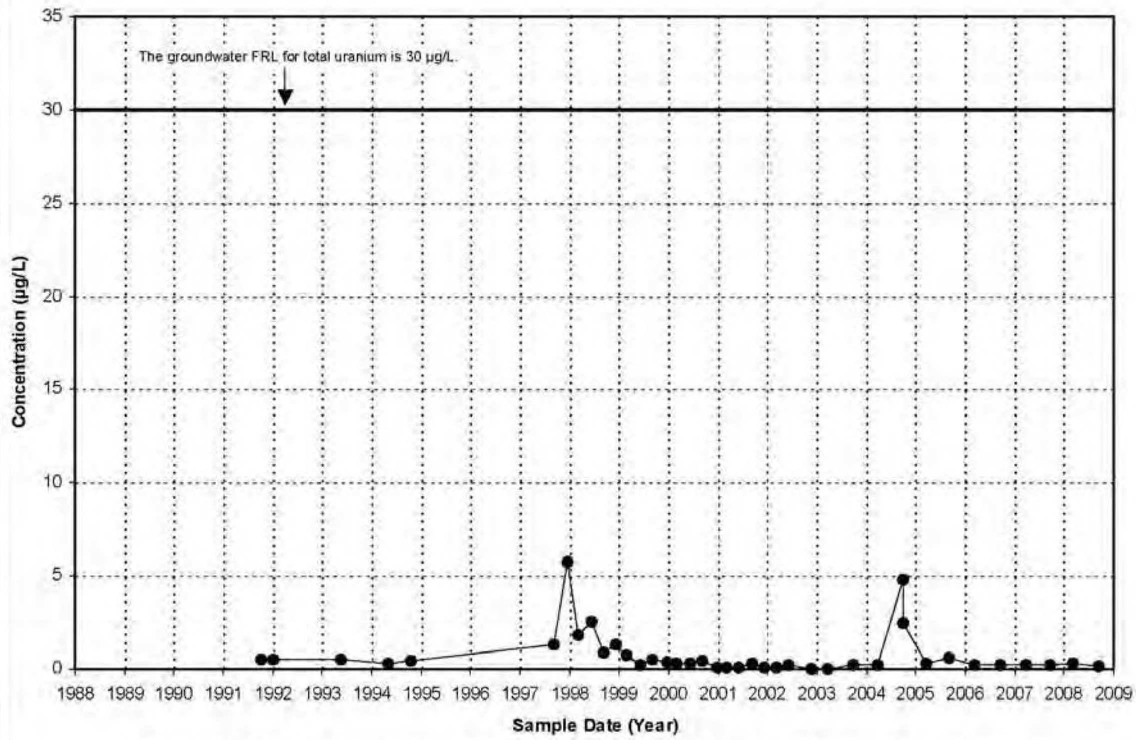


FIGURE A.2-65. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3397

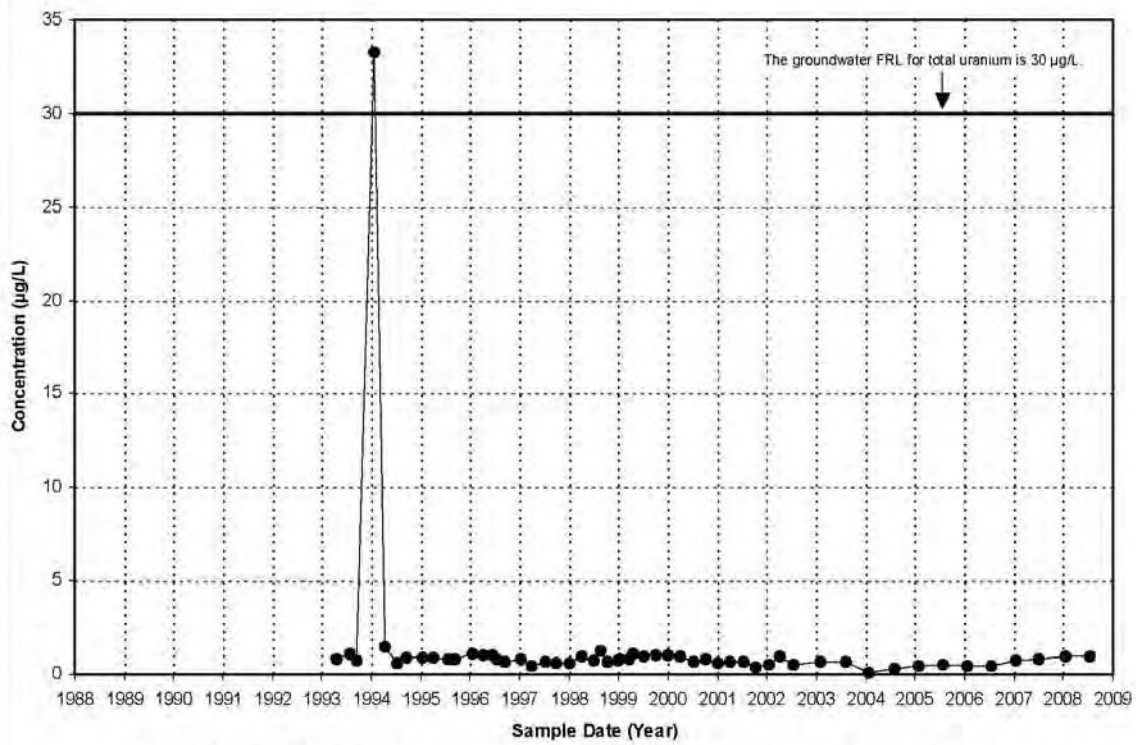


FIGURE A.2-66. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3398

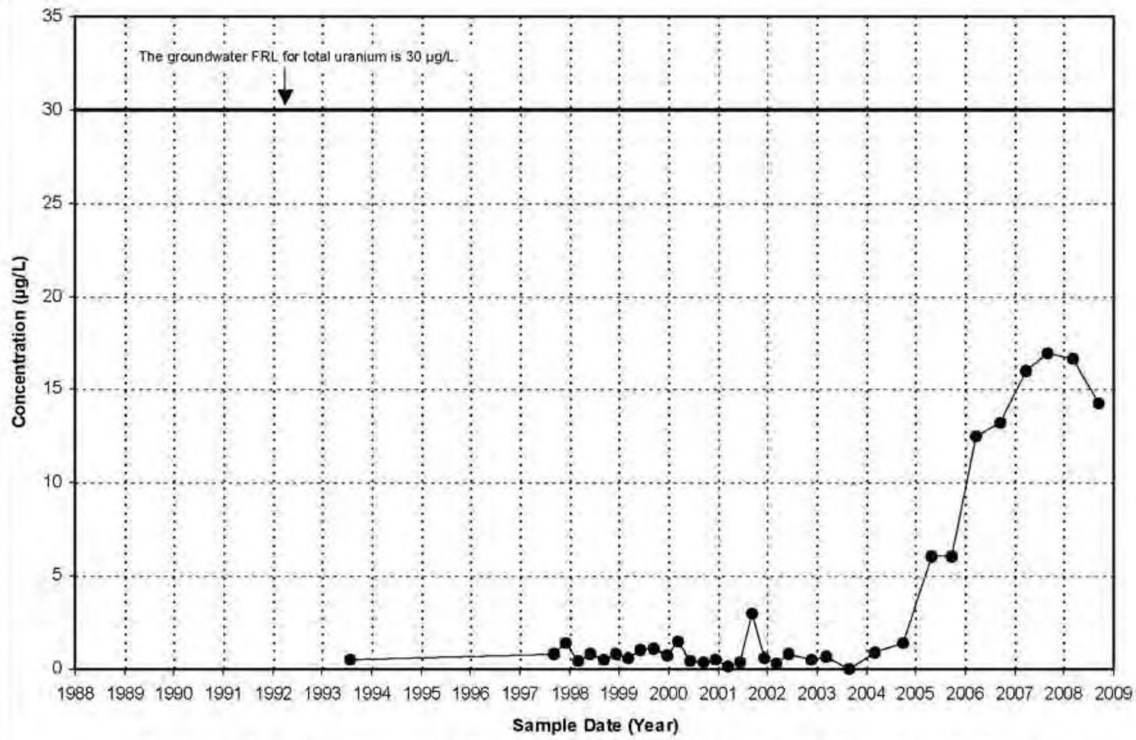


FIGURE A.2-67. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3402

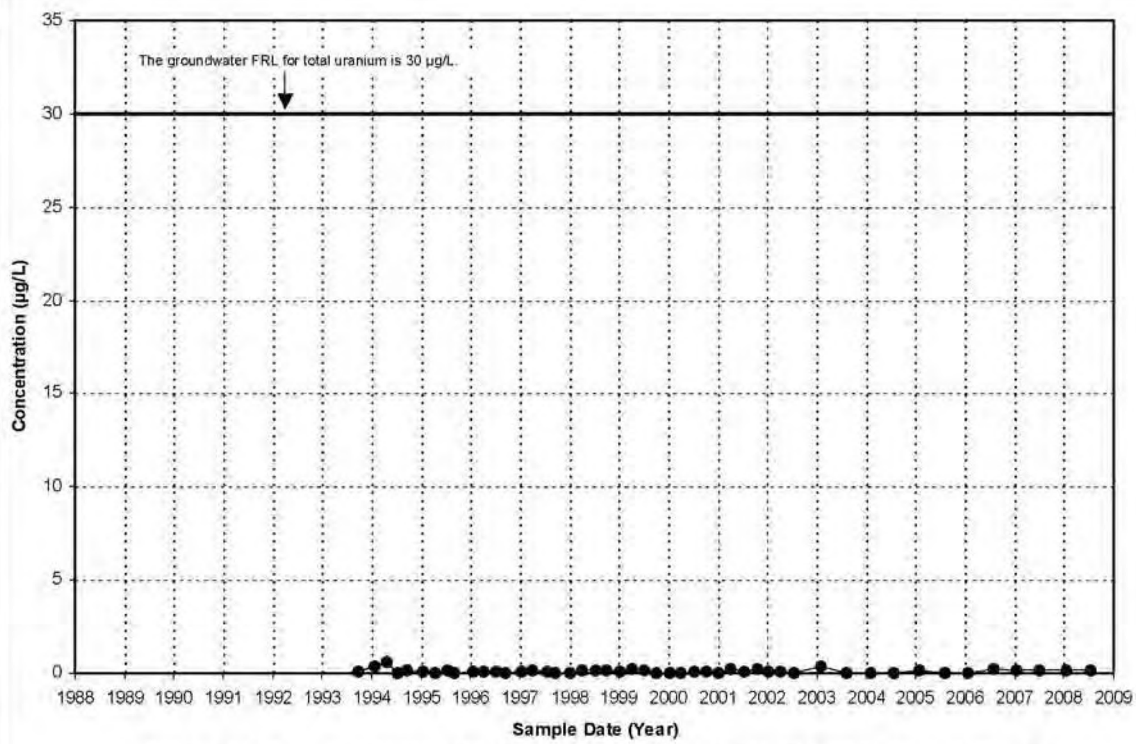


FIGURE A.2-68. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3424

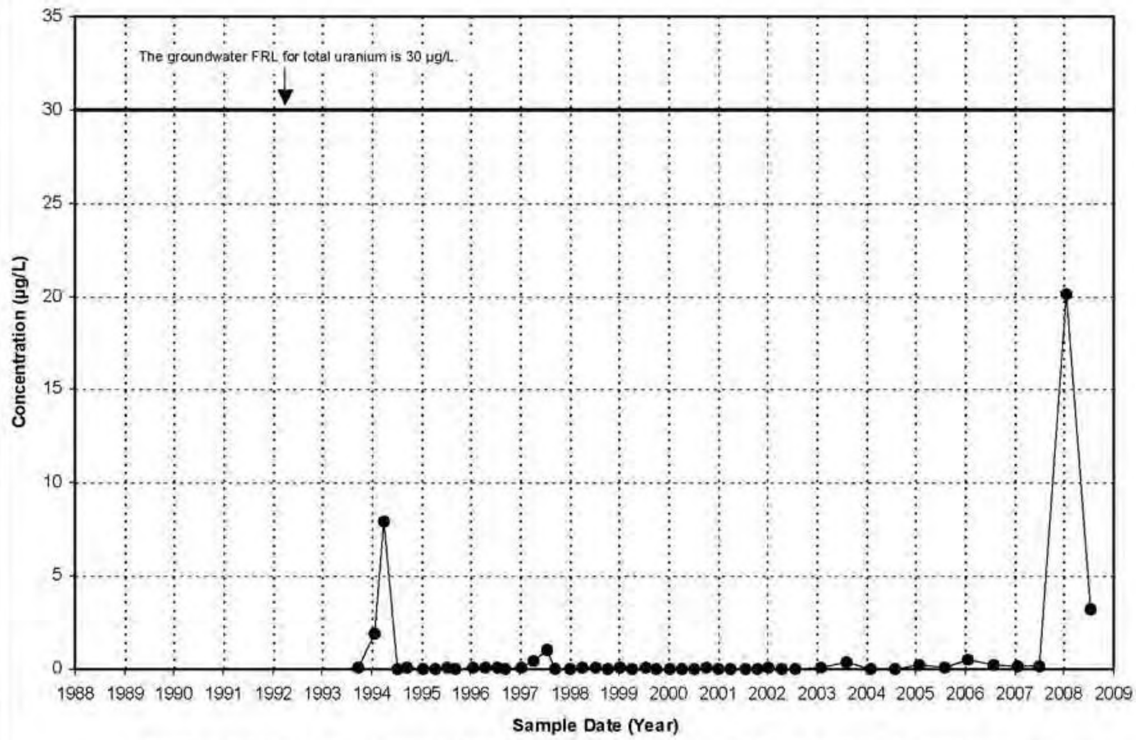


FIGURE A.2-69. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3426

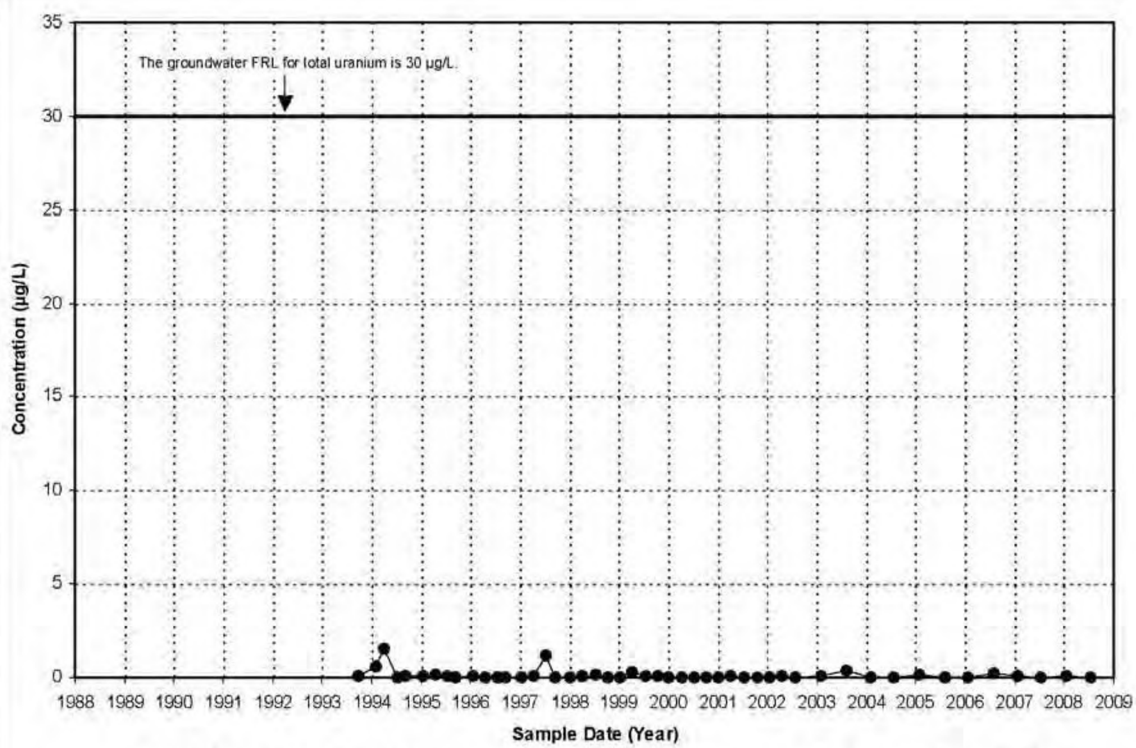


FIGURE A.2-70. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3429

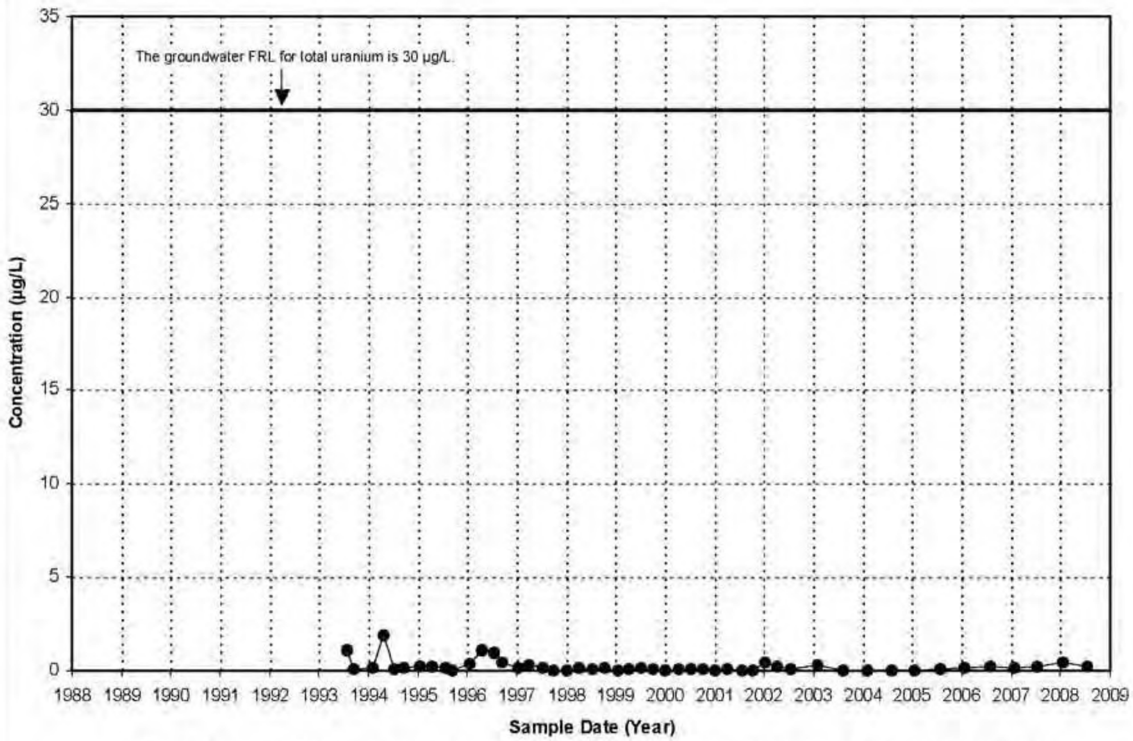


FIGURE A.2-71. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3431

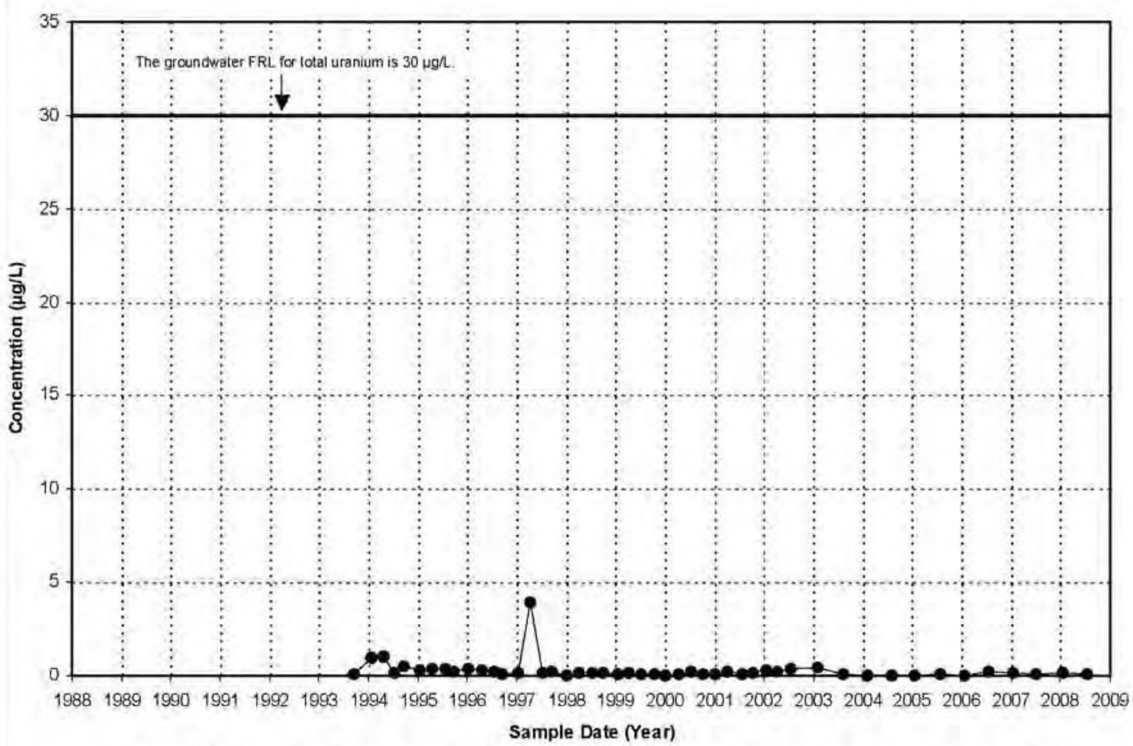


FIGURE A.2-72. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3432

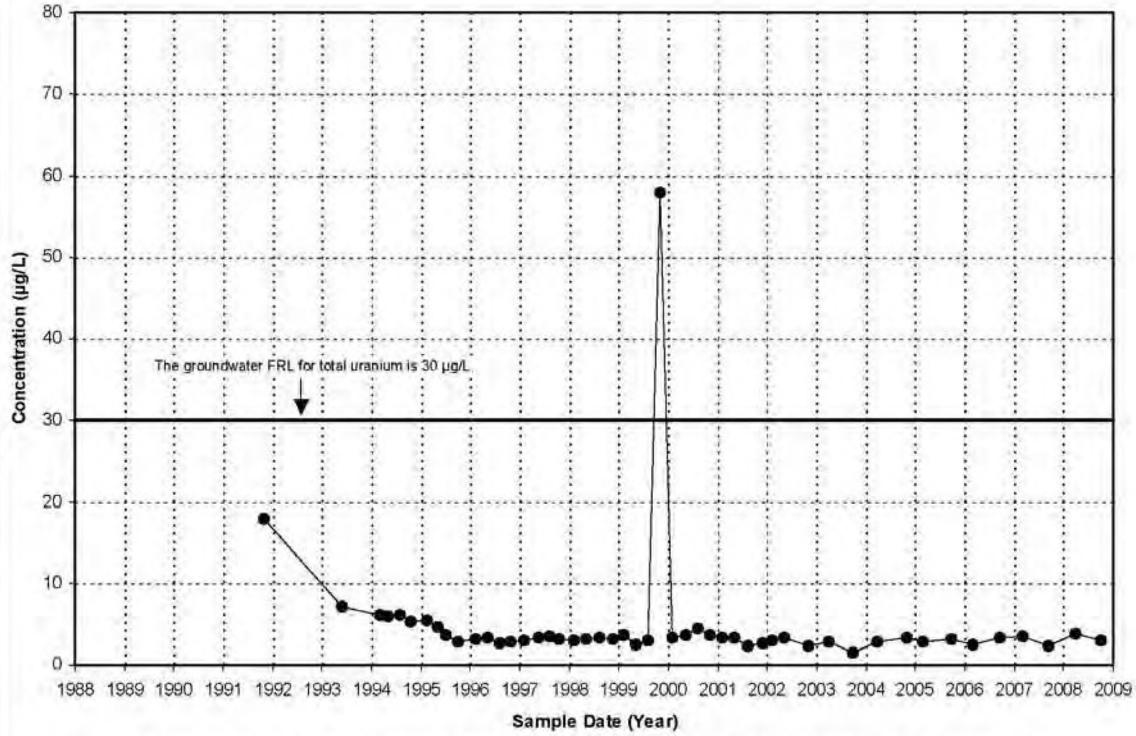


FIGURE A.2-73. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3550

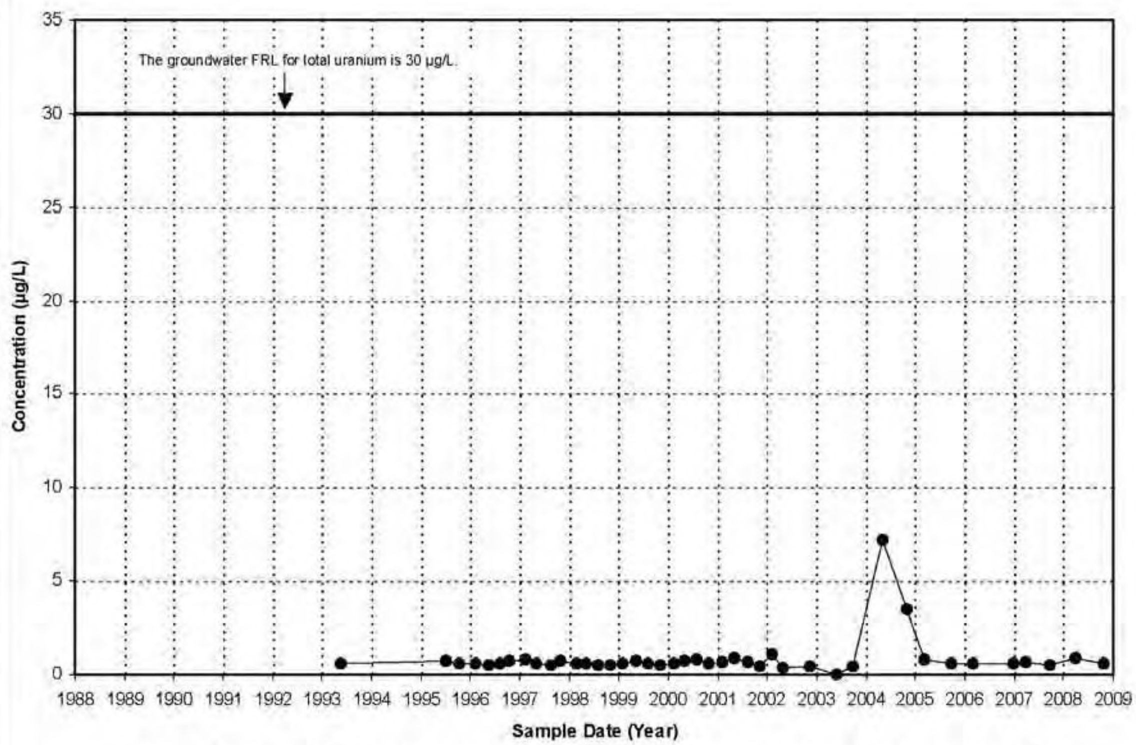


FIGURE A.2-74. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3552

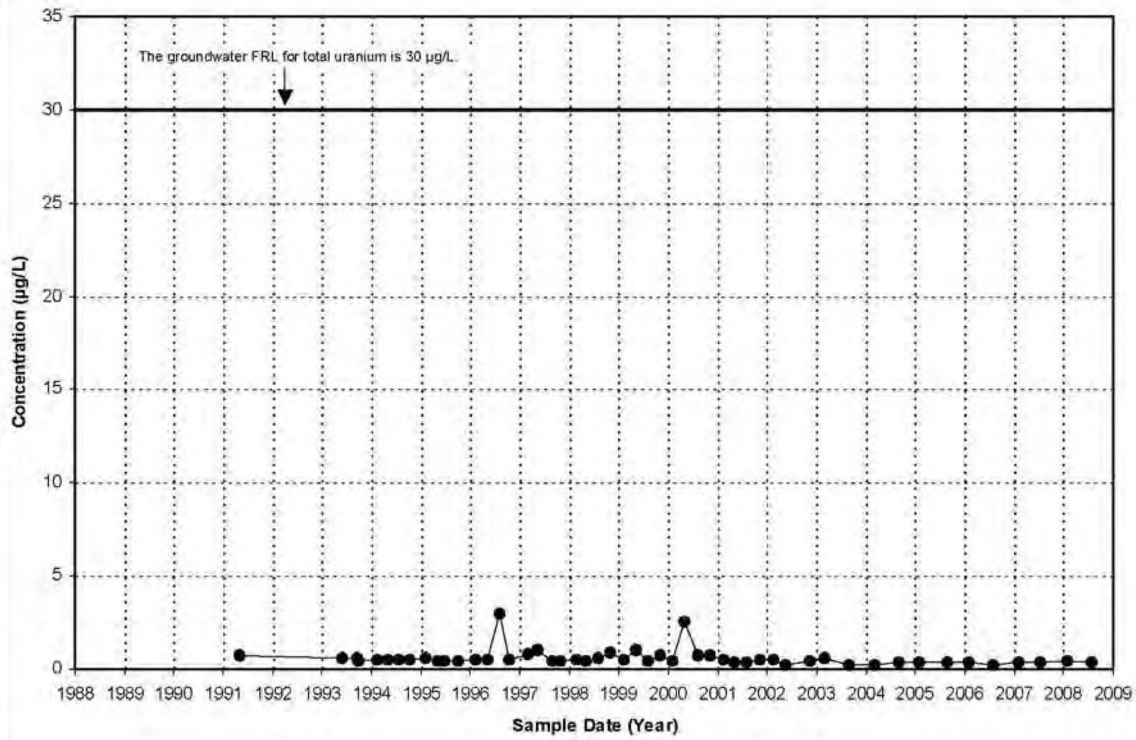


FIGURE A.2-75. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3636

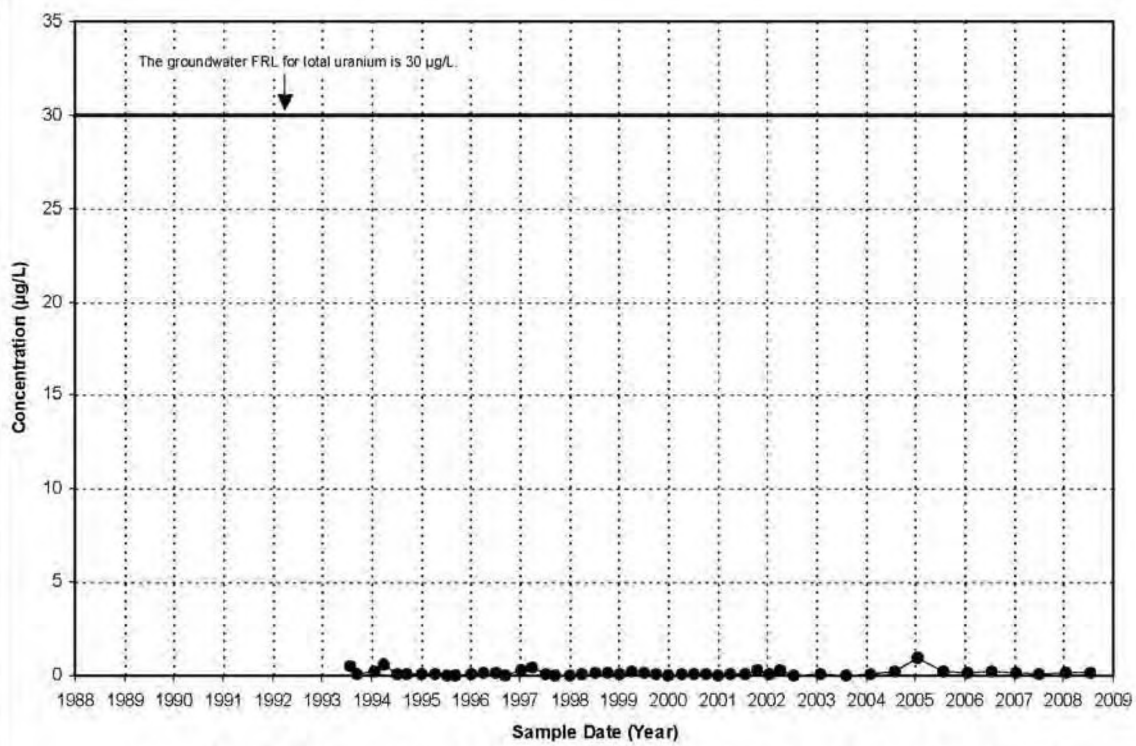


FIGURE A.2-76. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3733

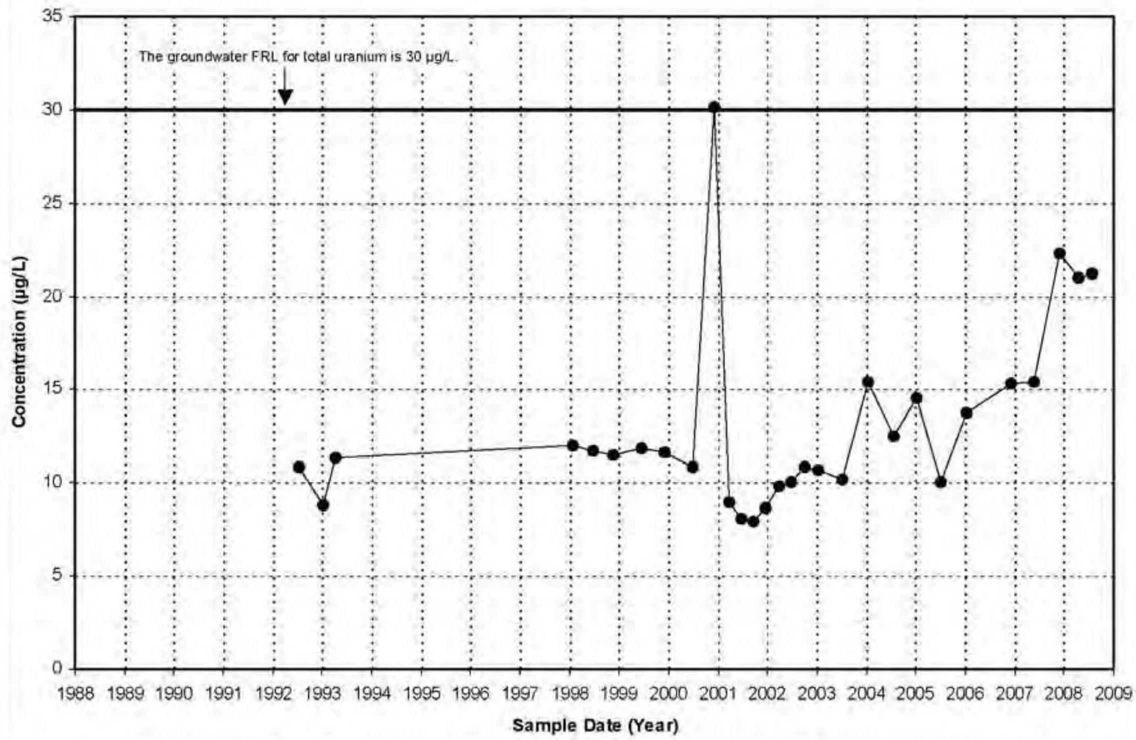


FIGURE A.2-77. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3821

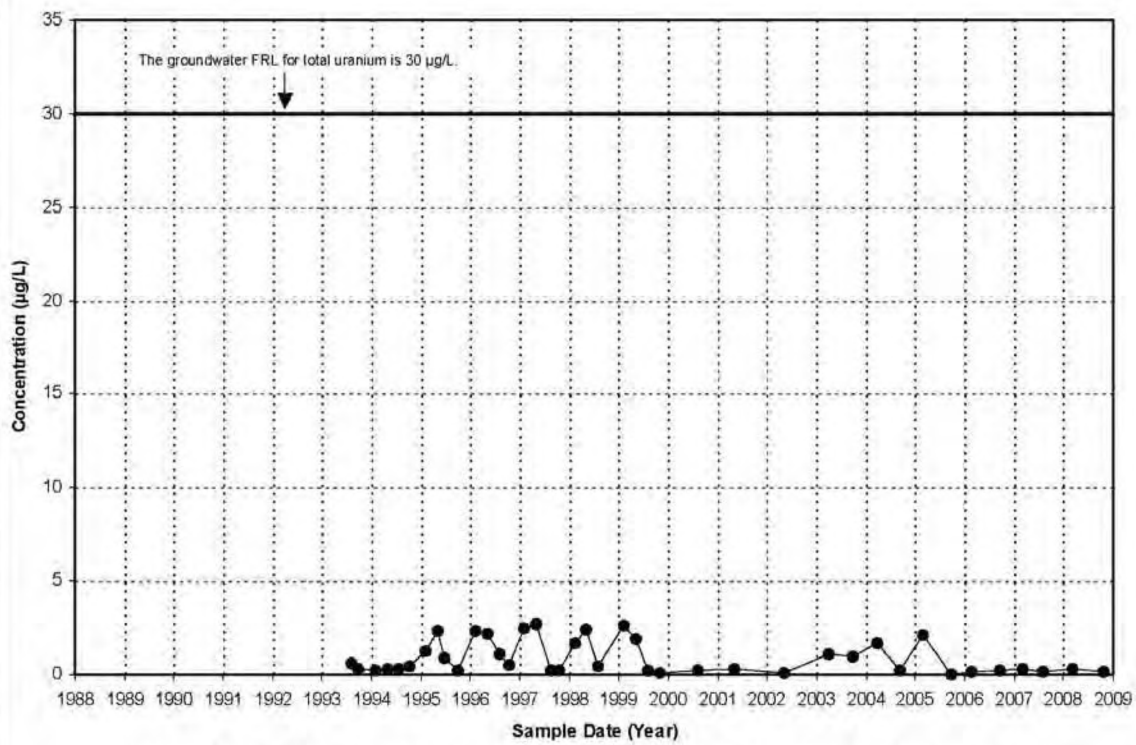


FIGURE A.2-78. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3880

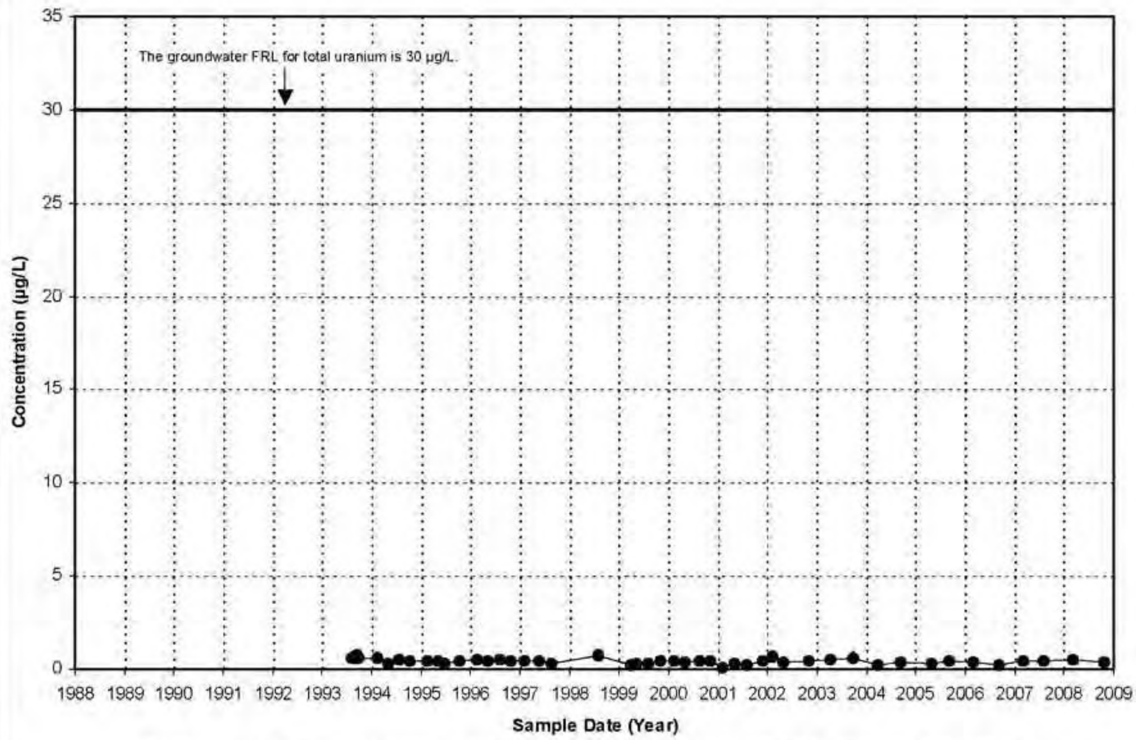


FIGURE A.2-79. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3897

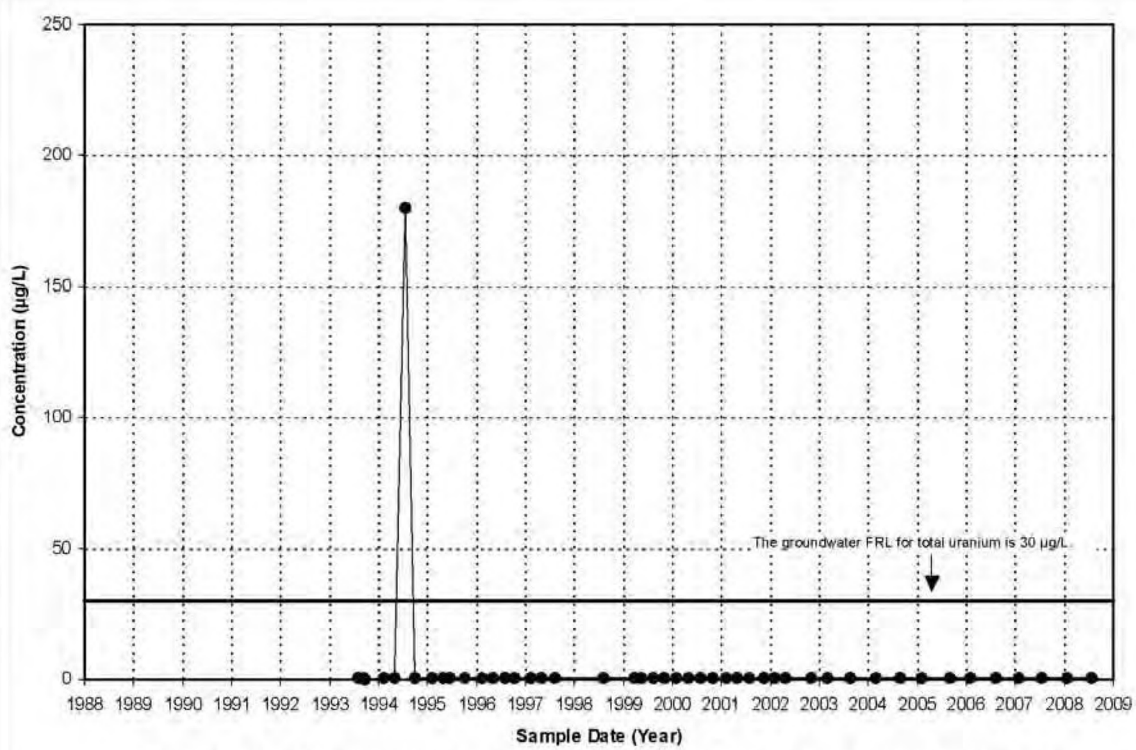


FIGURE A.2-80. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3898

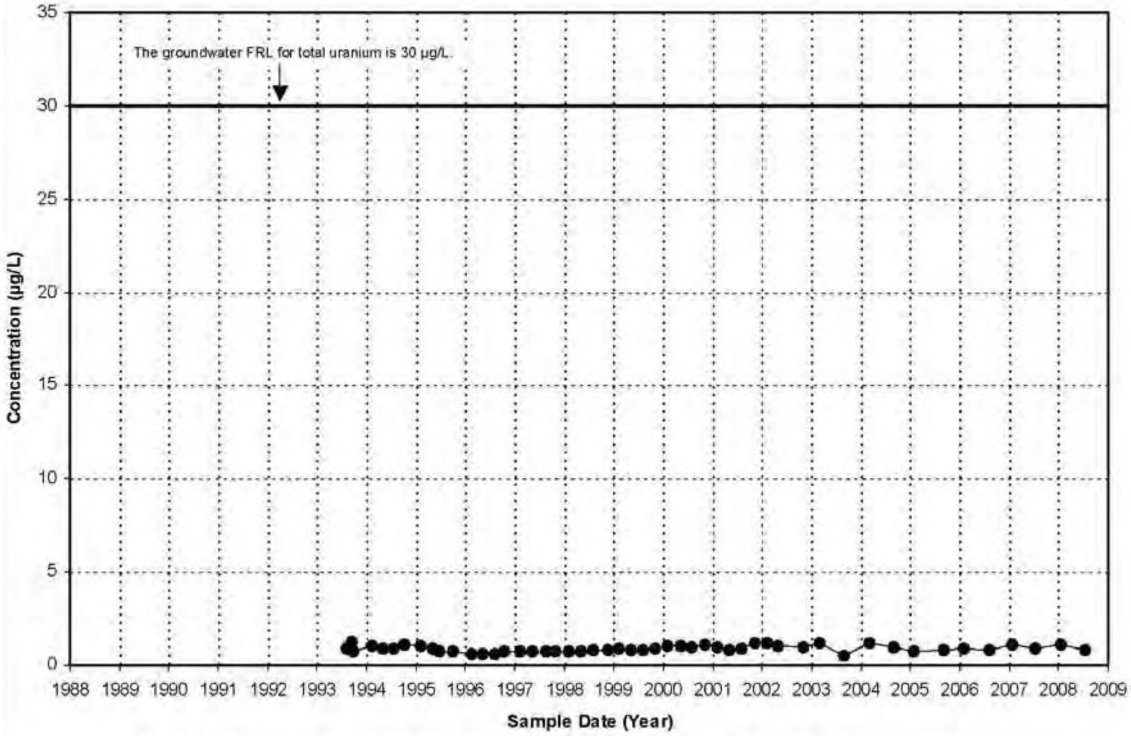


FIGURE A.2-81. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3899

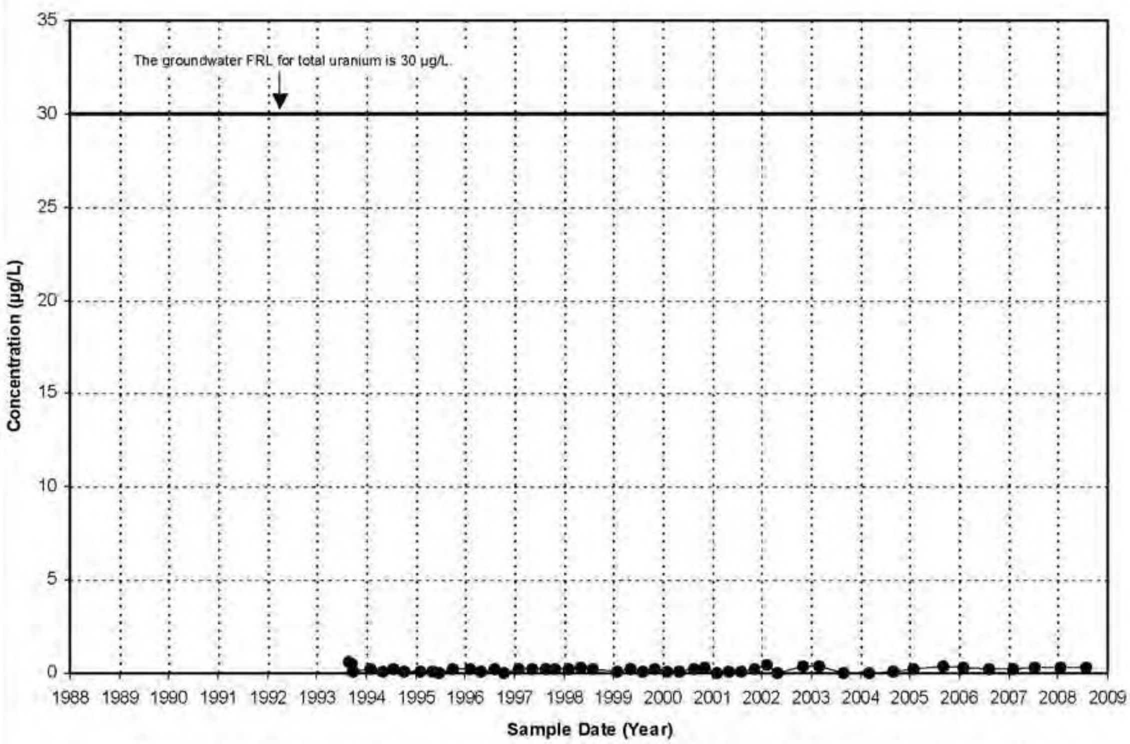


FIGURE A.2-82. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3900

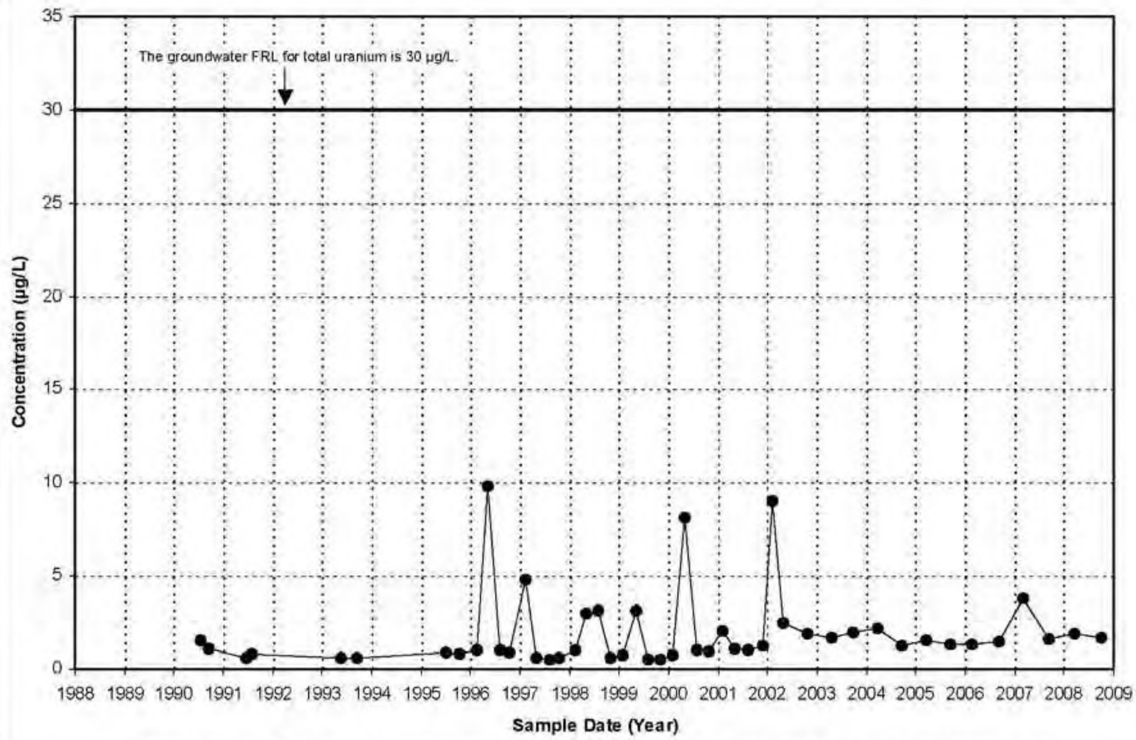


FIGURE A.2-83. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 4125

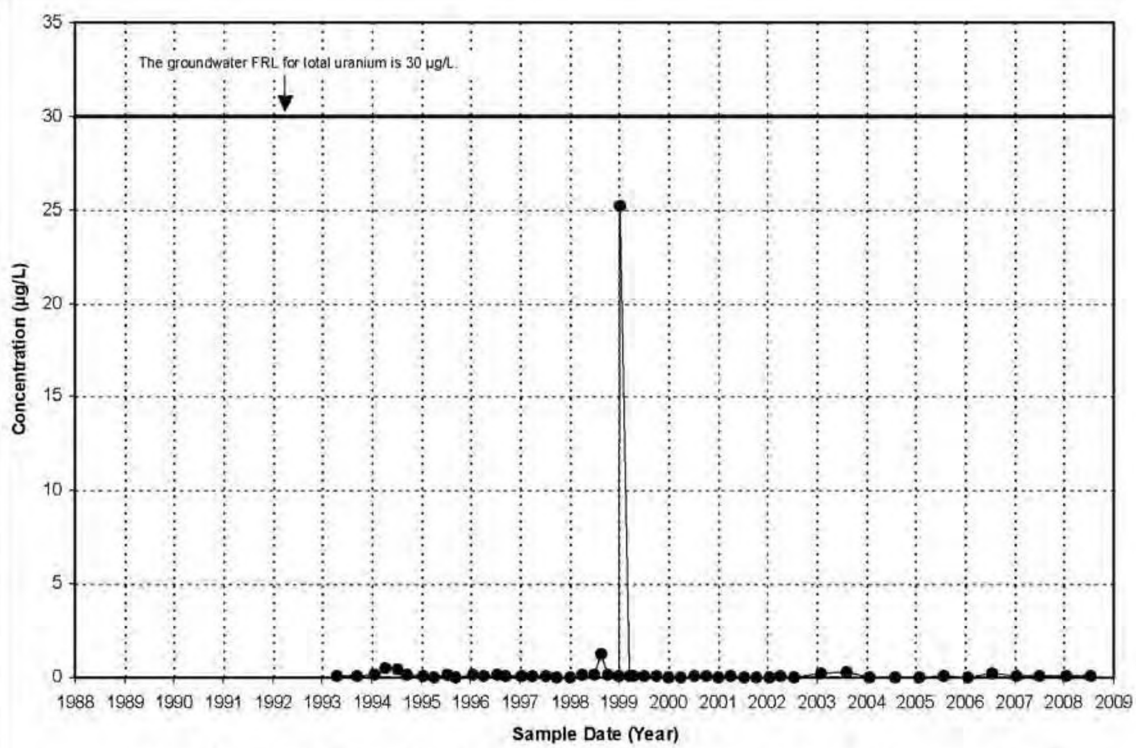


FIGURE A.2-84. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 4398

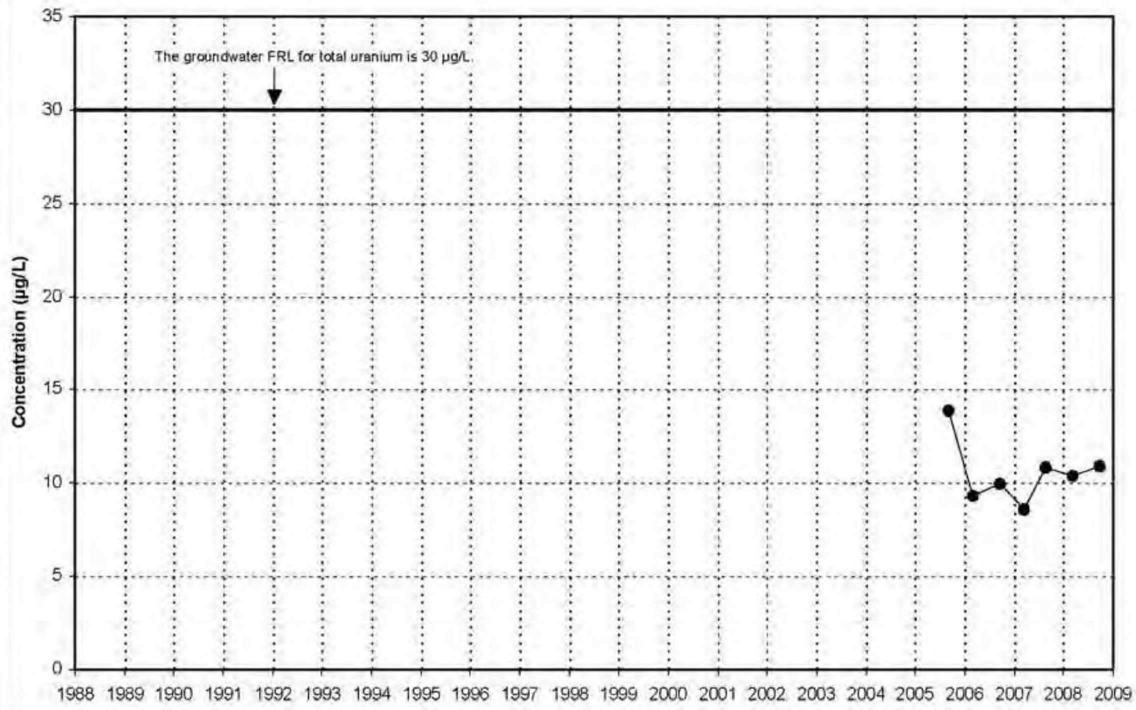


FIGURE A.2-85. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6015

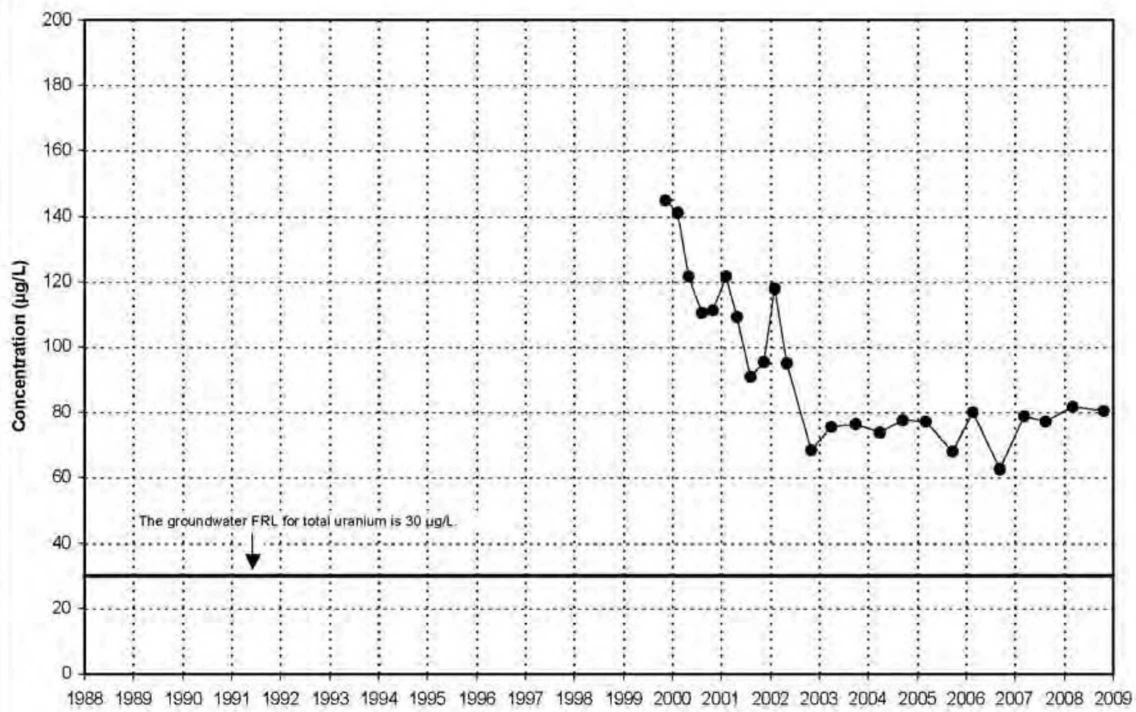


FIGURE A.2-86. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6880

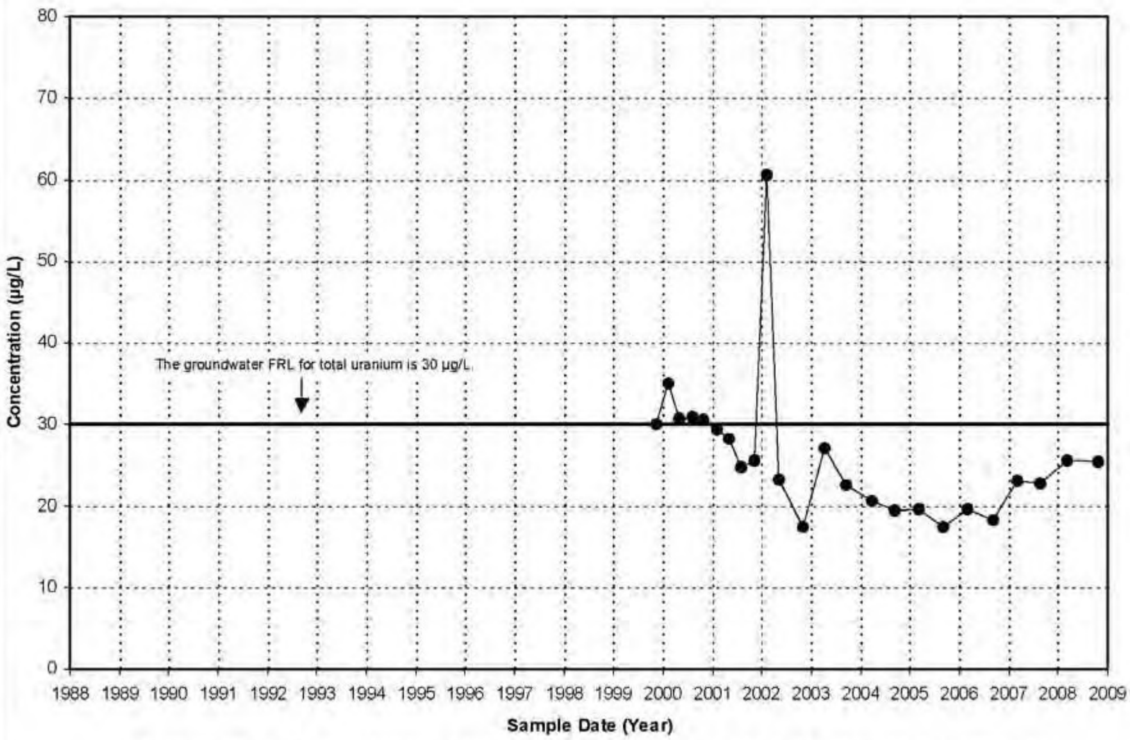


FIGURE A.2-87. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6881

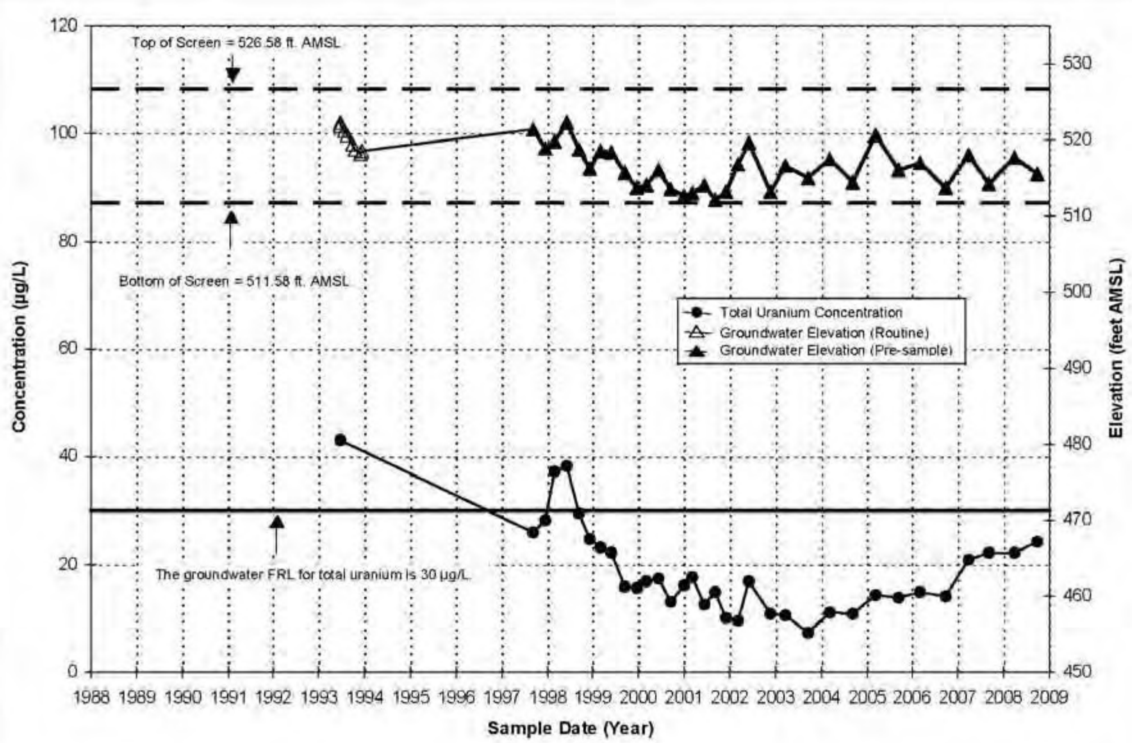


FIGURE A.2-88. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21033

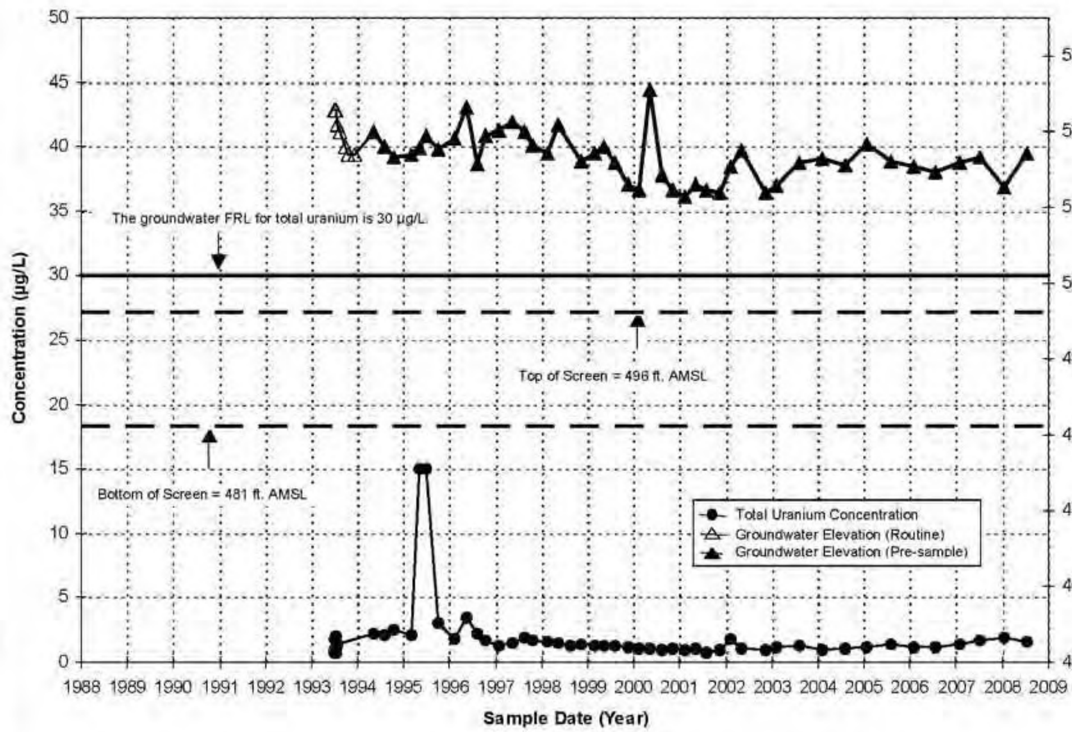


FIGURE A.2-89. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21063

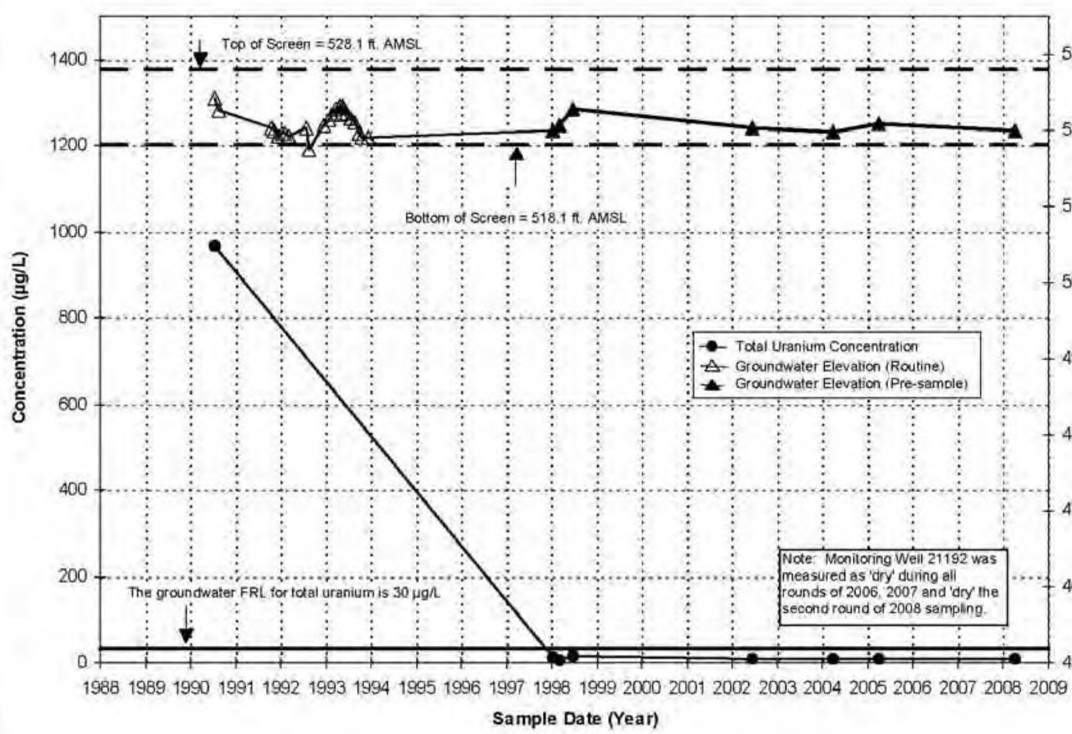


FIGURE A.2-90. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21192

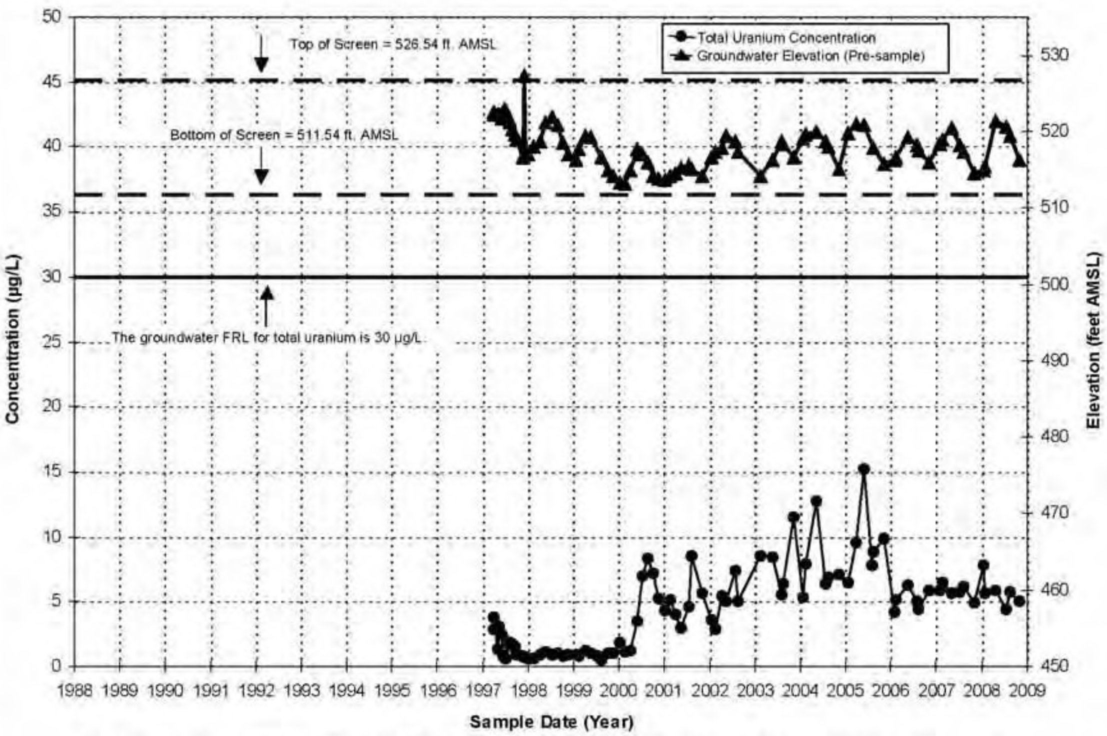


FIGURE A.2-91. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22198

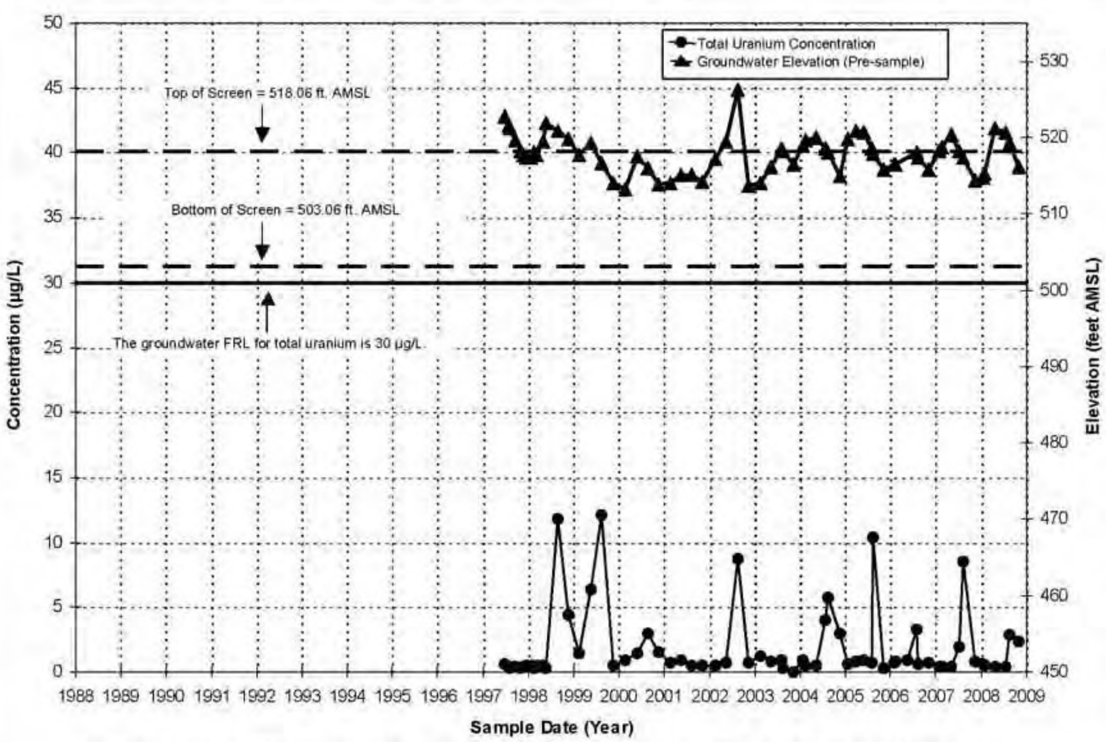


FIGURE A.2-92. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22199

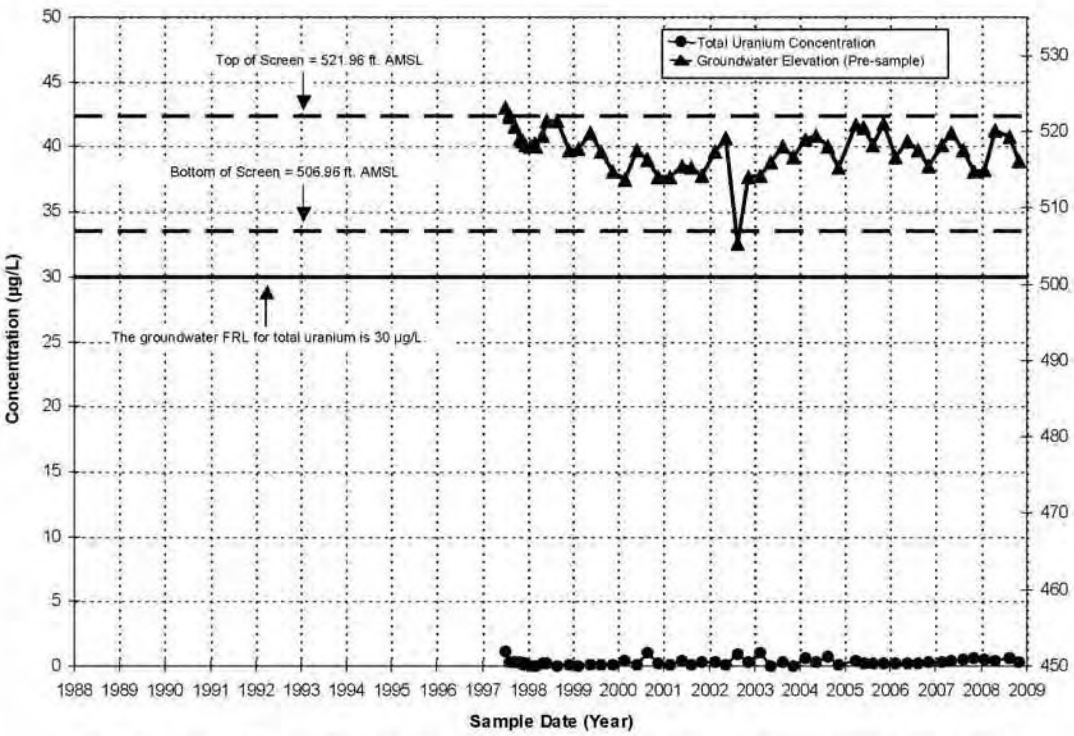


FIGURE A.2-93. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22200

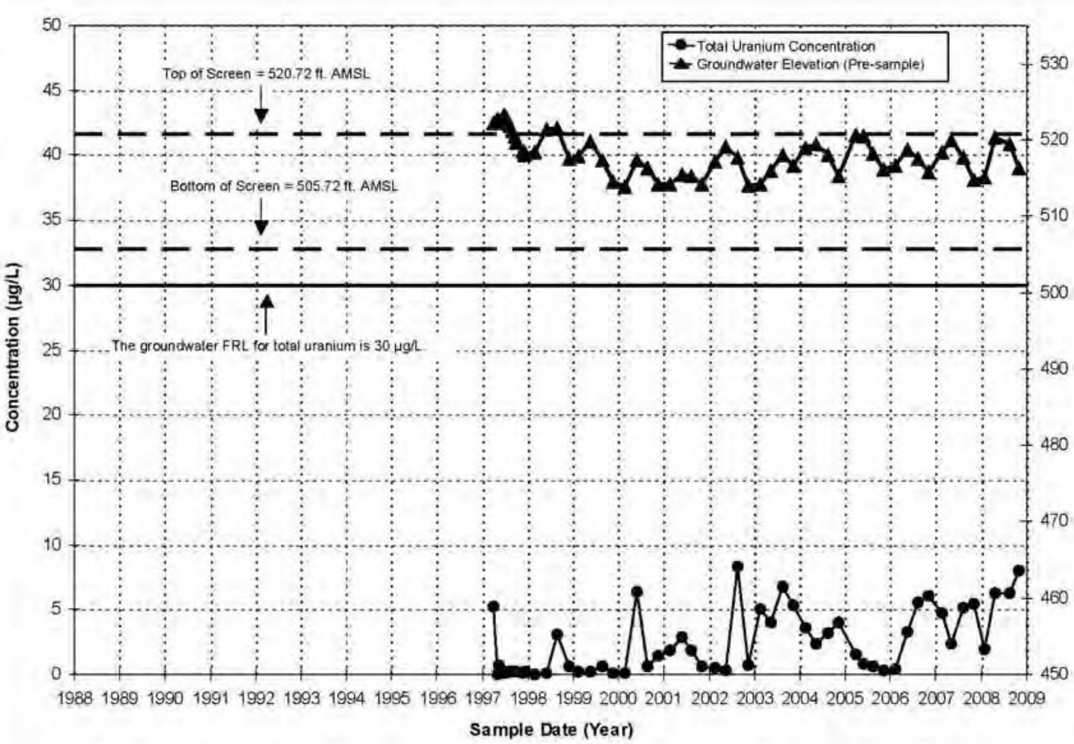


FIGURE A.2-94. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22201

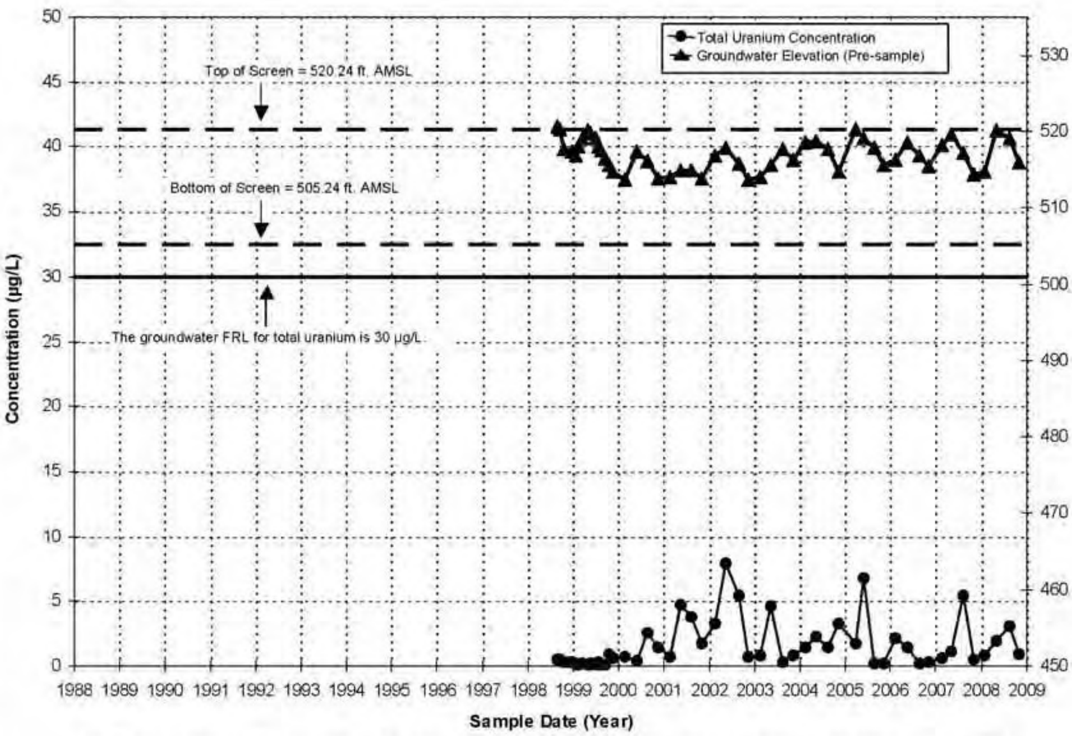


FIGURE A.2-95. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22203

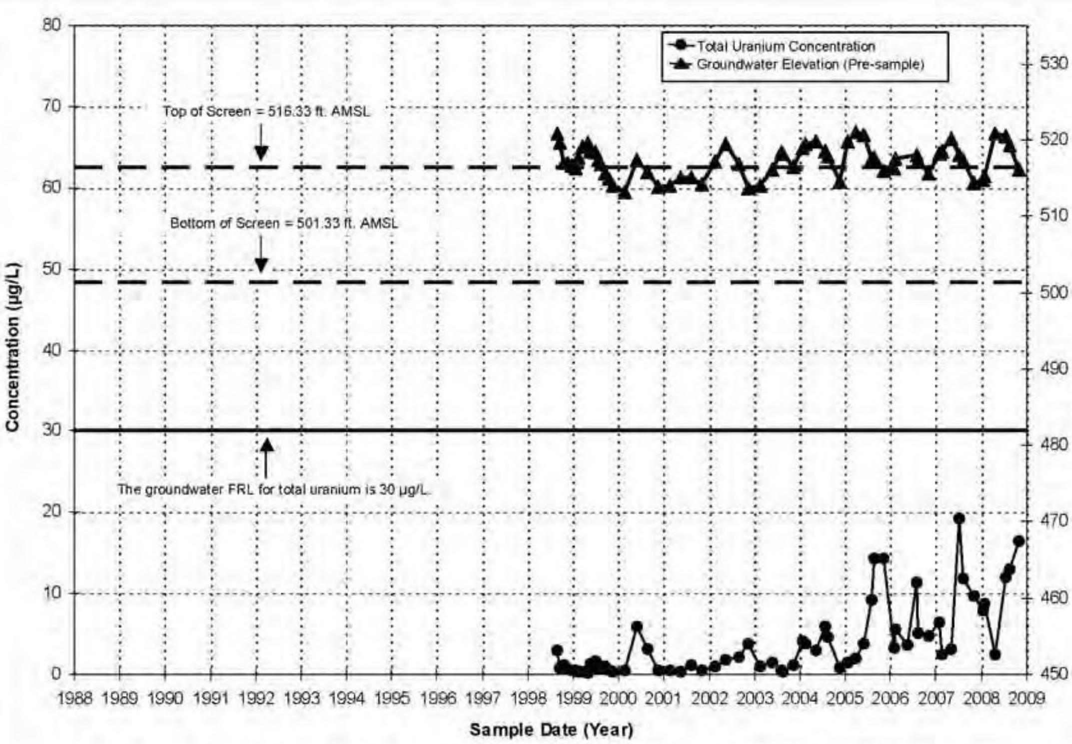


FIGURE A.2-96. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22204

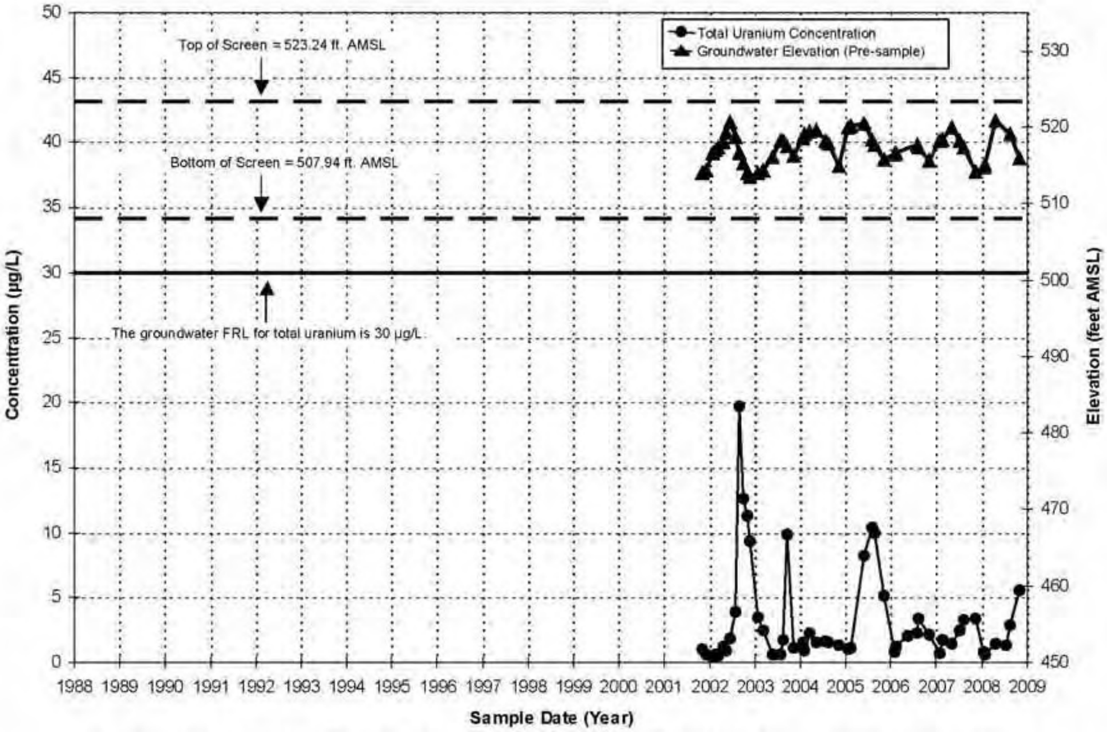


FIGURE A.2-97. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22205

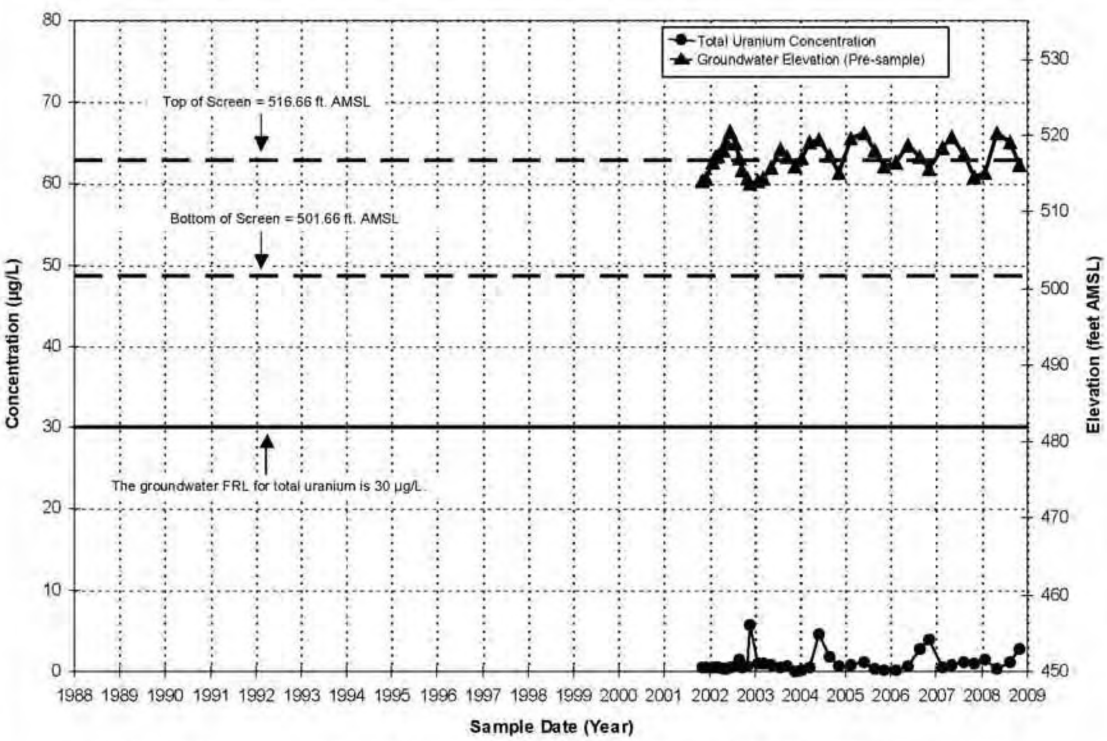


FIGURE A.2-98. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22206

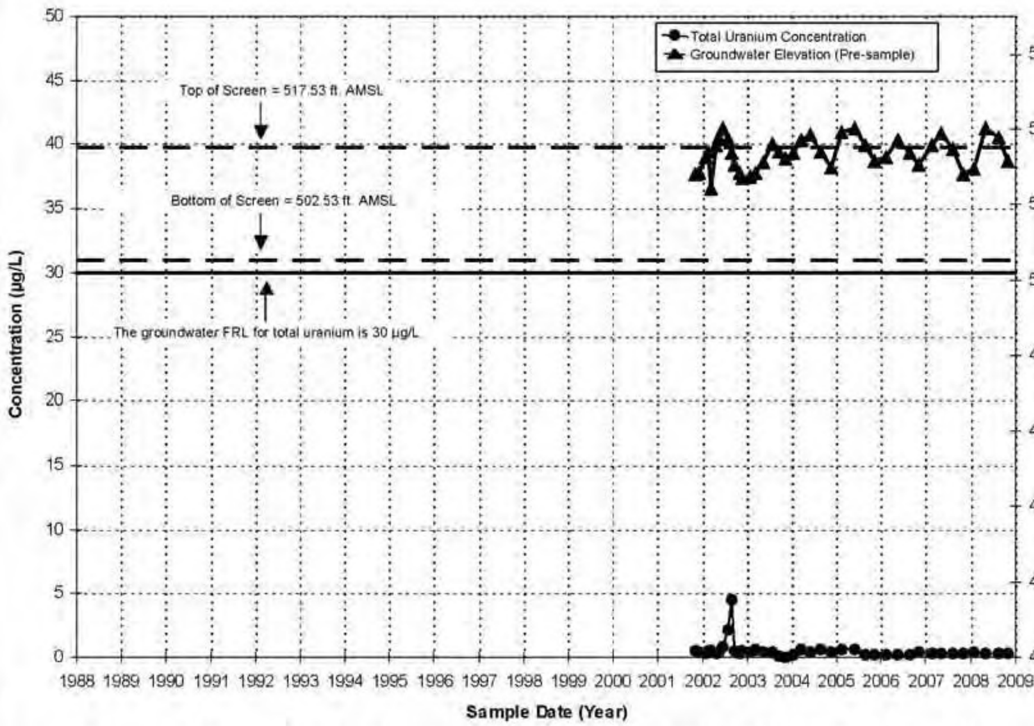


FIGURE A.2-99. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22207

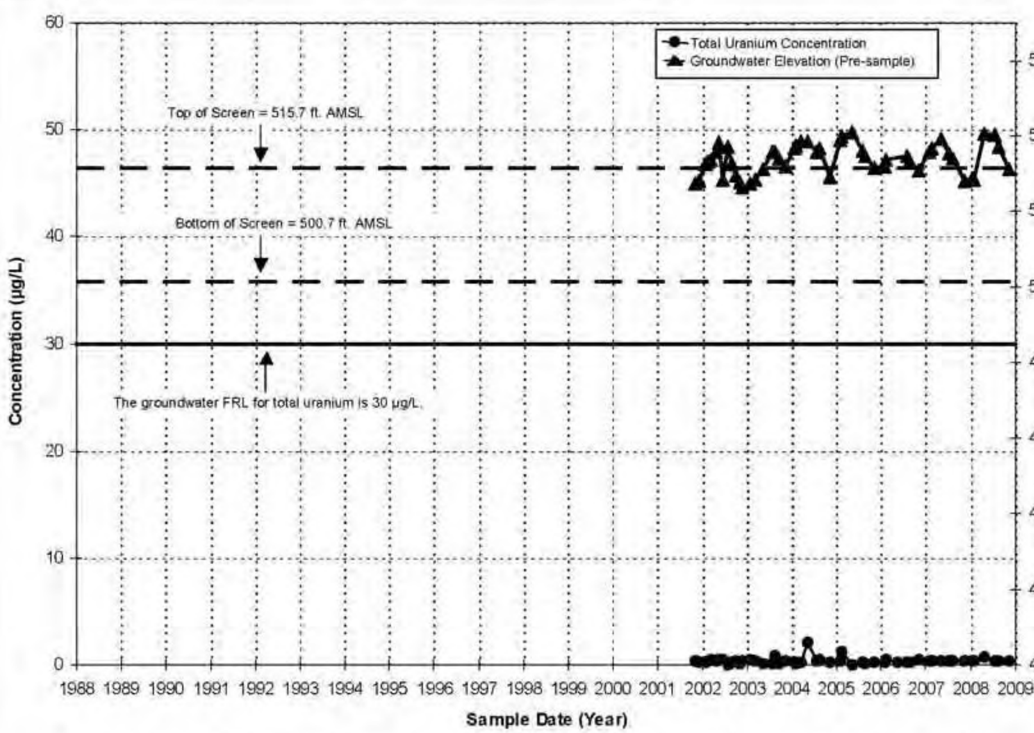


FIGURE A.2-100. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22208

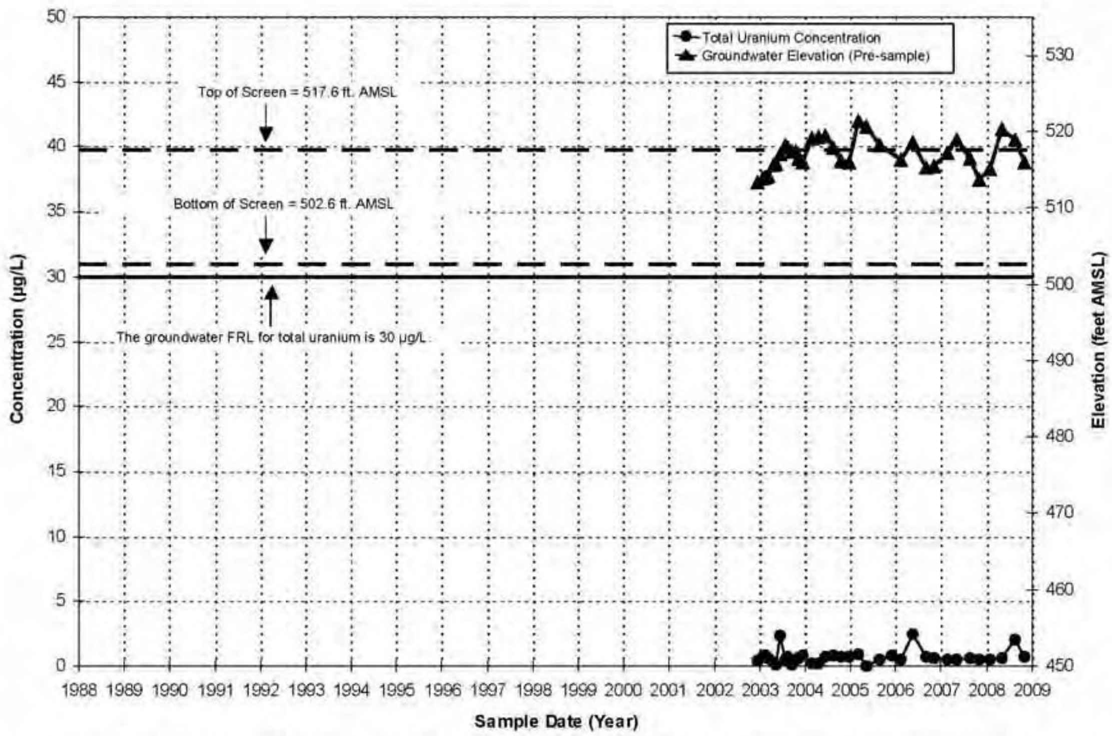


FIGURE A.2-101. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22209

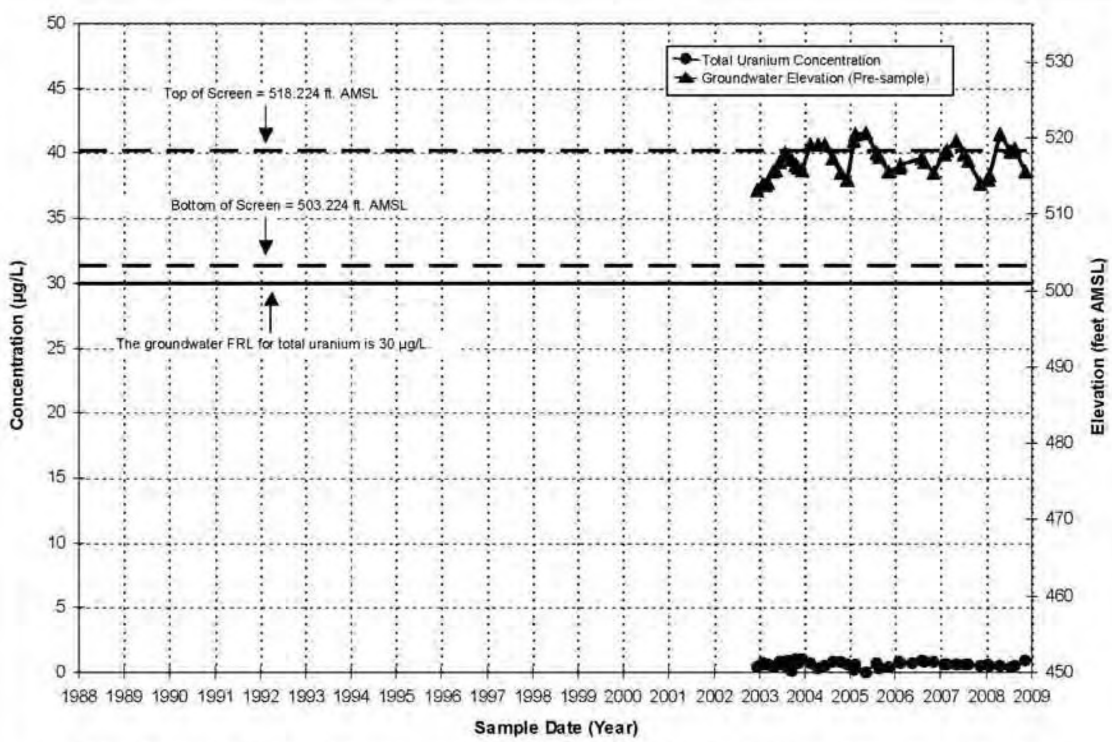


FIGURE A.2-102. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22210

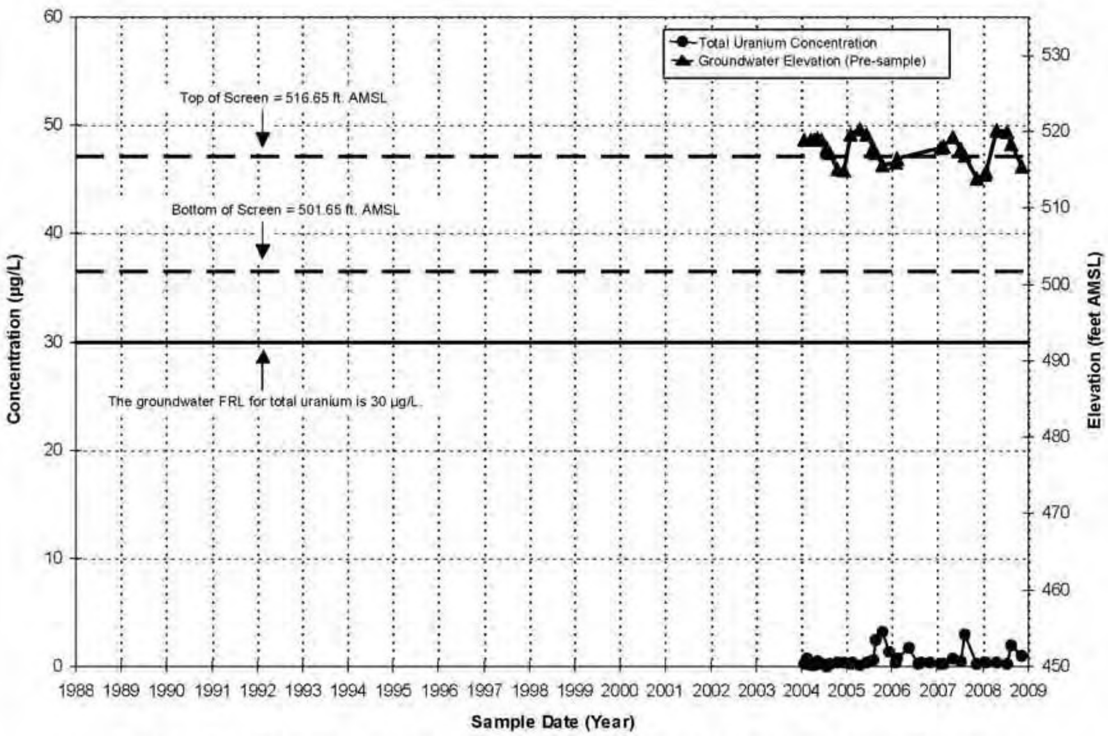


FIGURE A.2-103. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22211

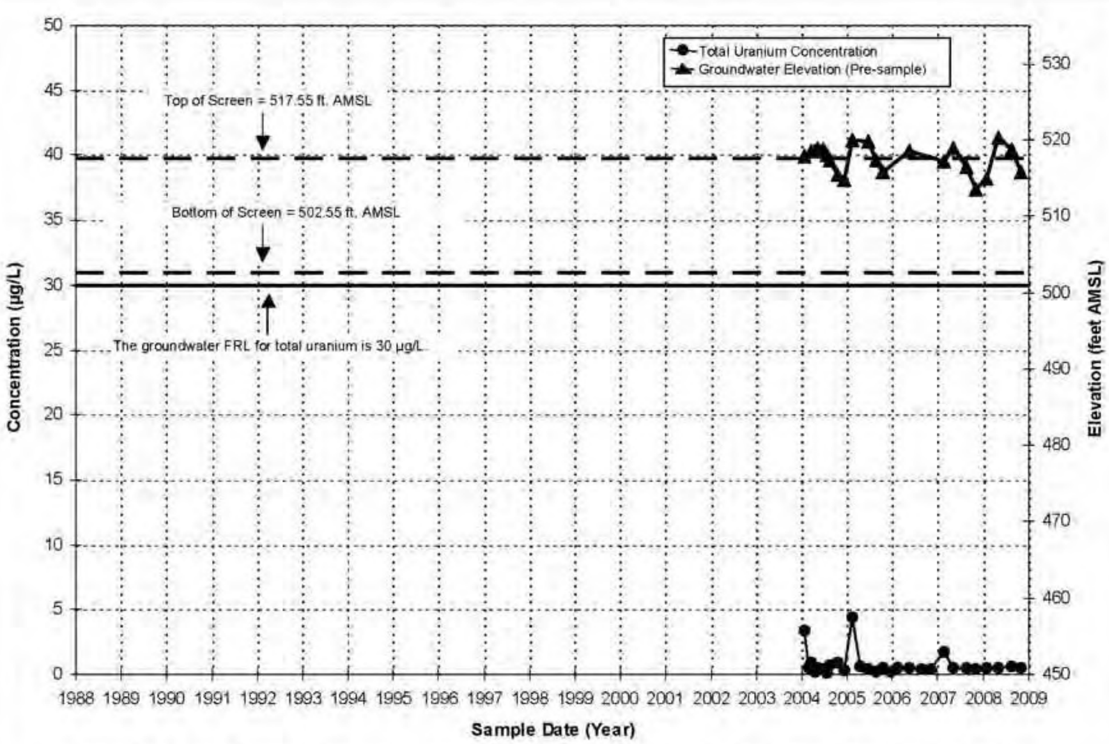


FIGURE A.2-104. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22212

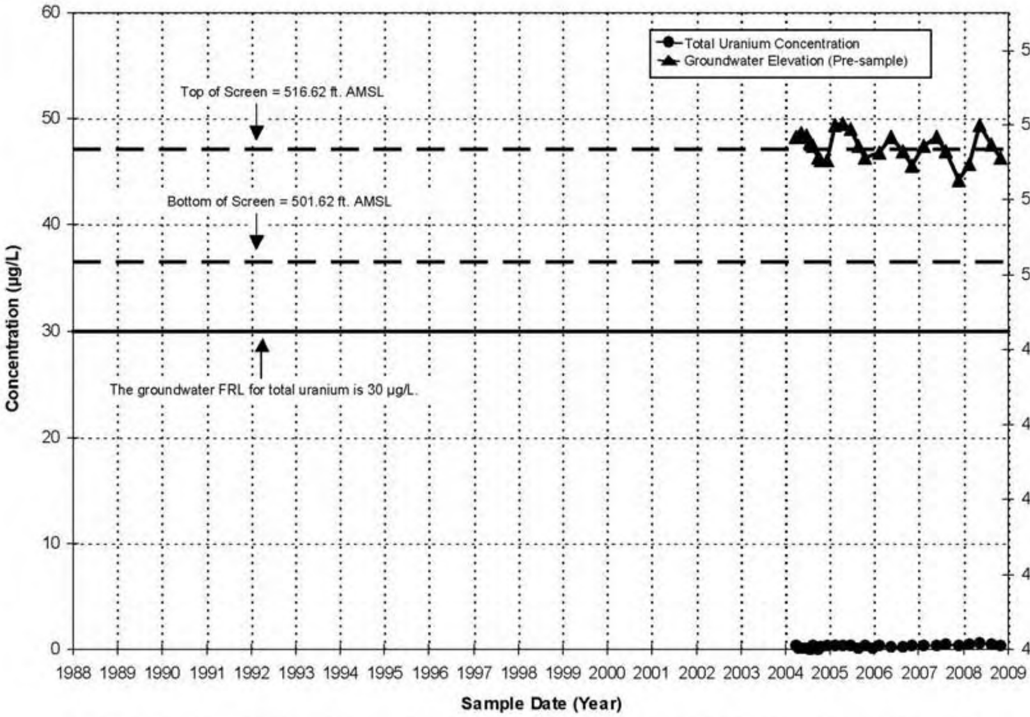


FIGURE A.2-105. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22213

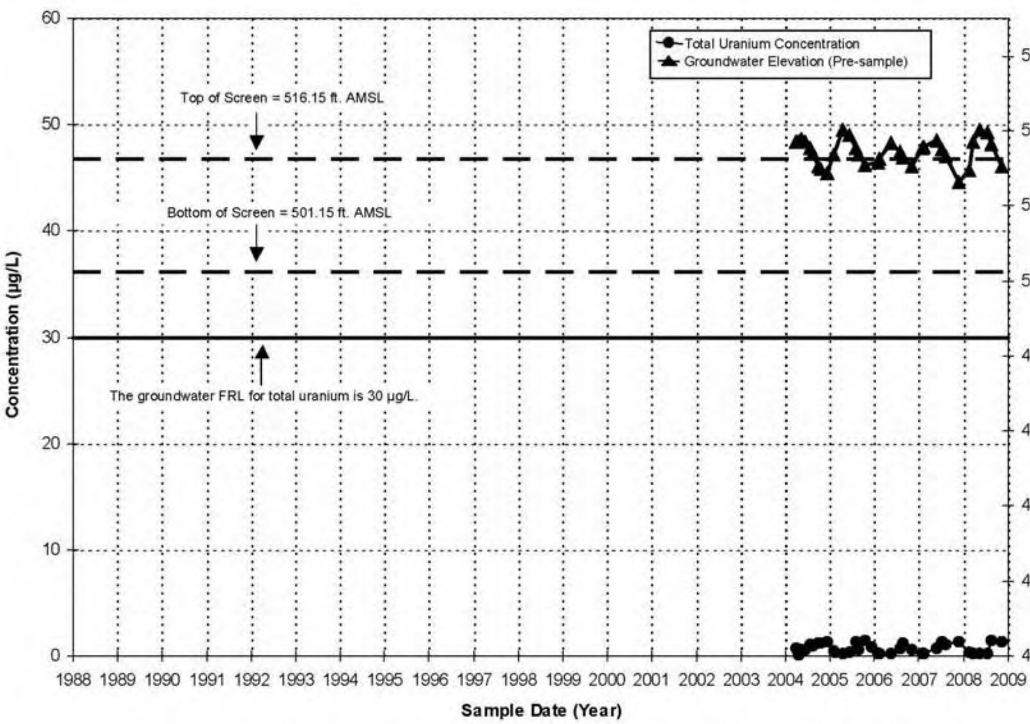


FIGURE A.2-106. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22214

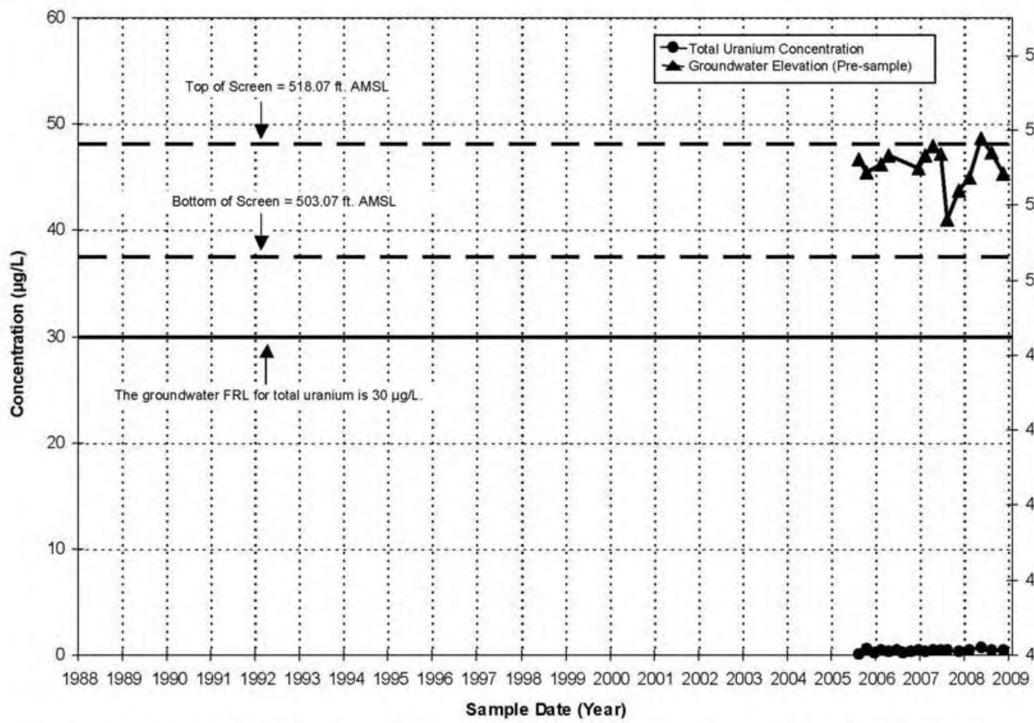


FIGURE A.2-107. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22215

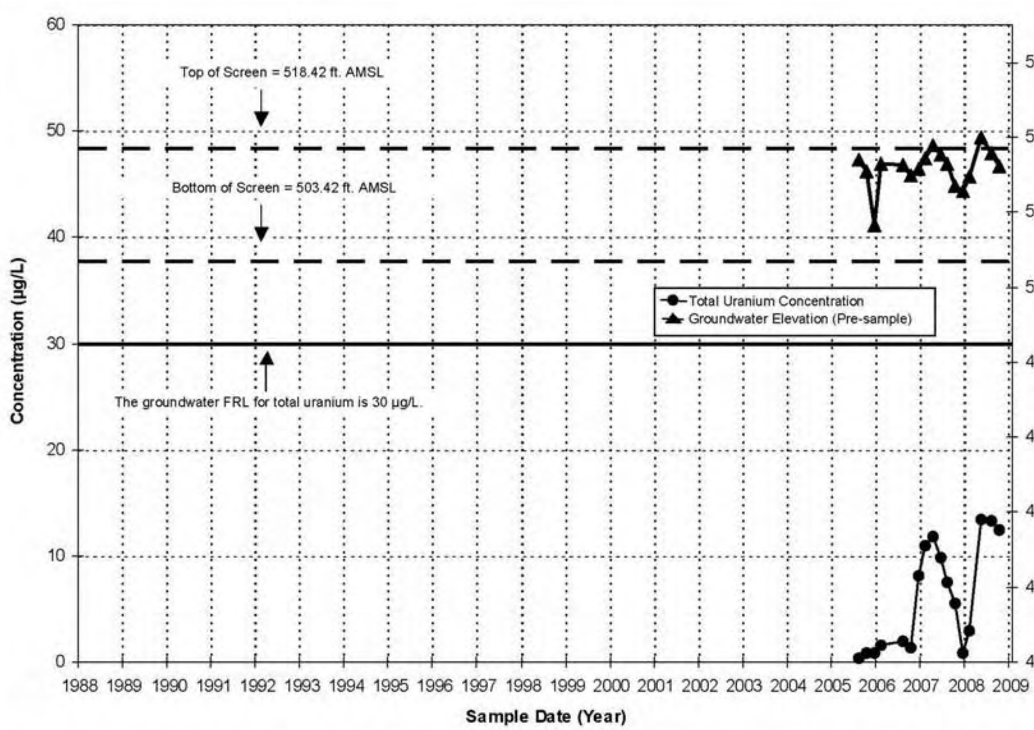


FIGURE A.2-108. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22216/22217

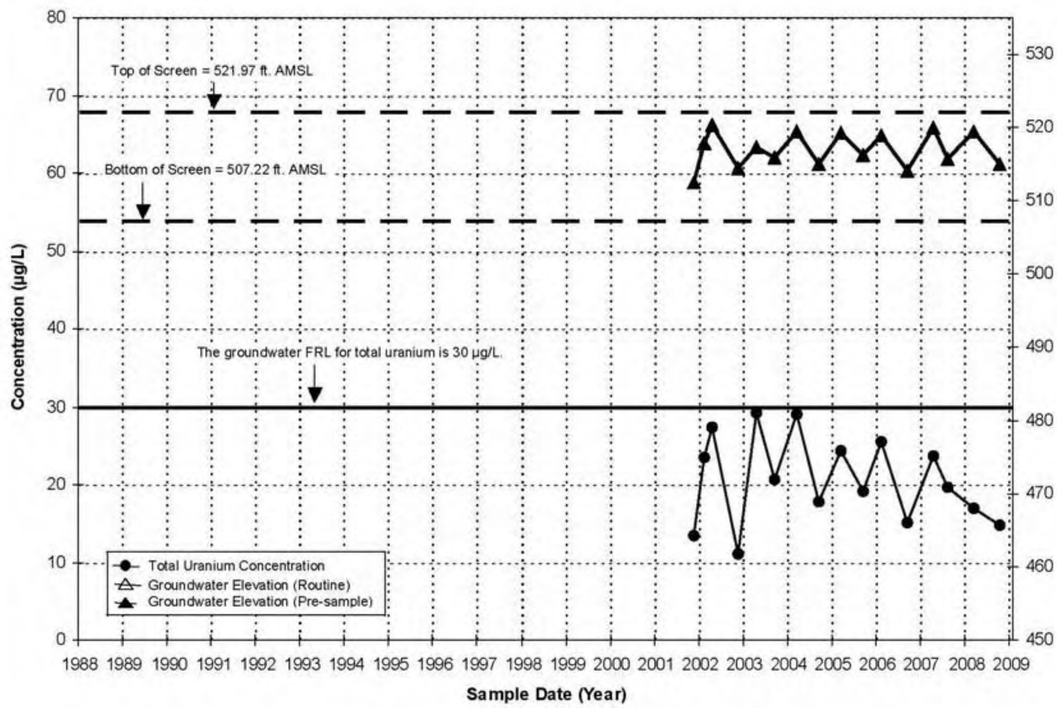


FIGURE A.2-109. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23064

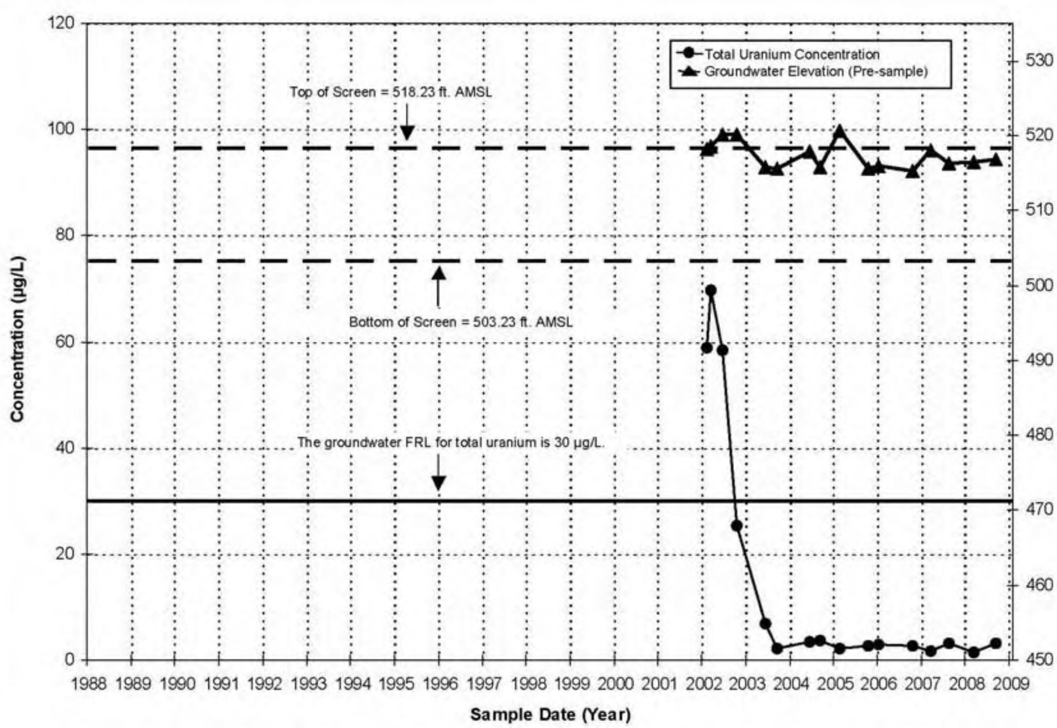


FIGURE A.2-110. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23118

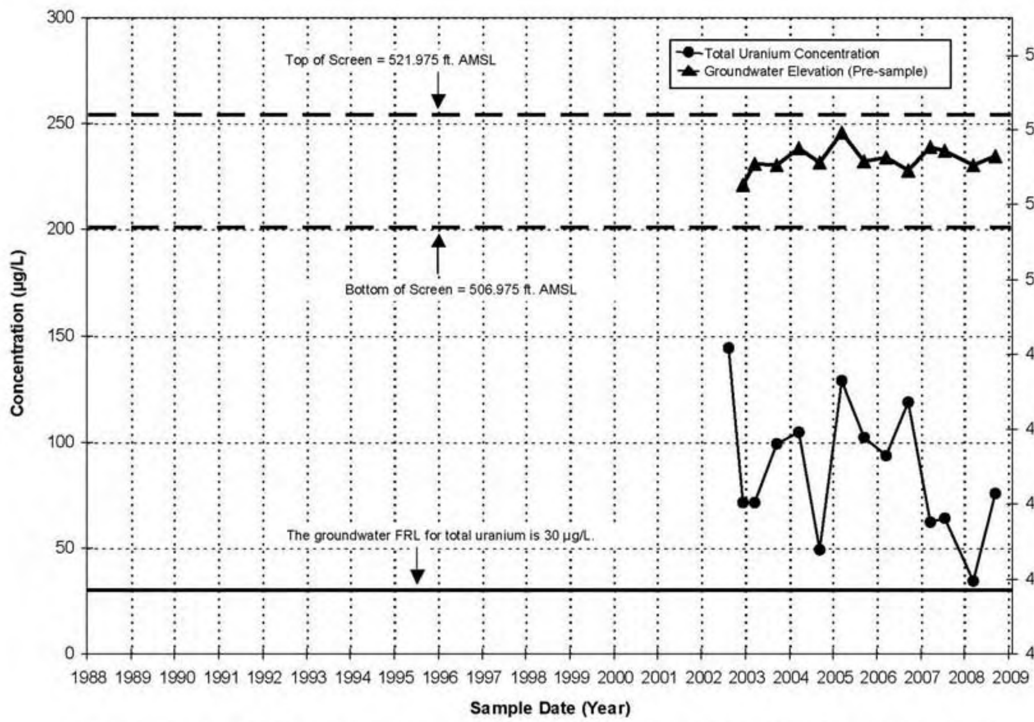


FIGURE A.2-111. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23271

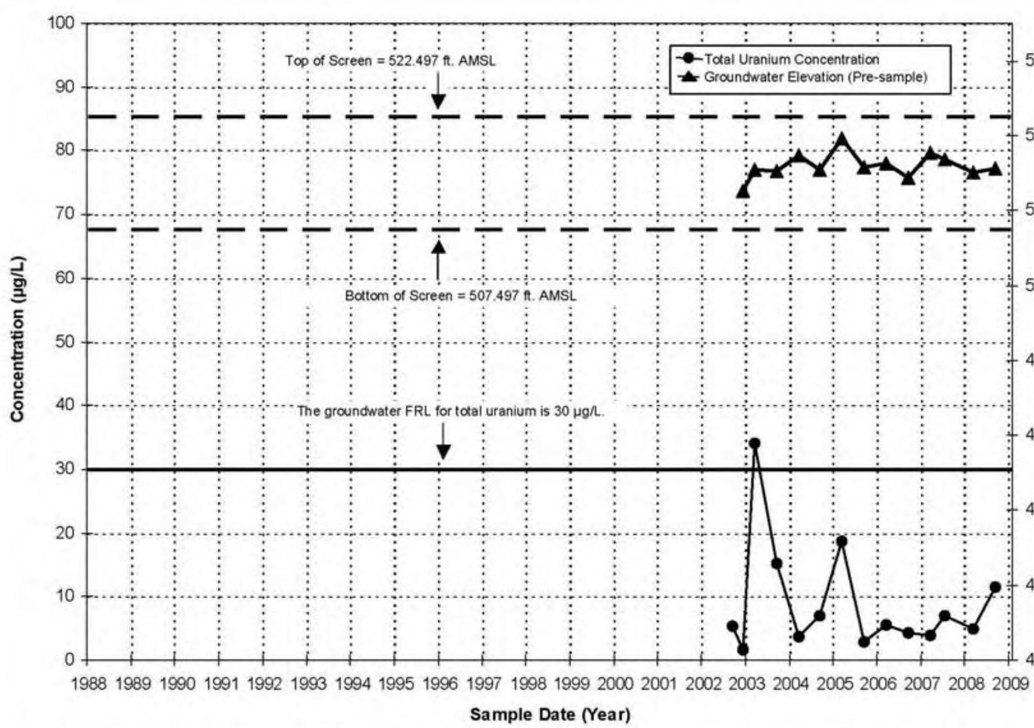


FIGURE A.2-112. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23272

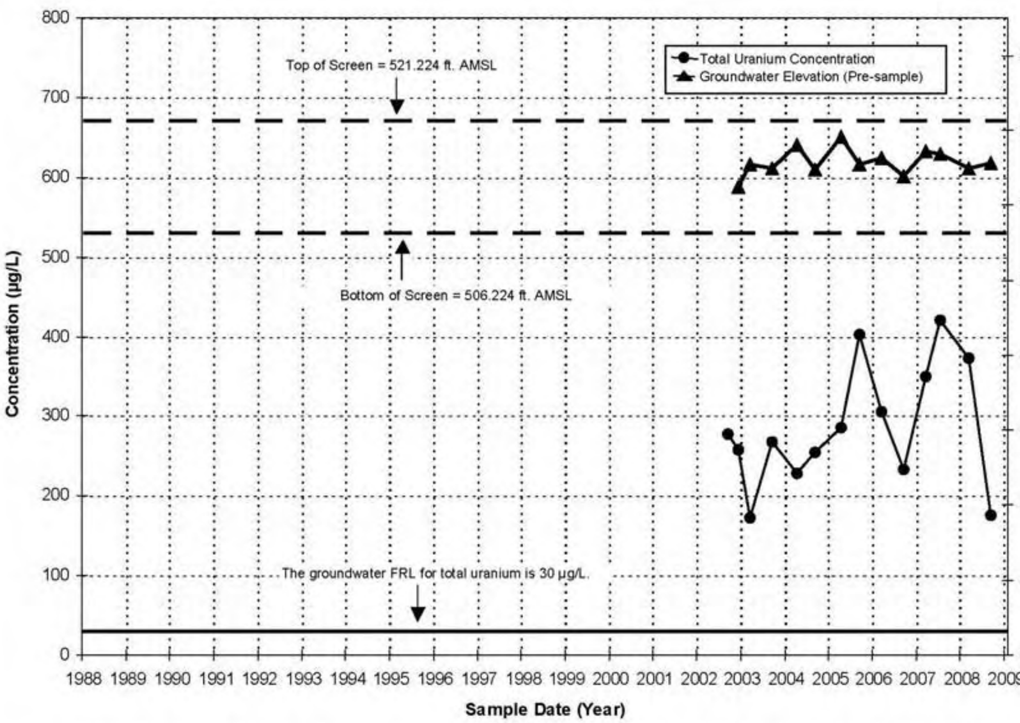


FIGURE A.2-113. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23273

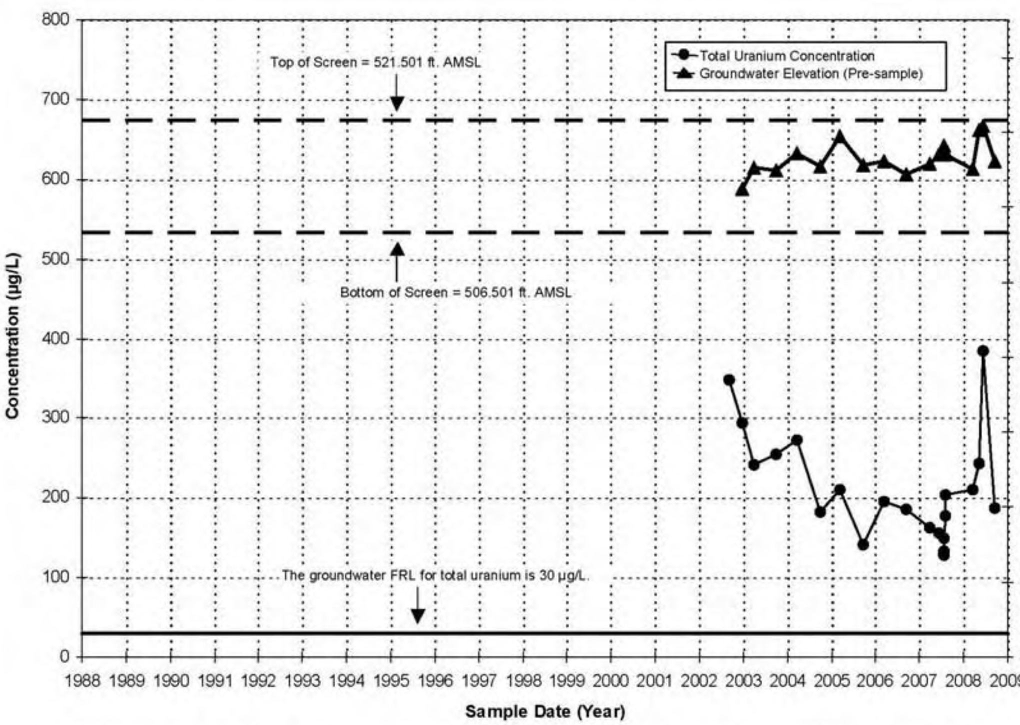


FIGURE A.2-114. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23274

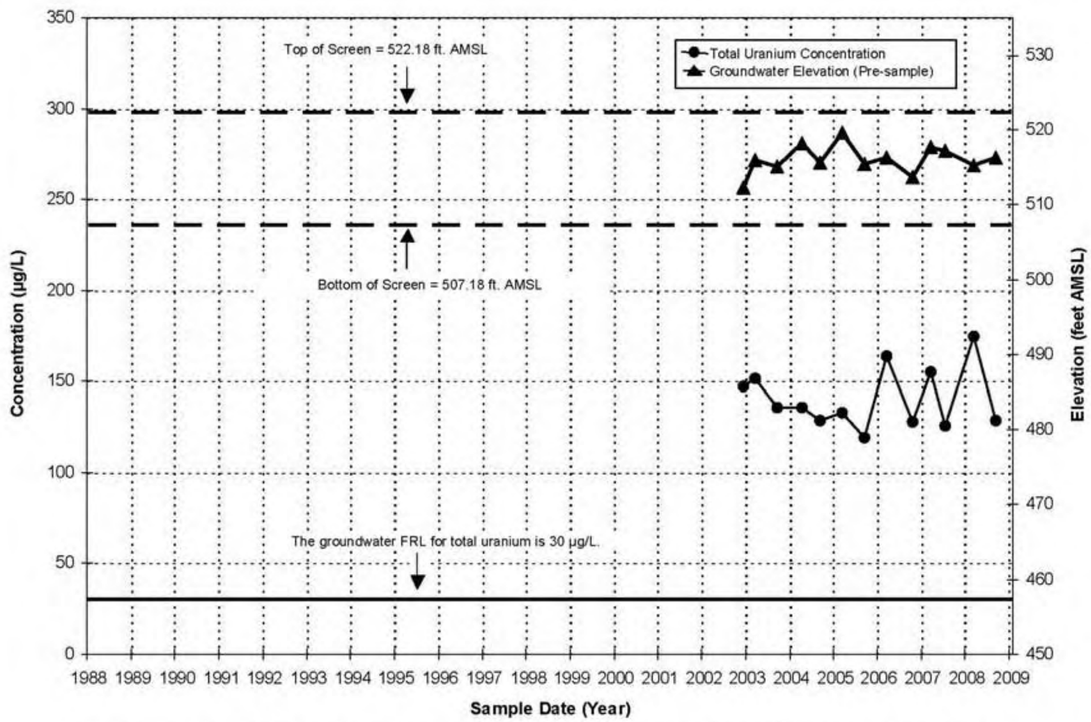


FIGURE A.2-115. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23275

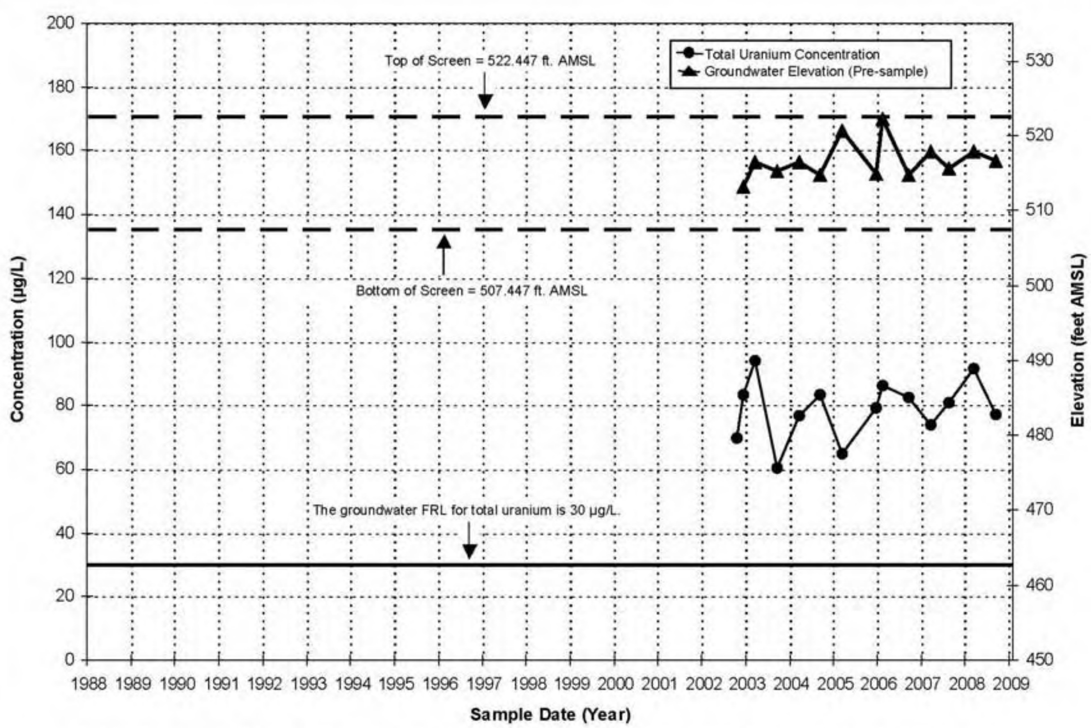


FIGURE A.2-116. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23276

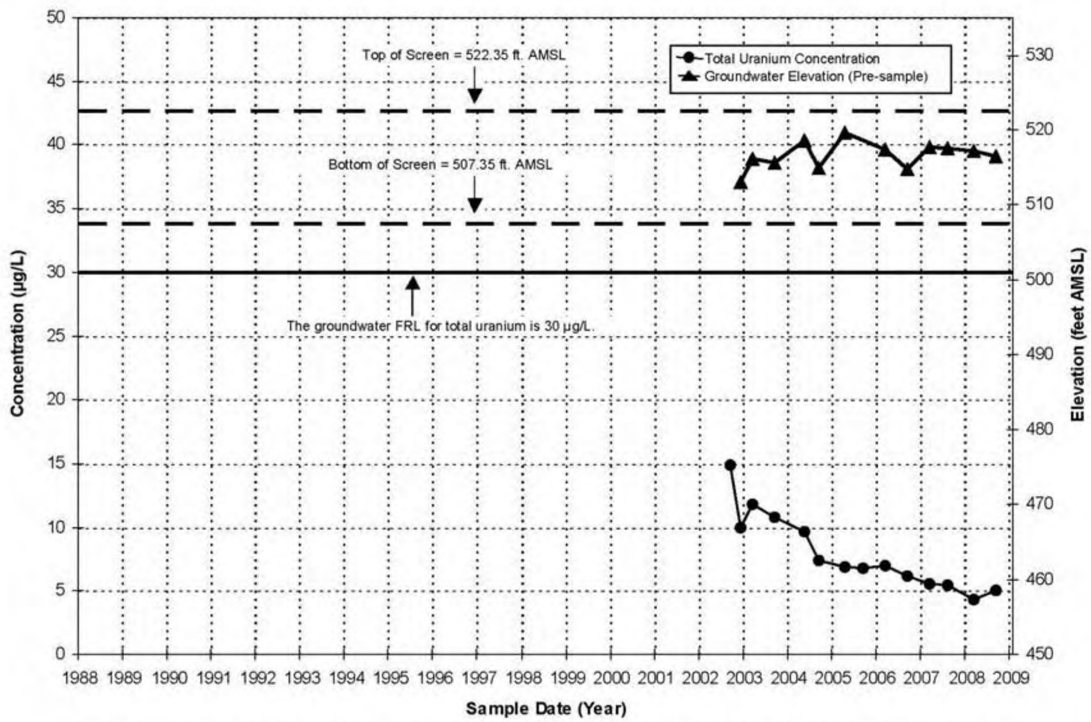


FIGURE A.2-117. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23277

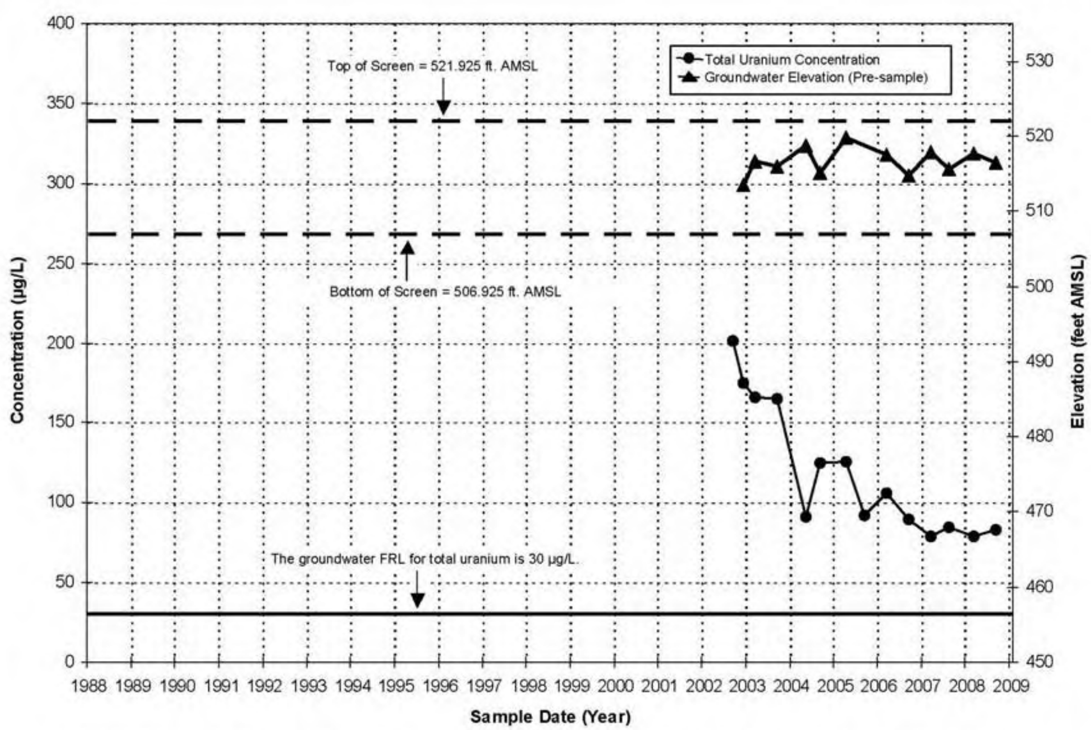


FIGURE A.2-118. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23278

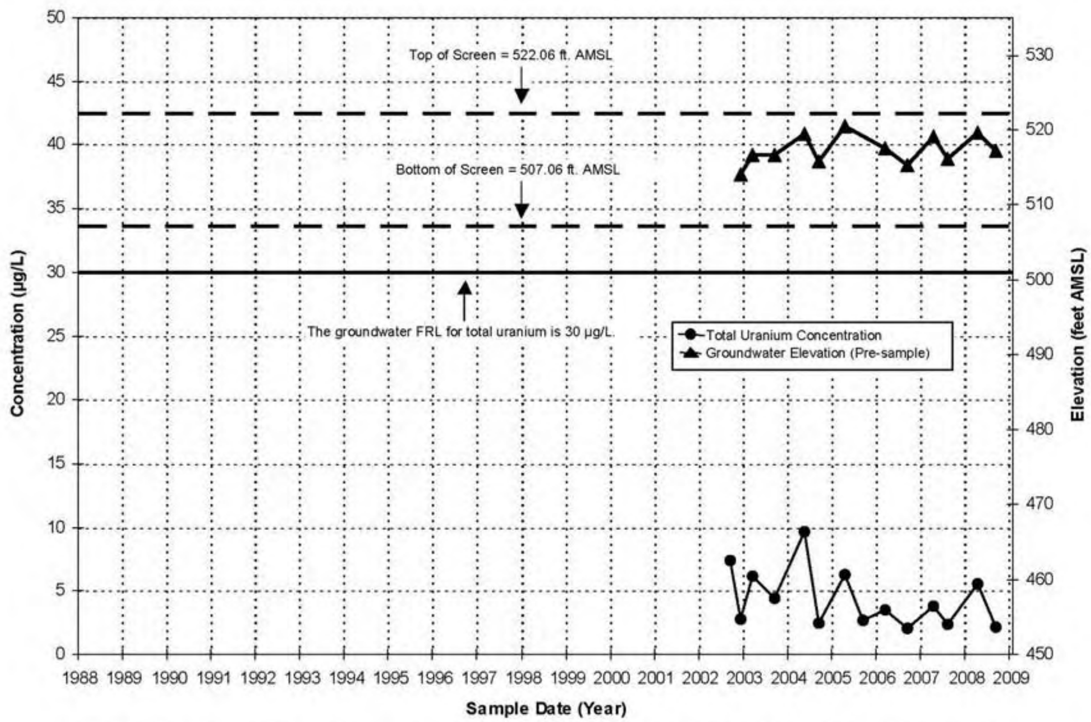


FIGURE A.2-119. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23279

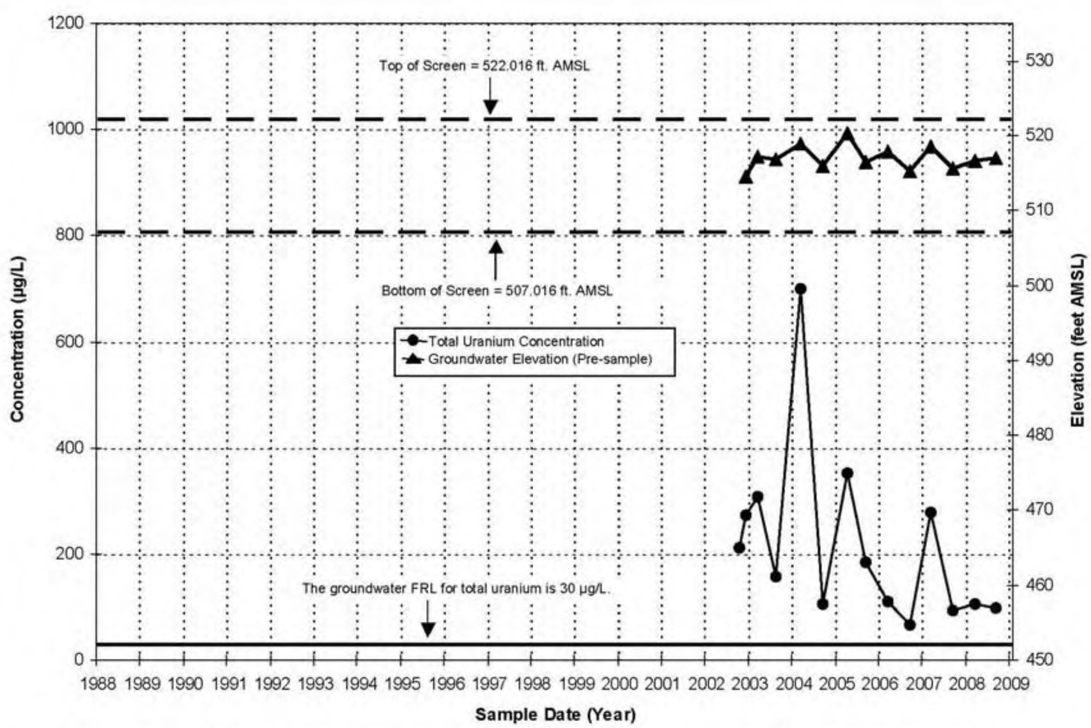


FIGURE A.2-120. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23280

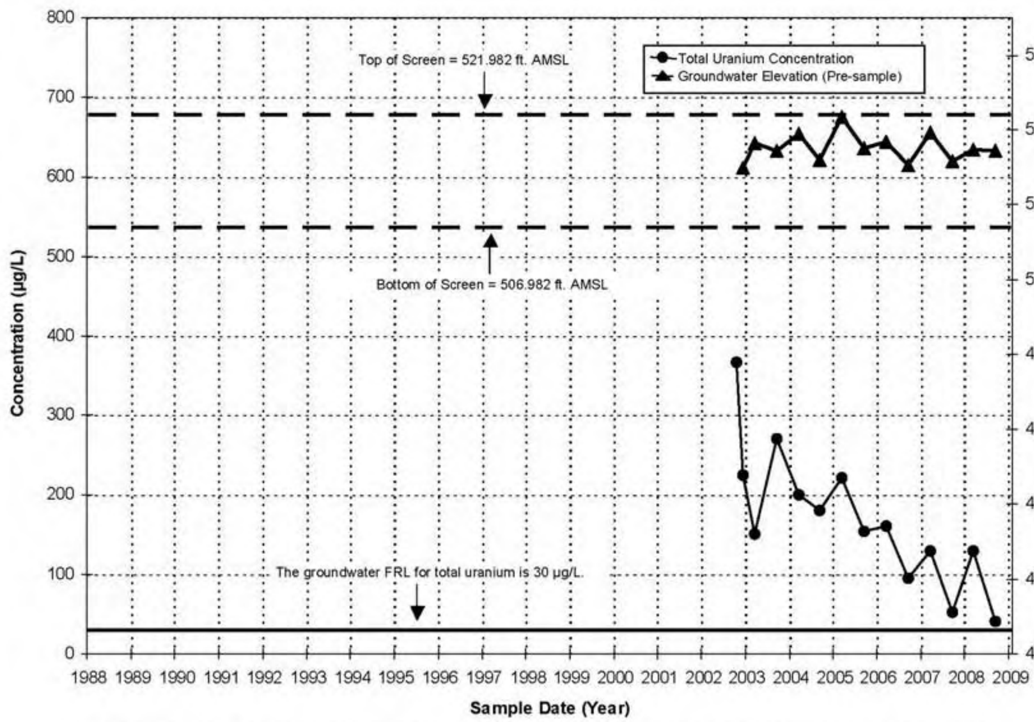


FIGURE A.2-121. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23281

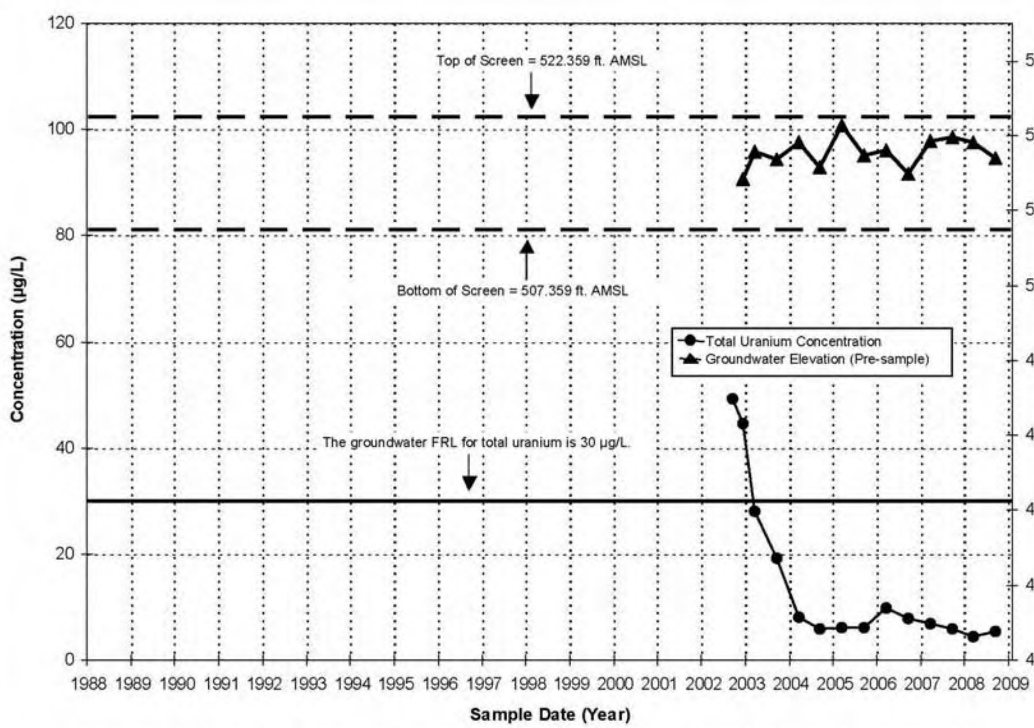


FIGURE A.2-122. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23282

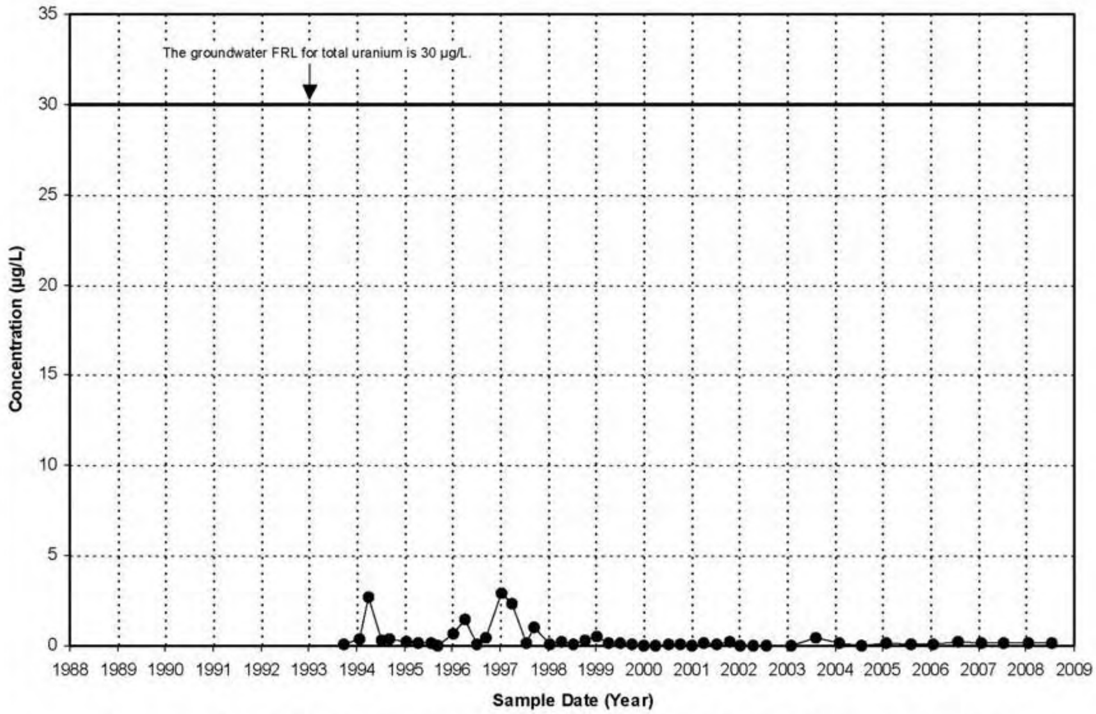


FIGURE A.2-123. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 31217

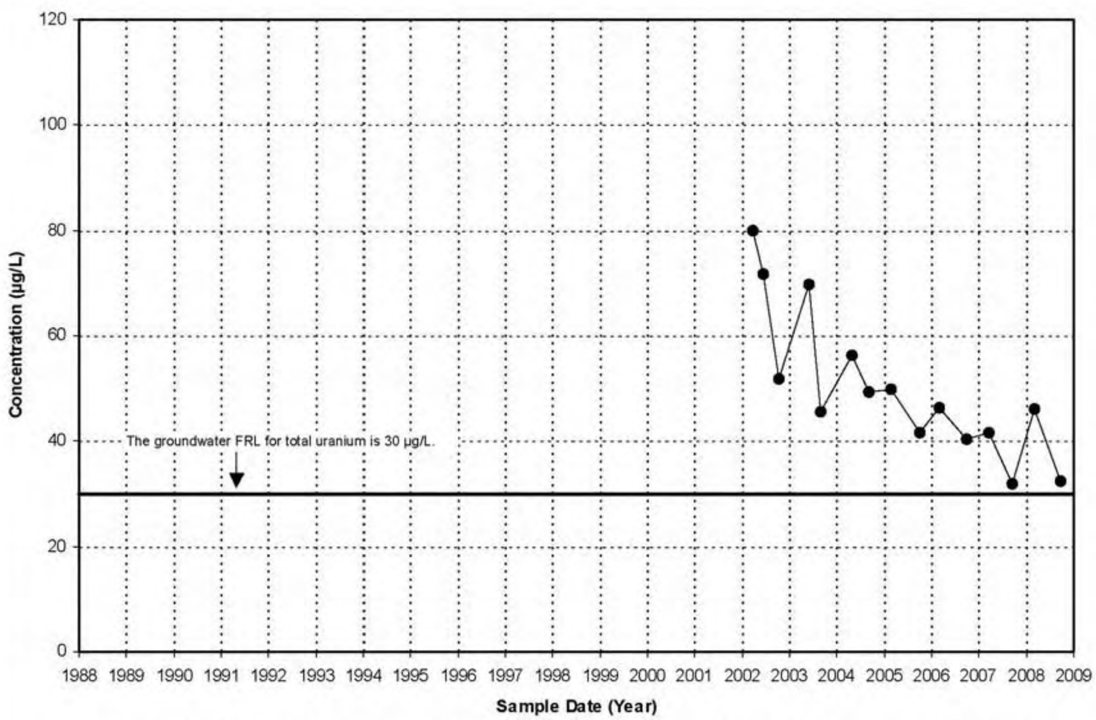


FIGURE A.2-124. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 32766

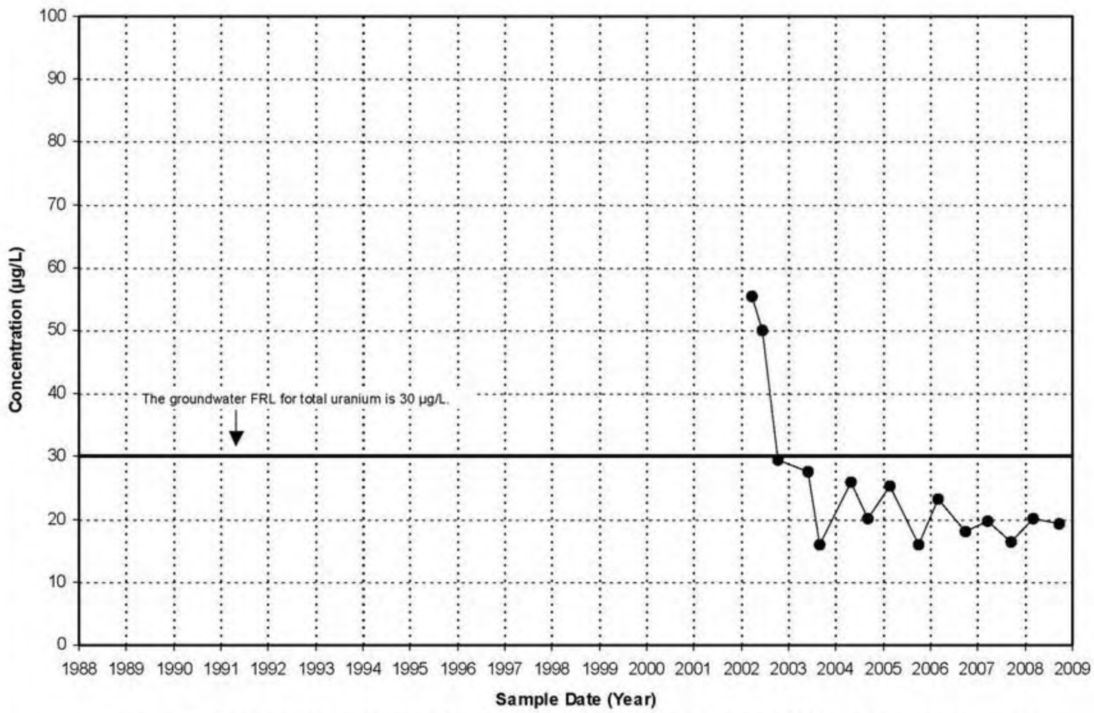


FIGURE A.2-125. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 32768

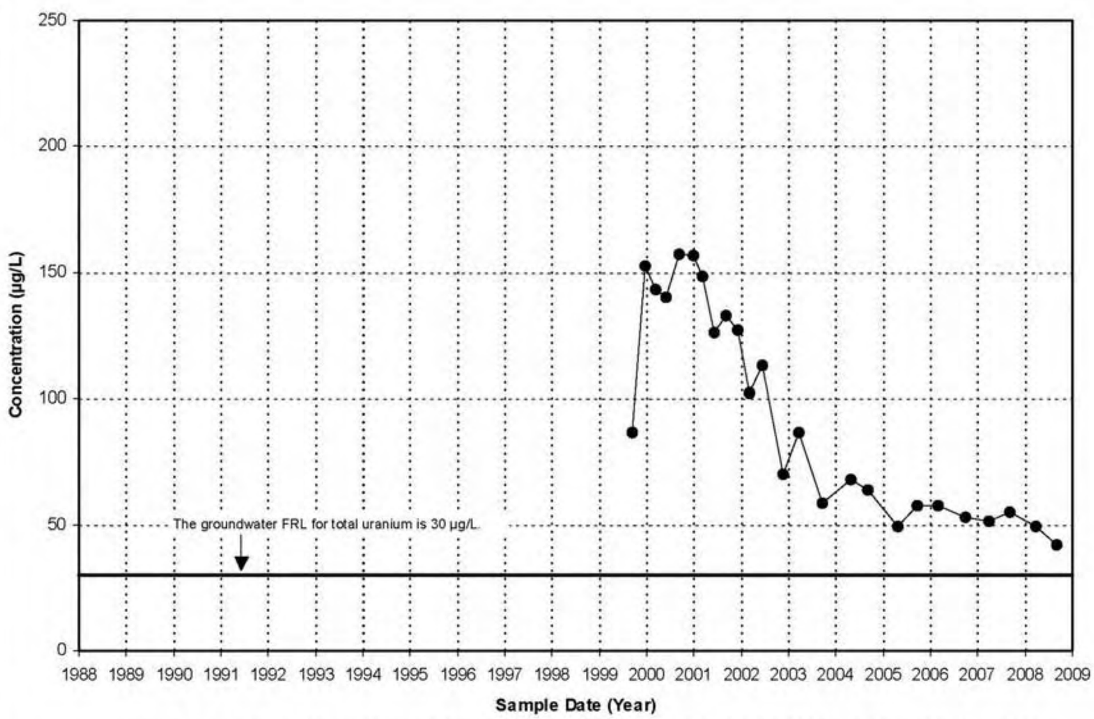


FIGURE A.2-126. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 62408

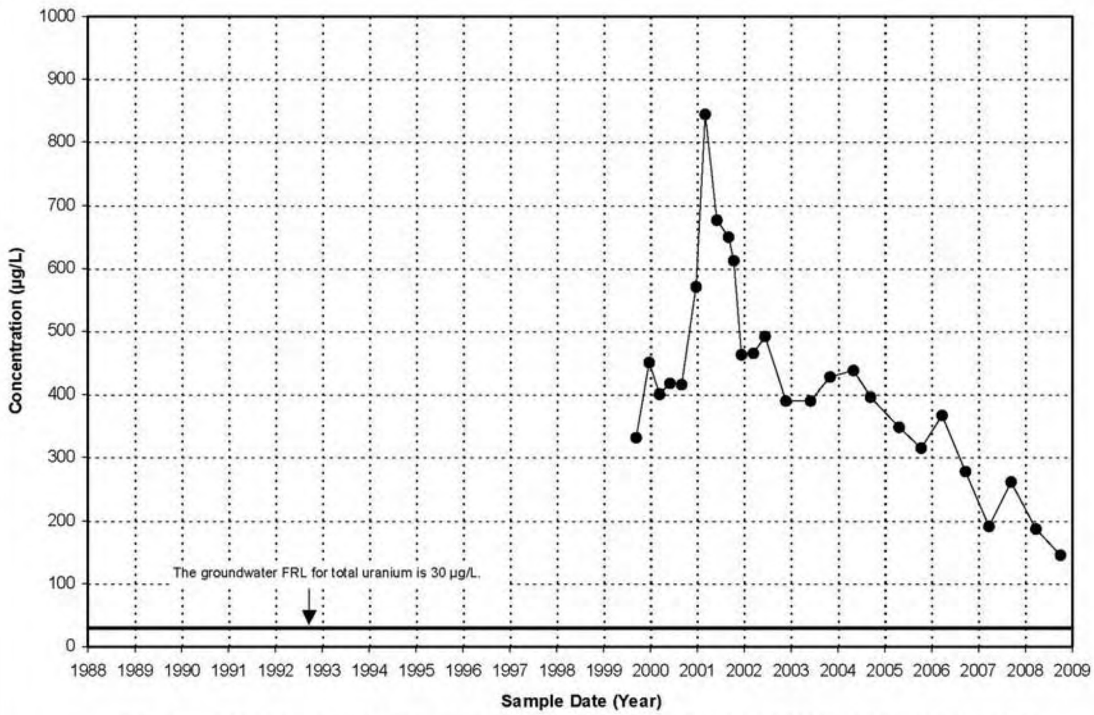


FIGURE A.2-127. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 62433

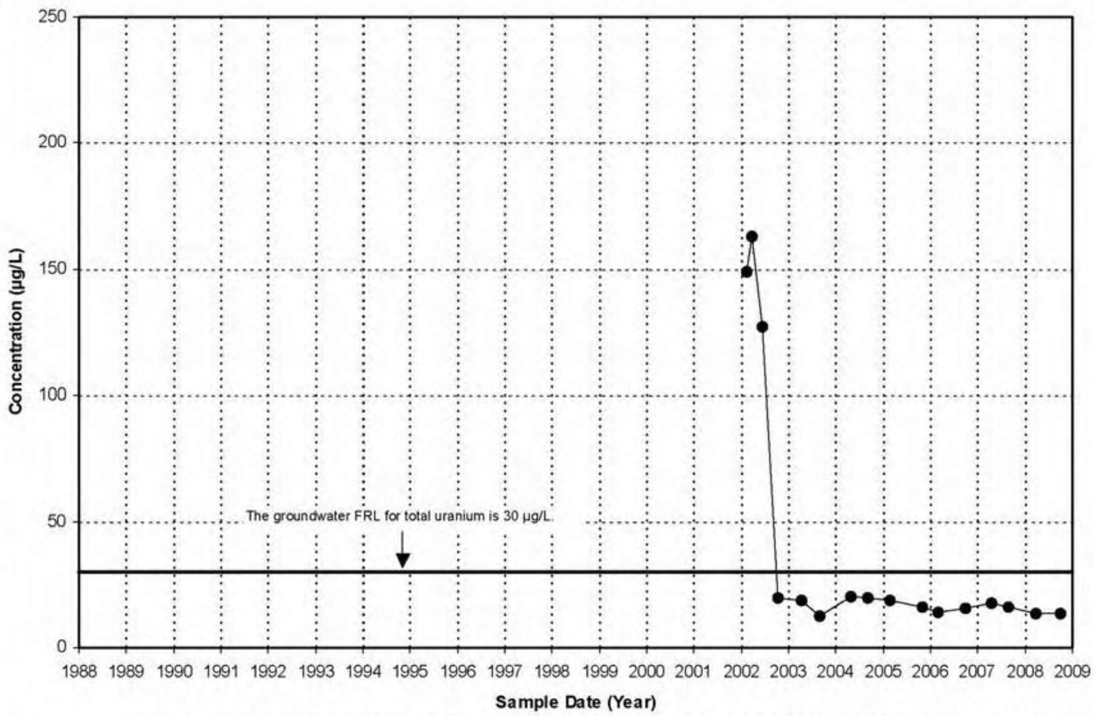


FIGURE A.2-128. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63116

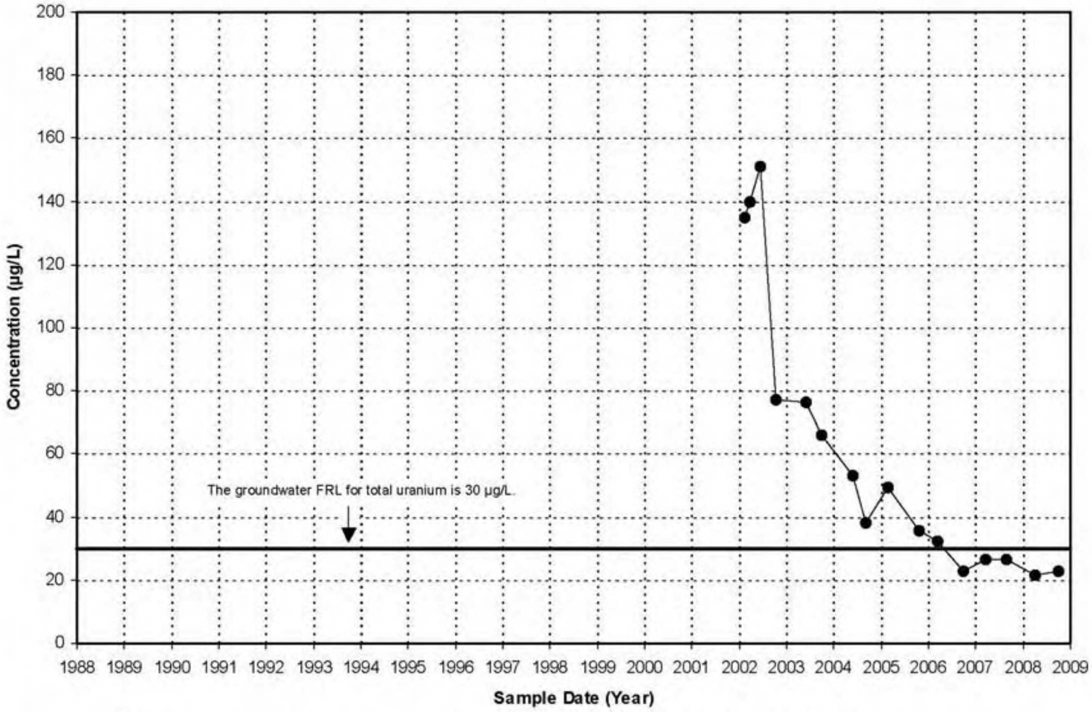


FIGURE A.2-129. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63119

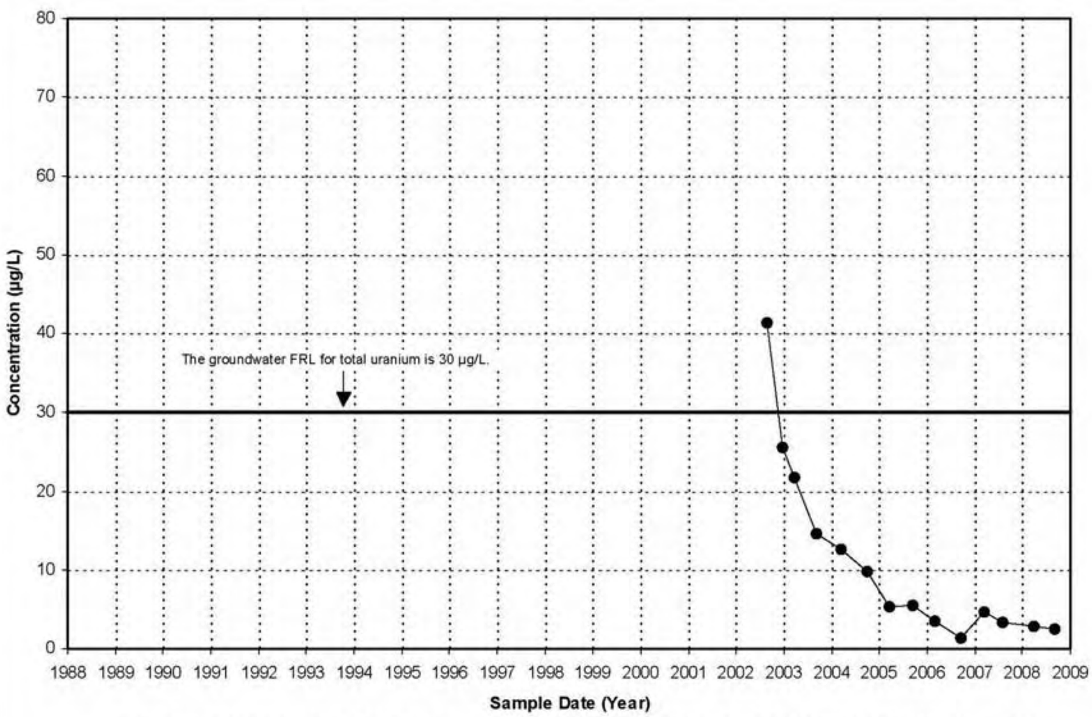


FIGURE A.2-130. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63283

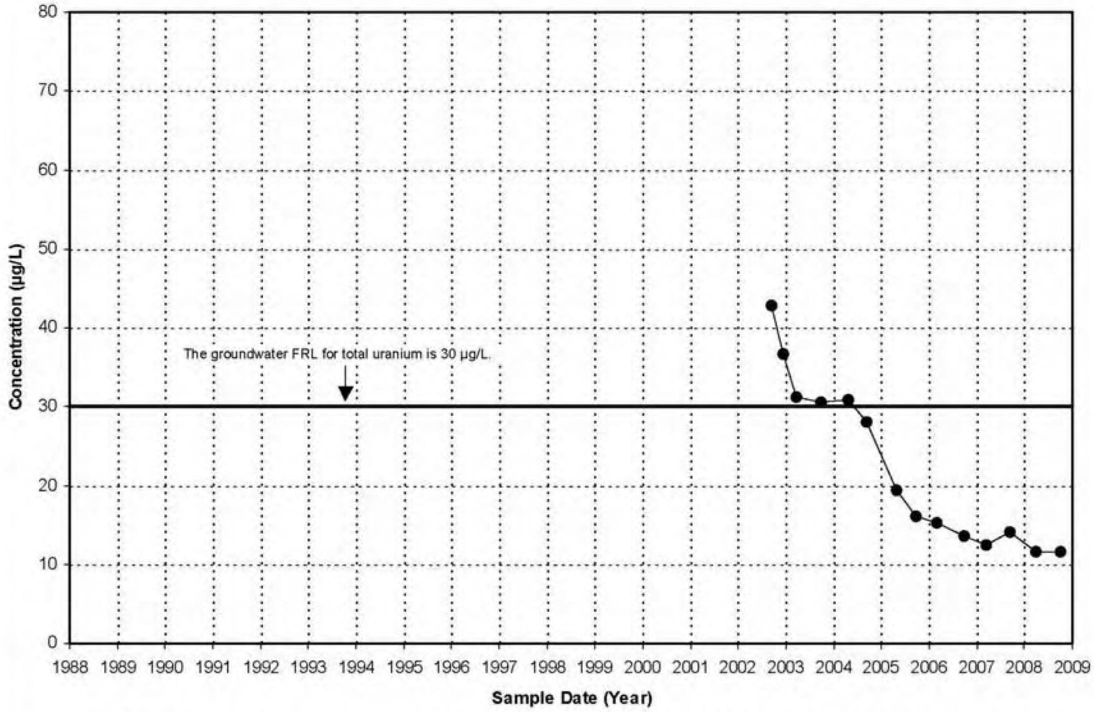


FIGURE A.2-131. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63284

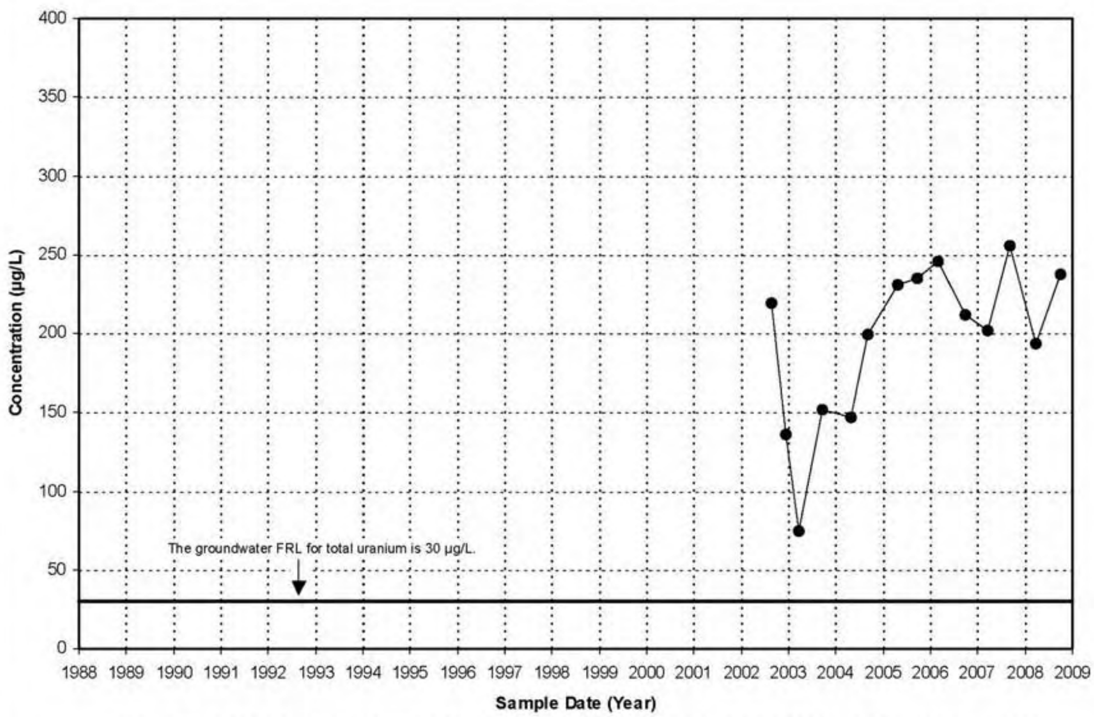


FIGURE A.2-132. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63285

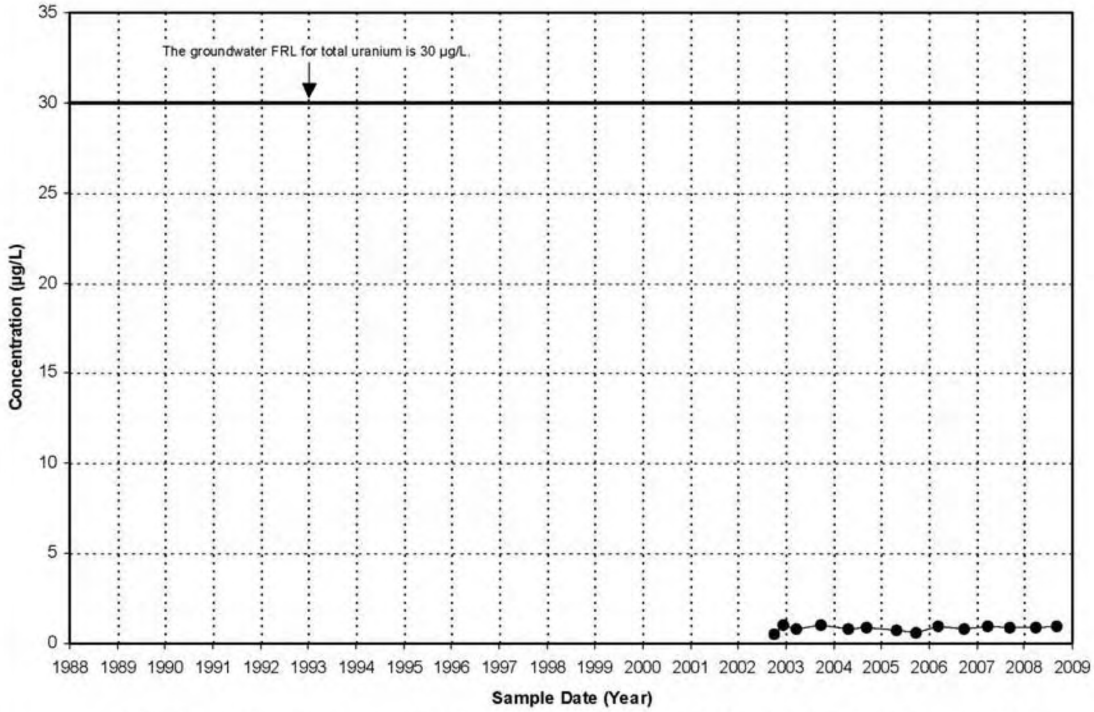


FIGURE A.2-133. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63286

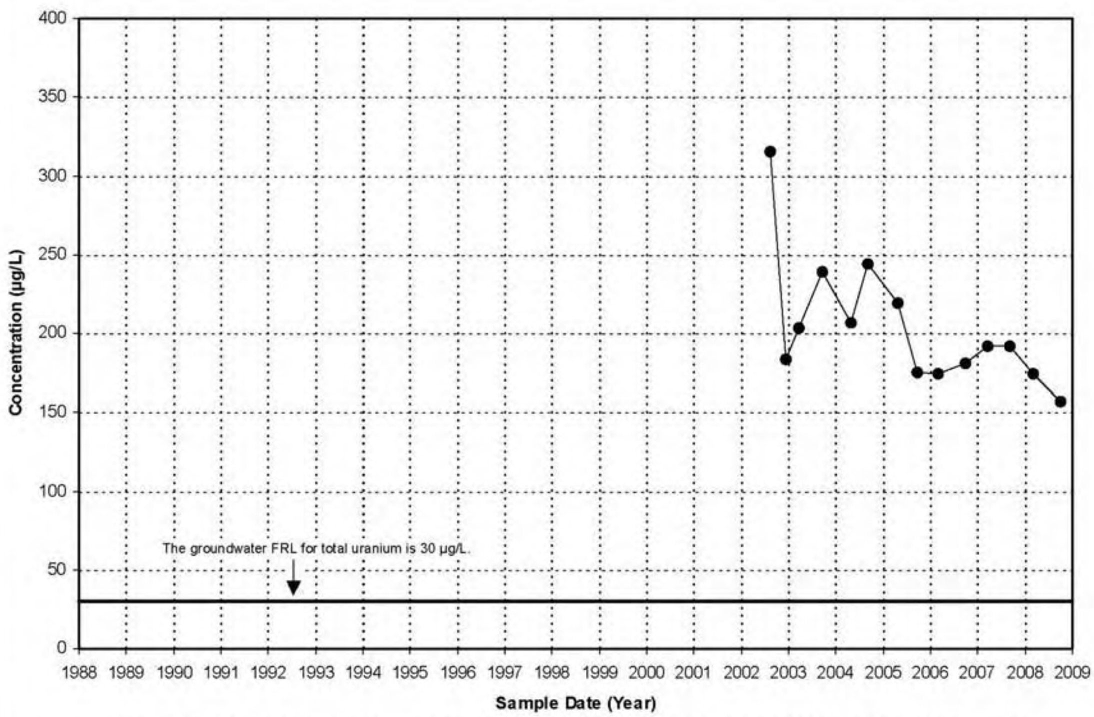


FIGURE A.2-134. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63287

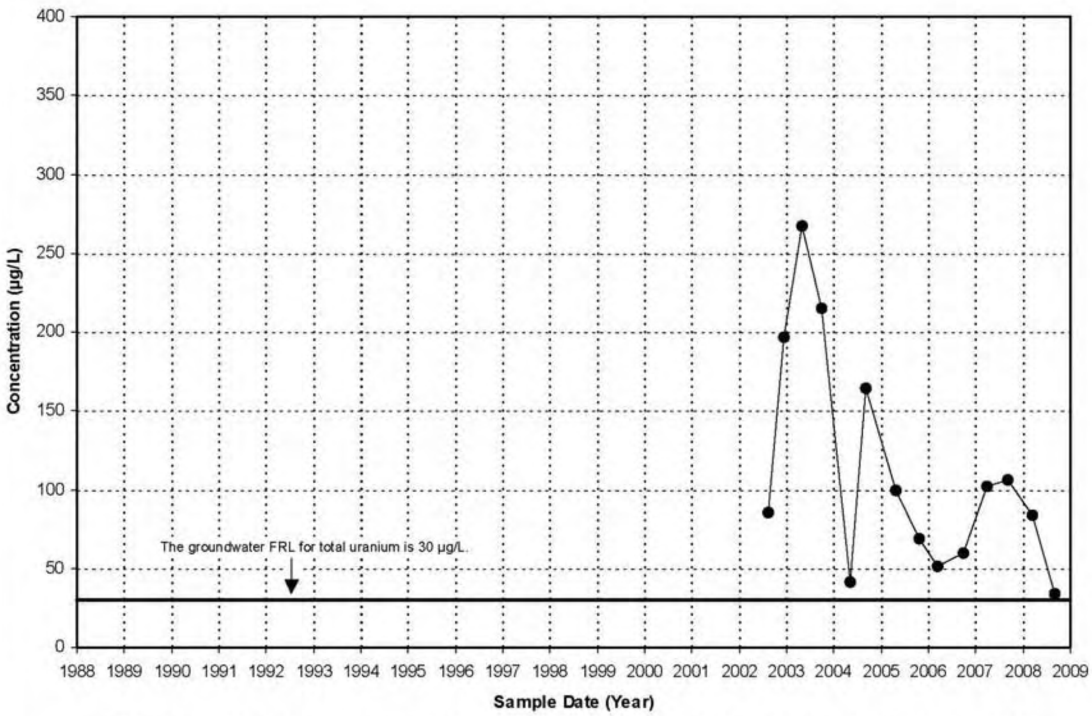


FIGURE A.2-135. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63288

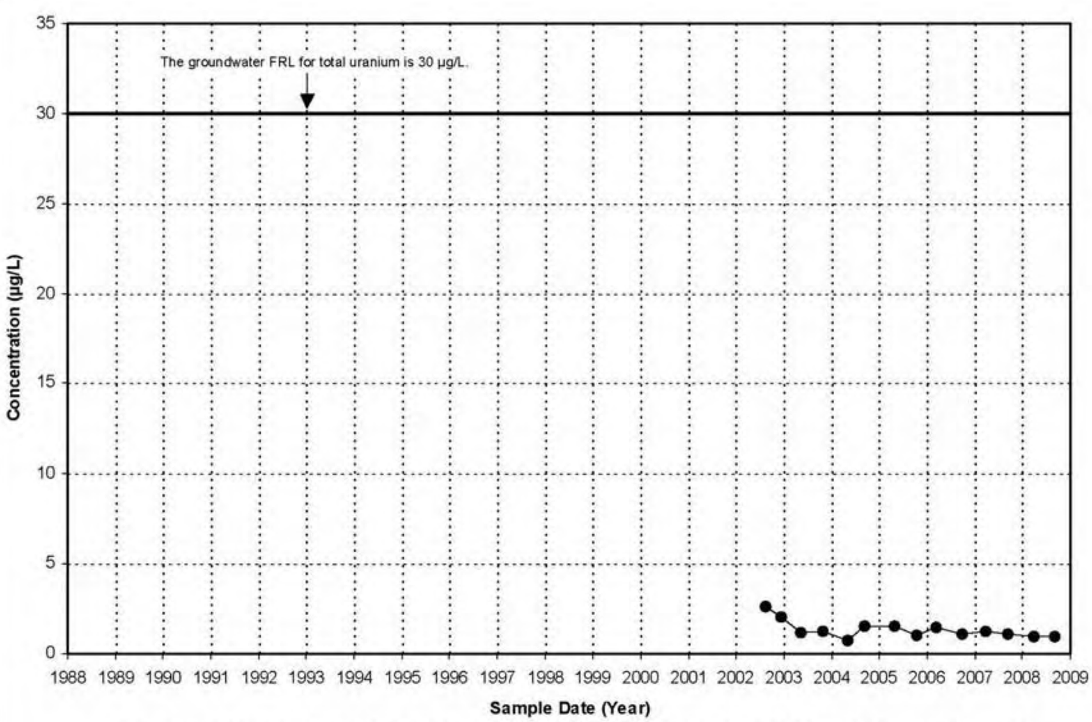


FIGURE A.2-136. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63289

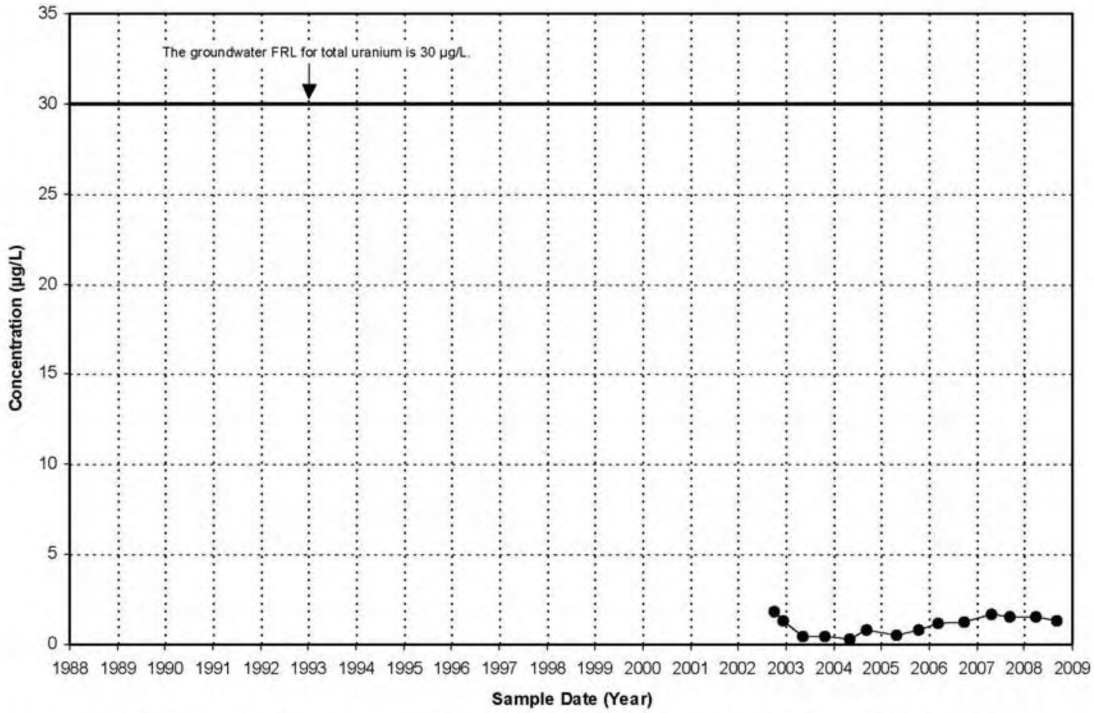


FIGURE A.2-137. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63290

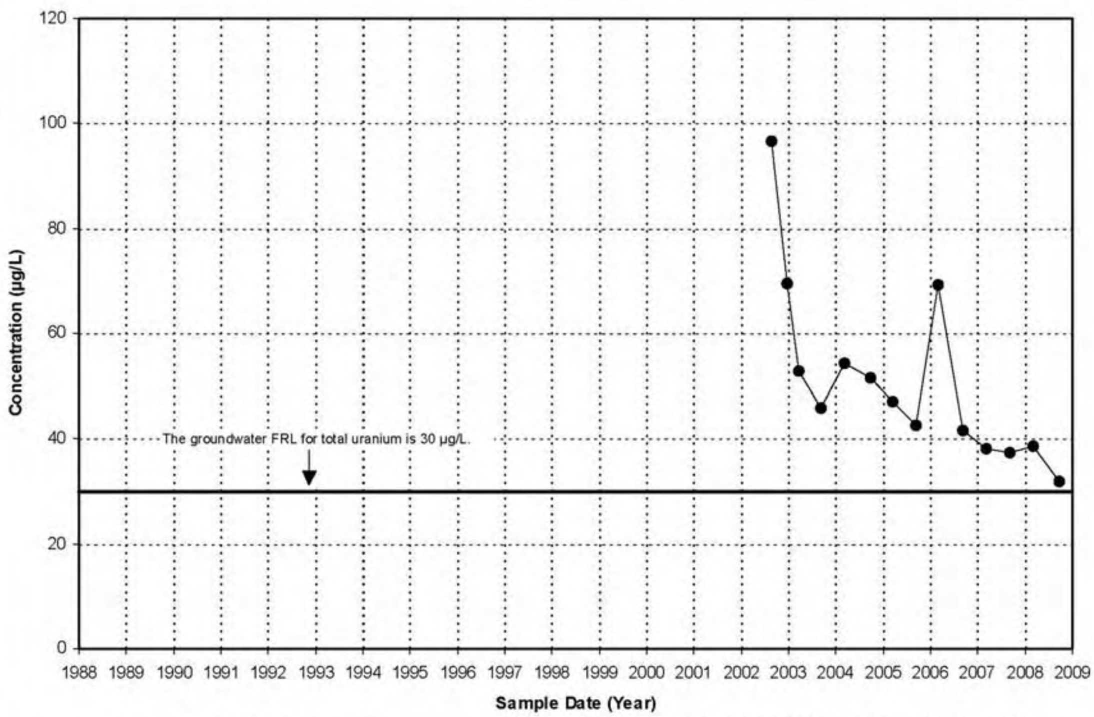


FIGURE A.2-138. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63291

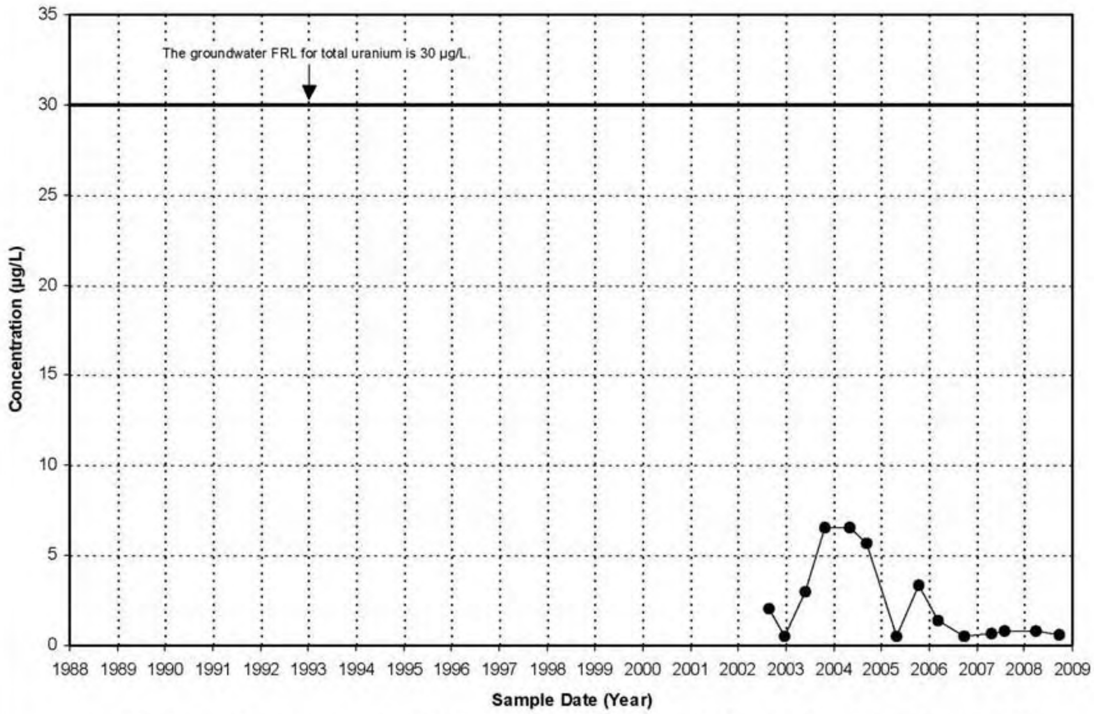


FIGURE A.2-139. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63292

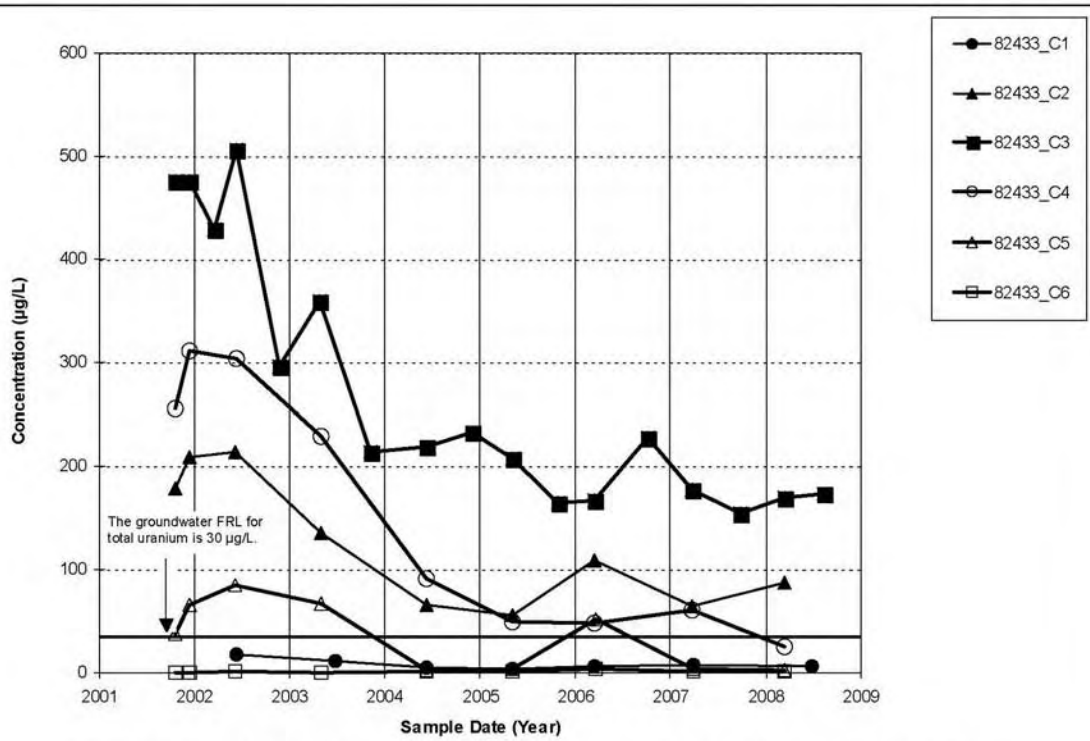


FIGURE A.2-140. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 82433

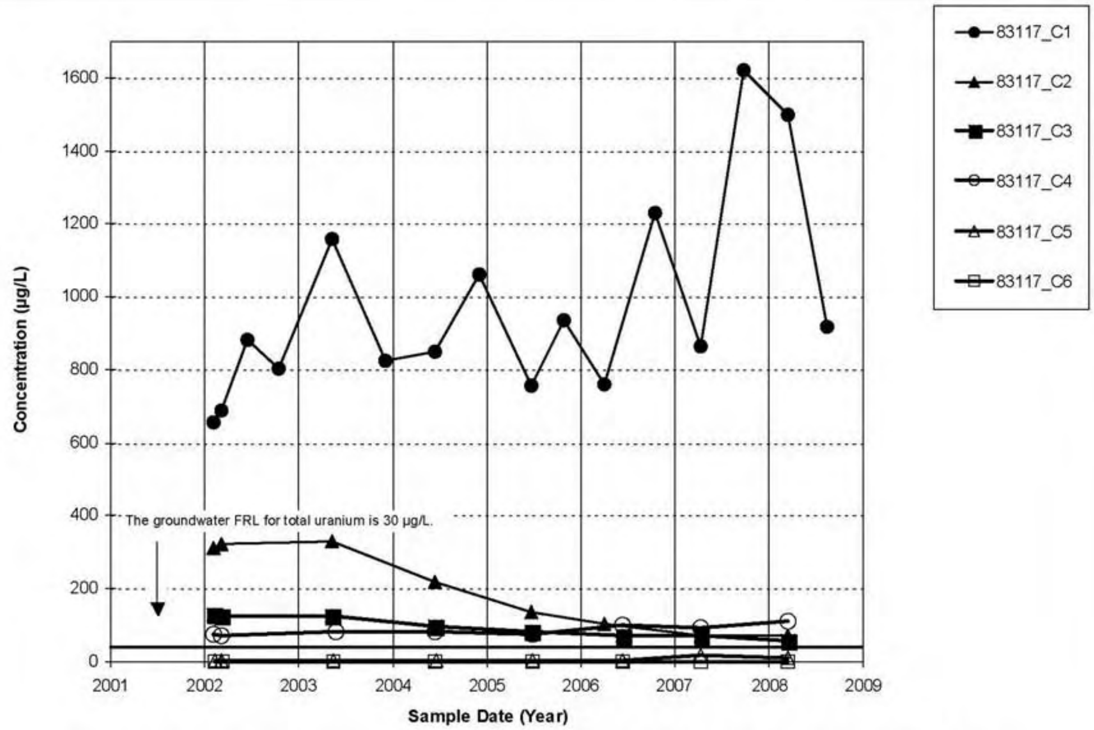


FIGURE A.2-141. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83117

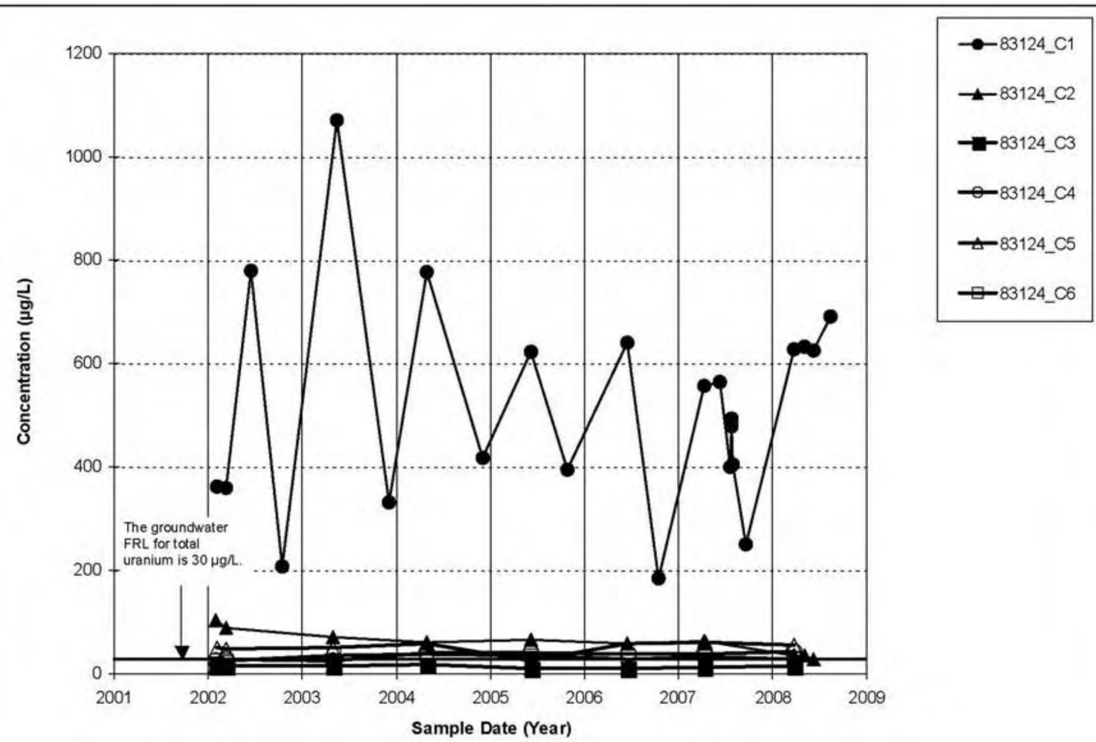


FIGURE A.2-142. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83124

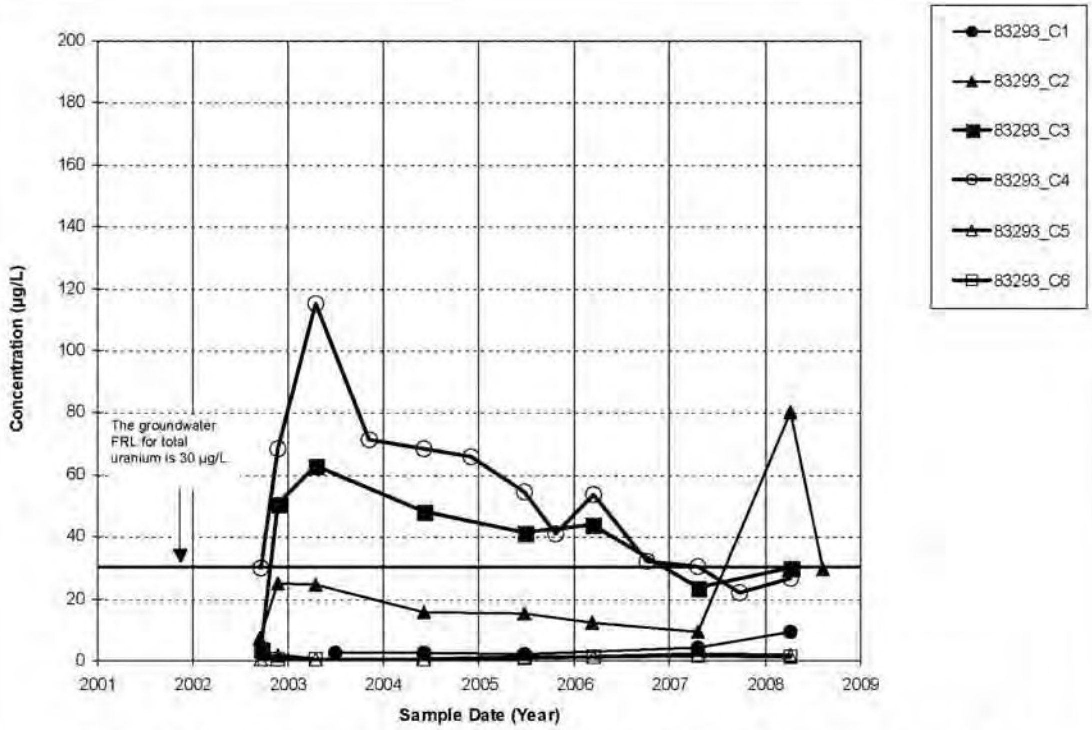


FIGURE A.2-143. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83293

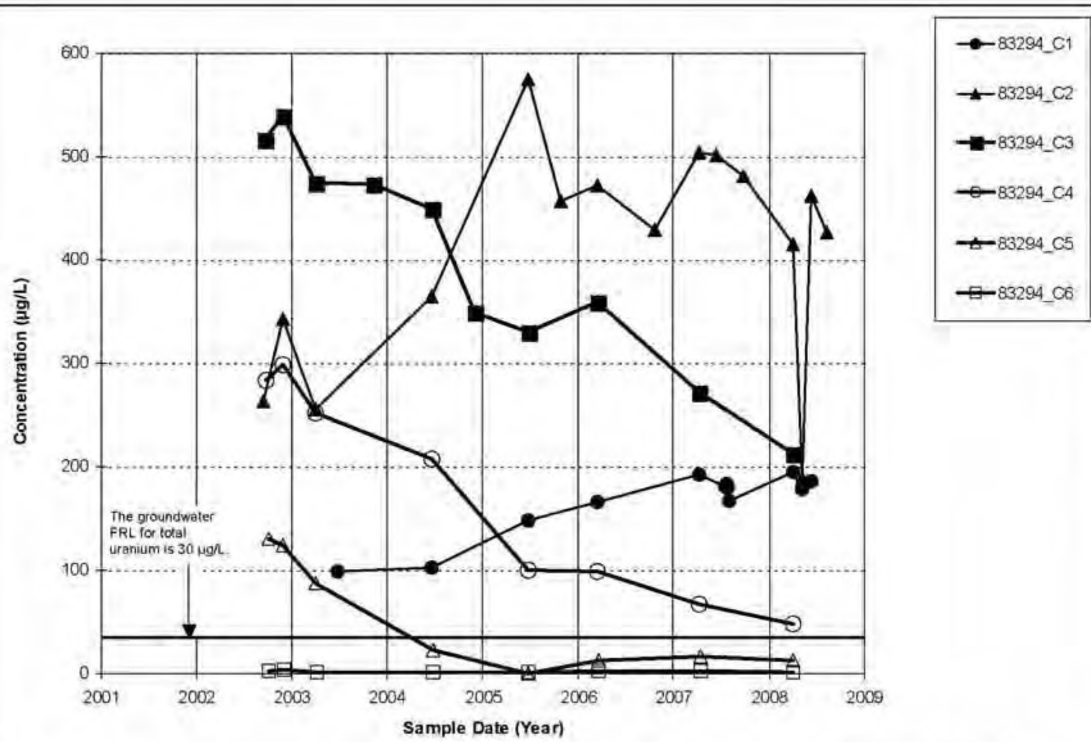


FIGURE A.2-144. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83294

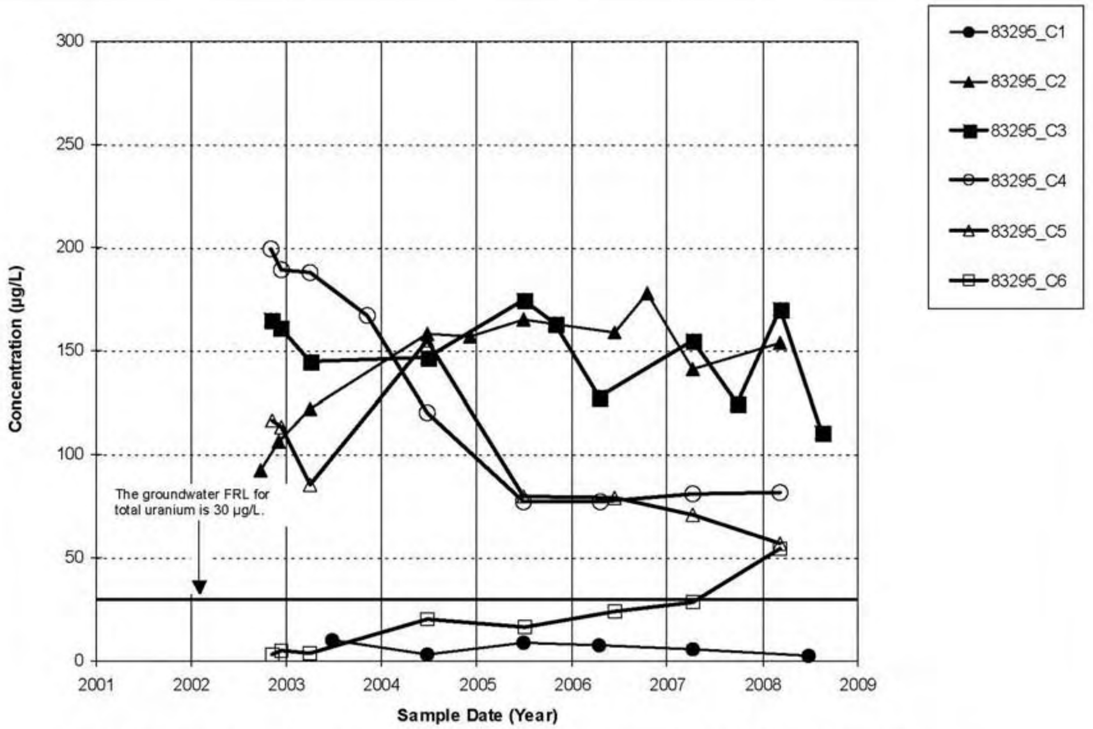


FIGURE A.2-145. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83295

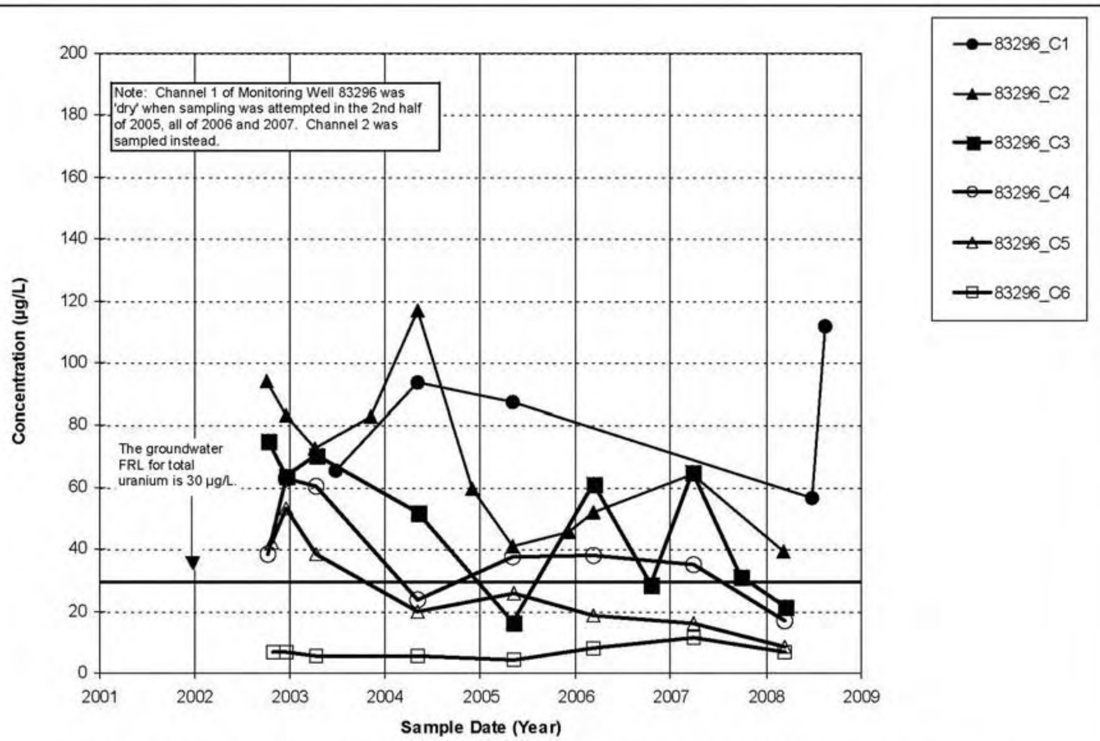


FIGURE A.2-146. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83296

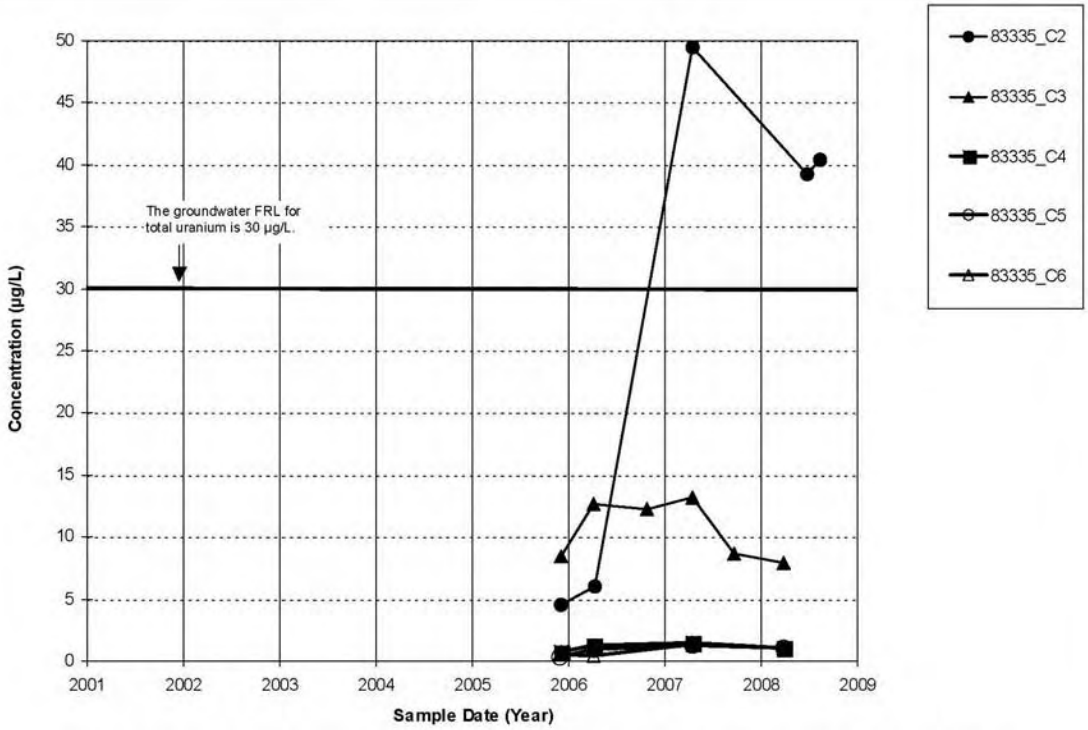


FIGURE A.2-147. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83335

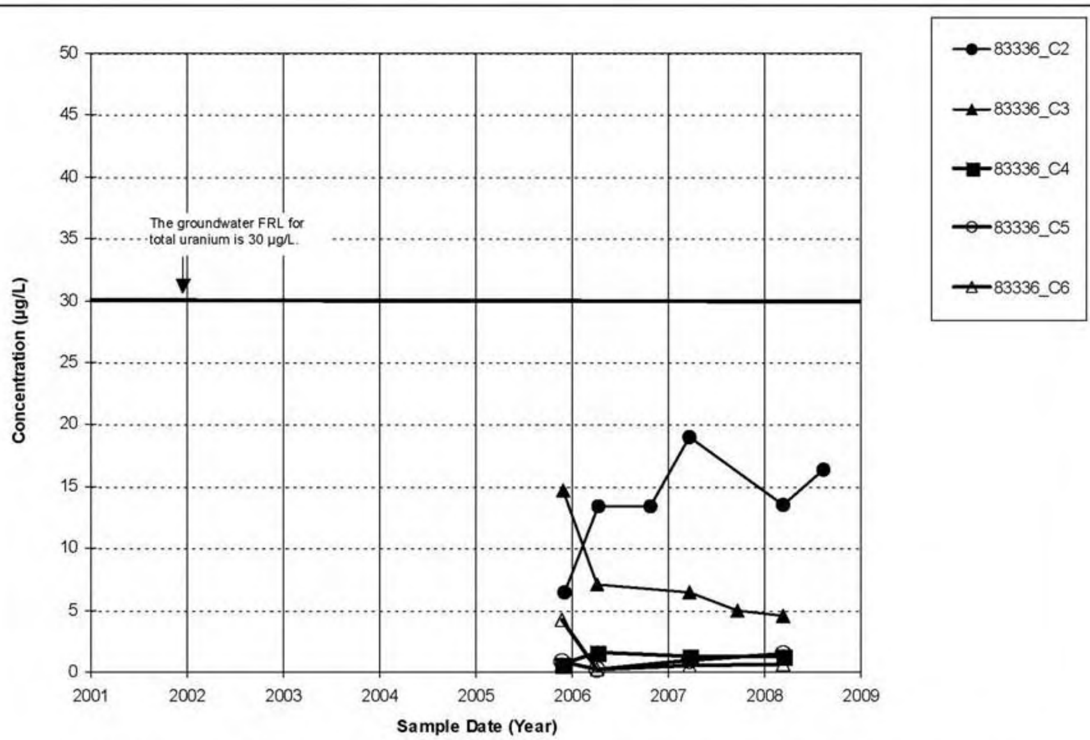


FIGURE A.2-148. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83336

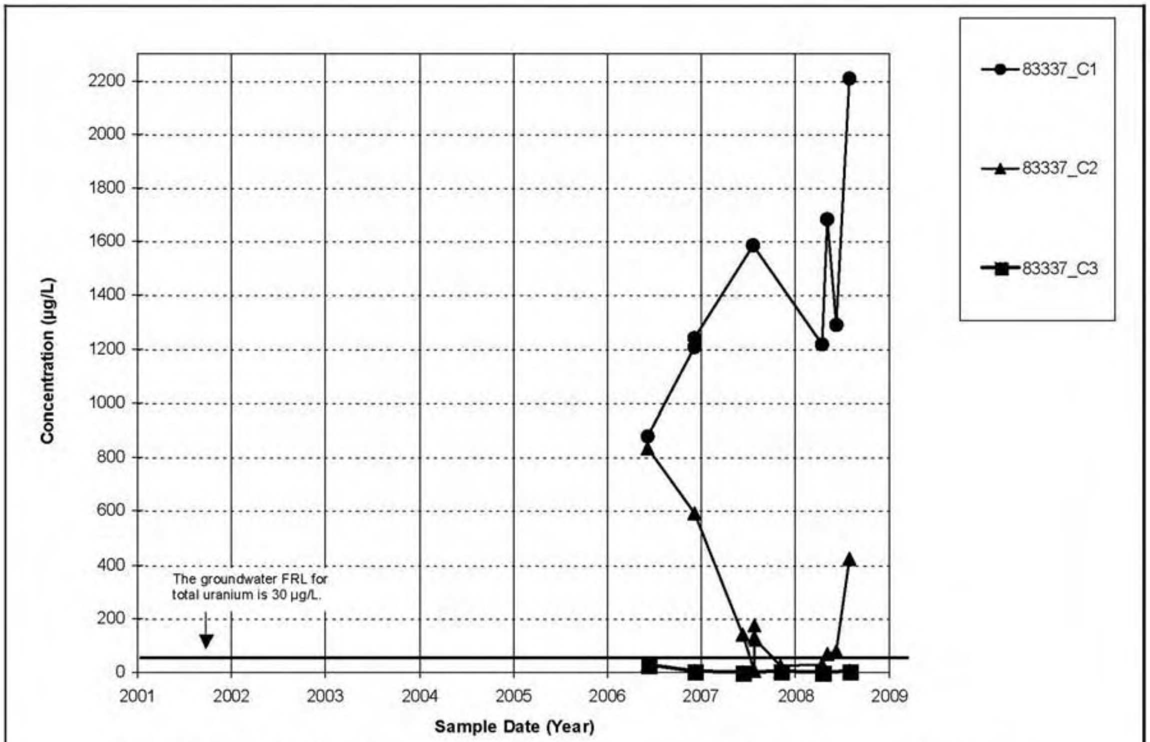


FIGURE A.2-149. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83337

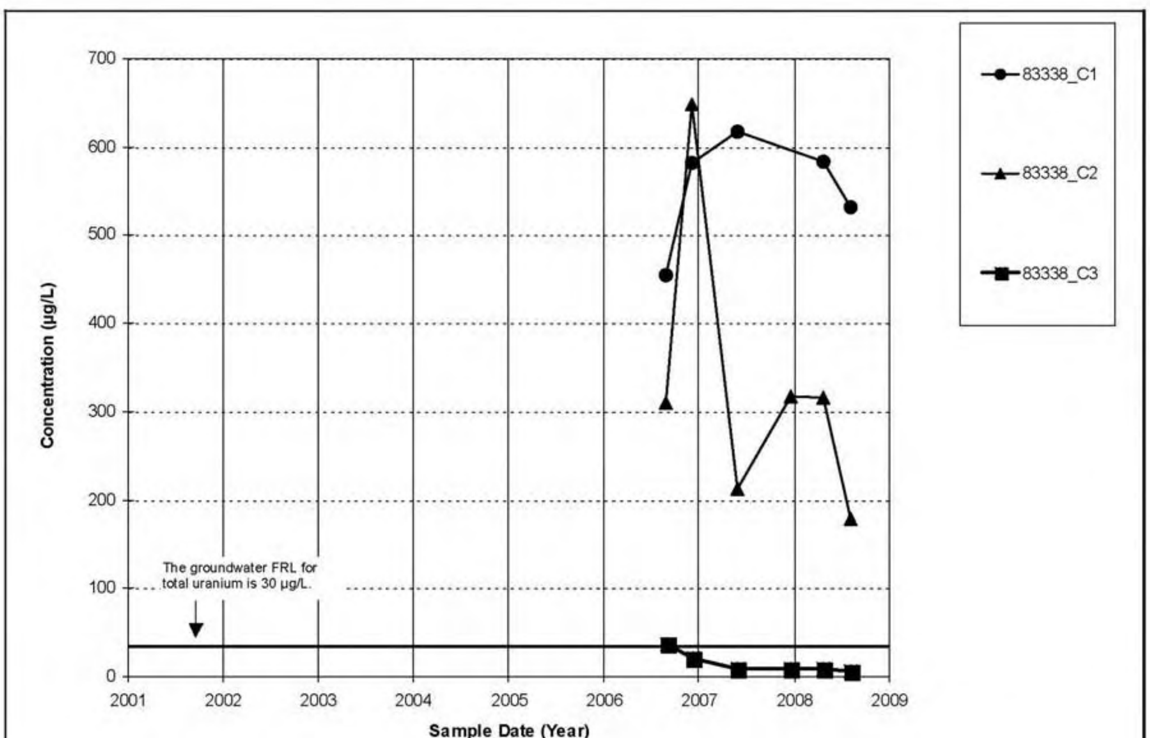


FIGURE A.2-150. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83338

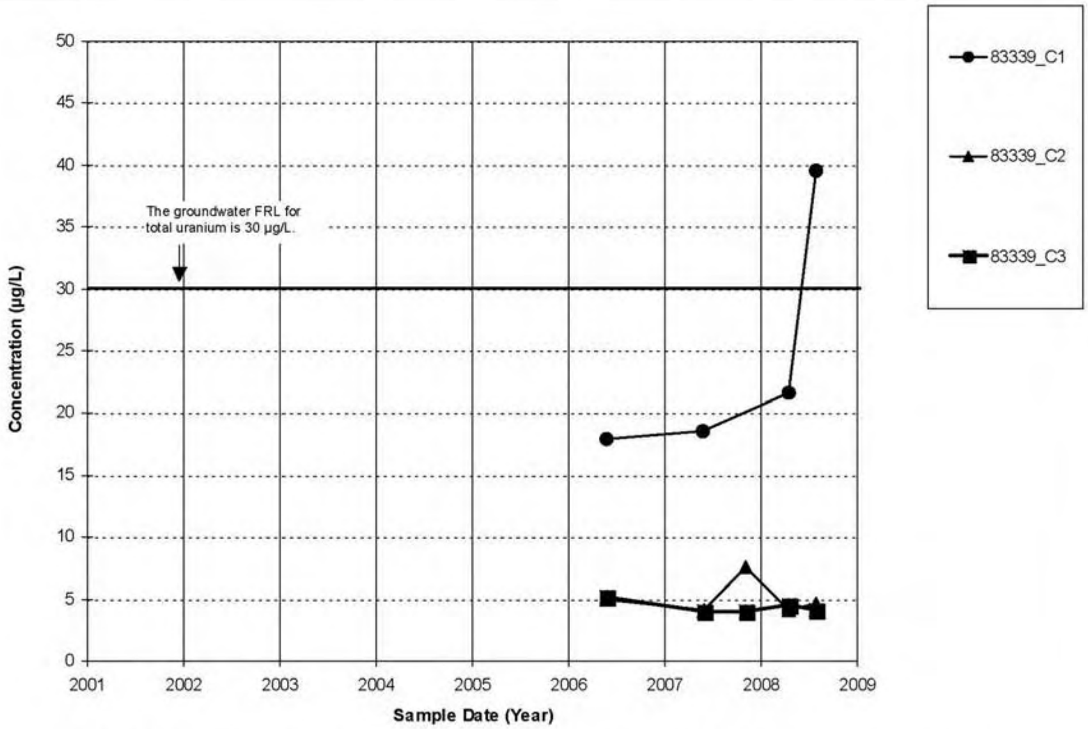


FIGURE A.2-151. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83339

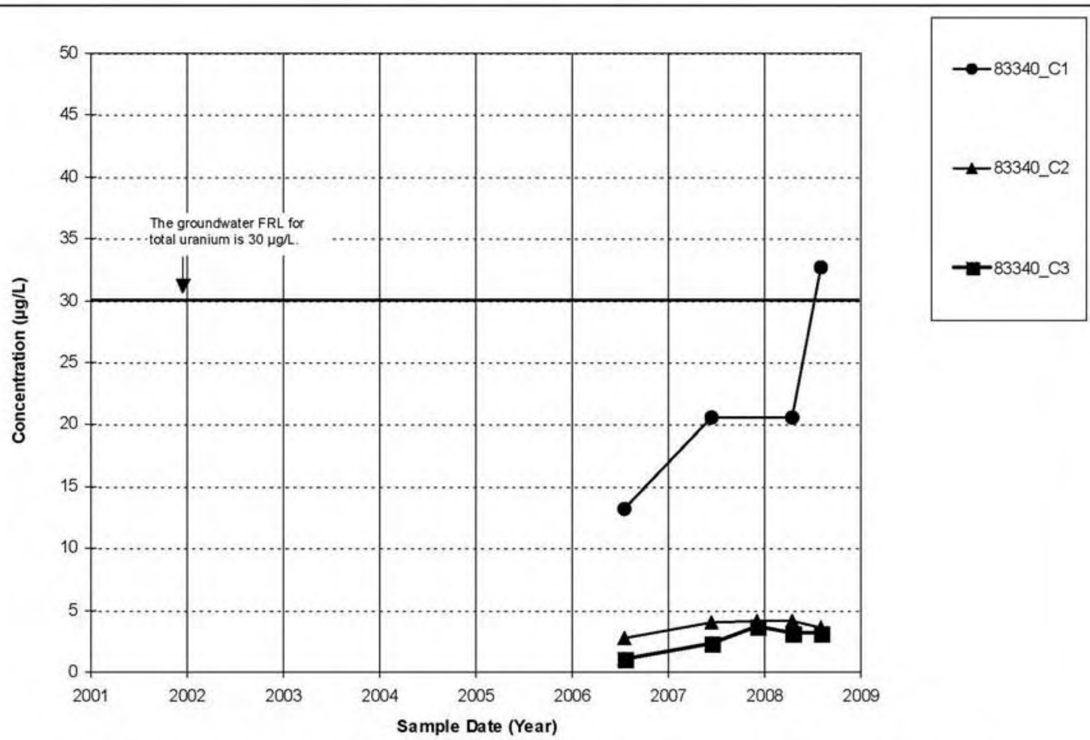


FIGURE A.2-152. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83340

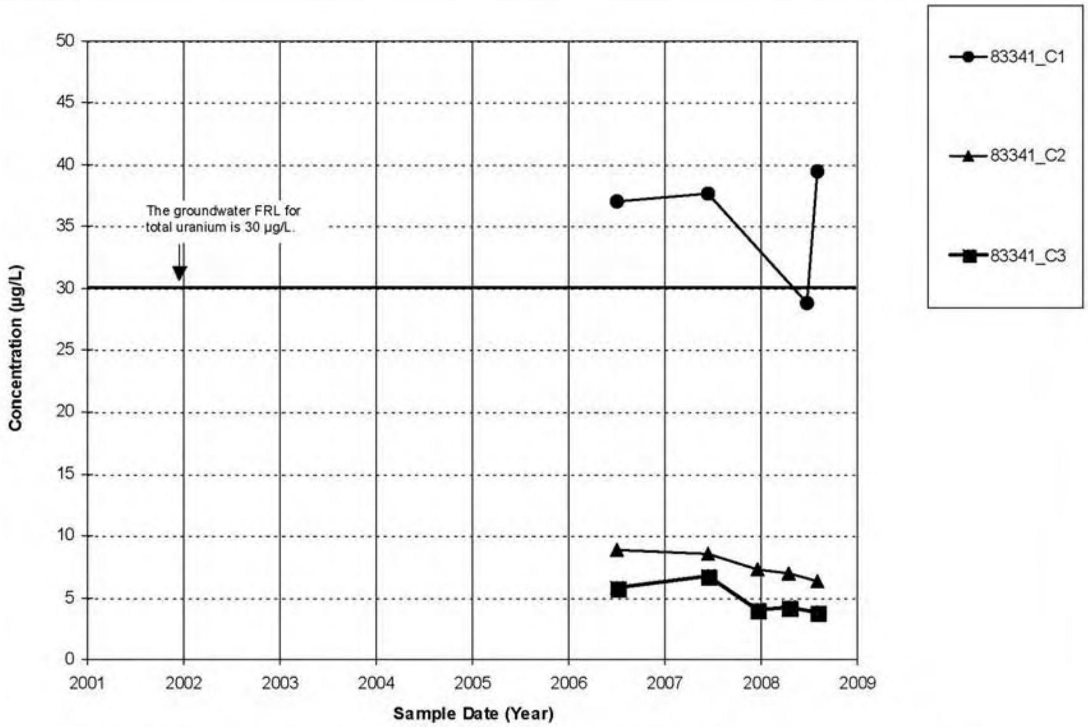


FIGURE A.2-153. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83341

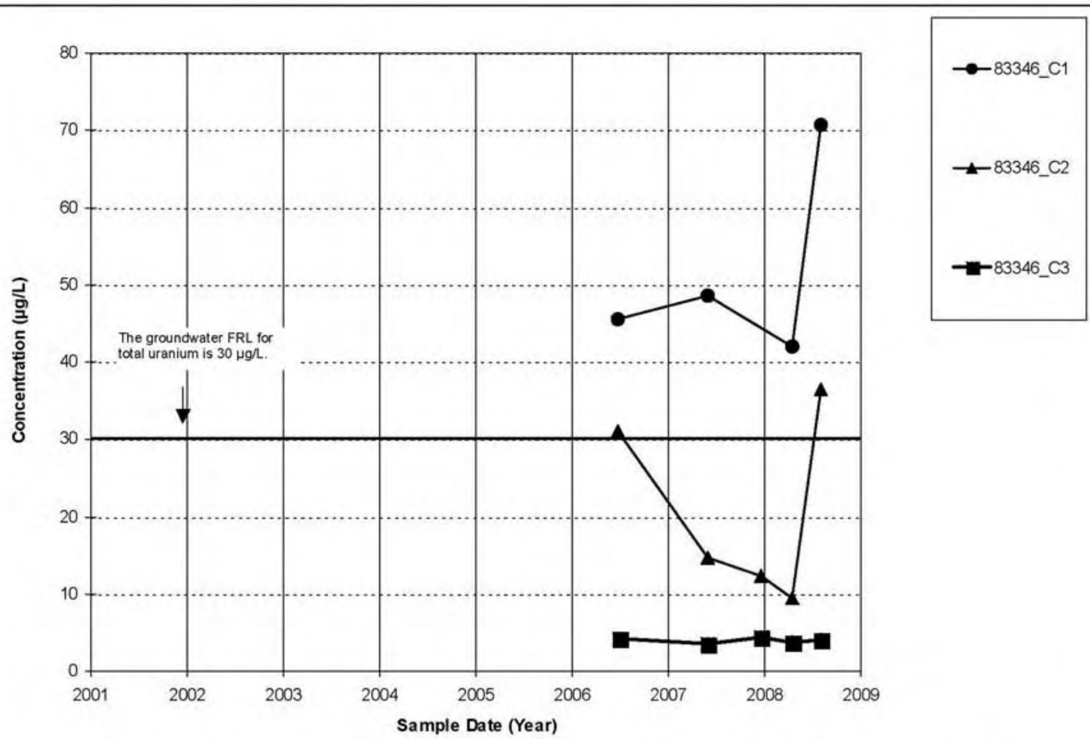


FIGURE A.2-154. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83346

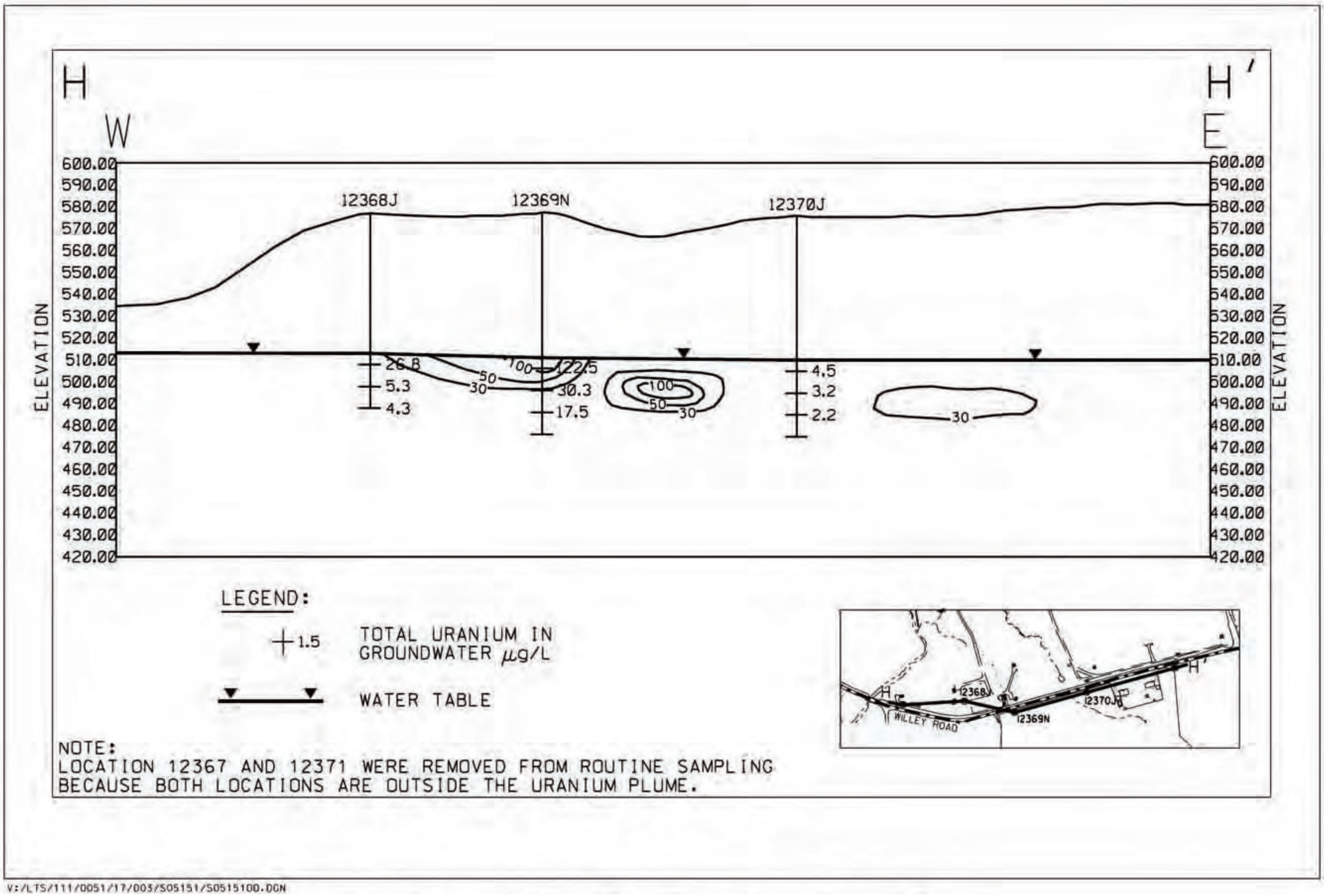


Figure A.2−155. Total Uranium in Groundwater (2008) South of Former Re-injection Wells

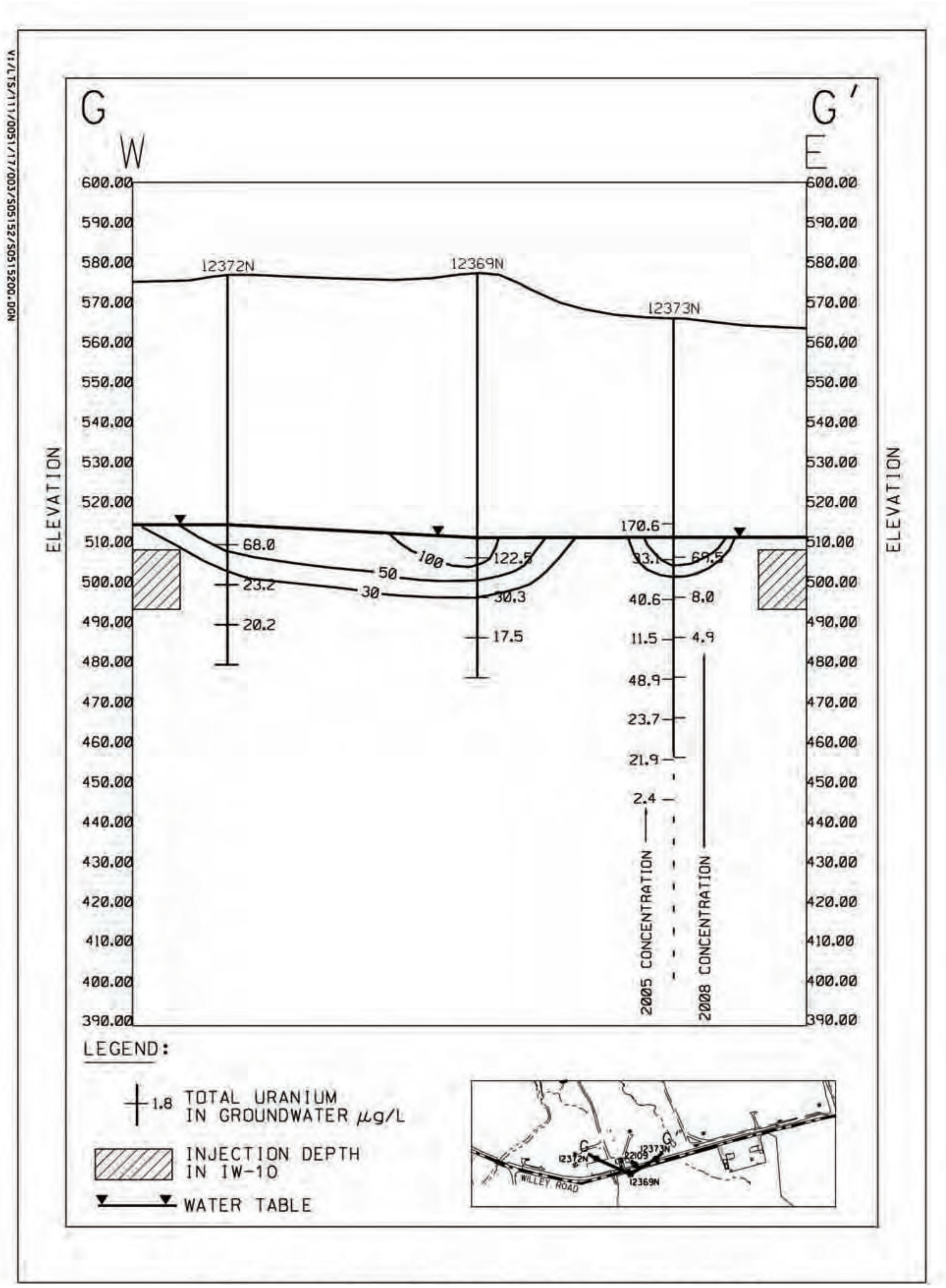


Figure A.2−156. Total Uranium in Groundwater (2008) Next to and South of IW−10

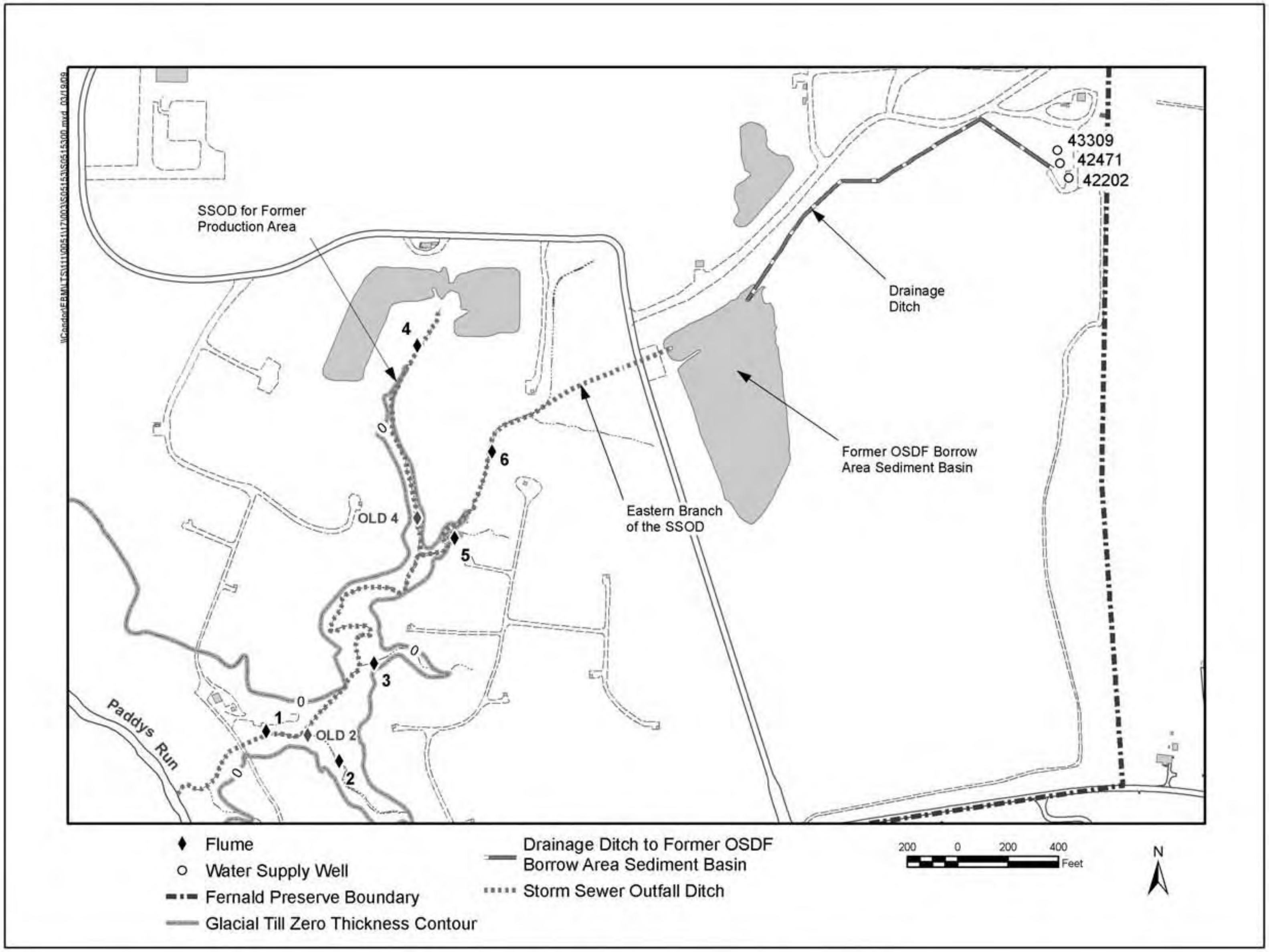


Figure A.2−157. SSOD Flumes and Water Supply Wells

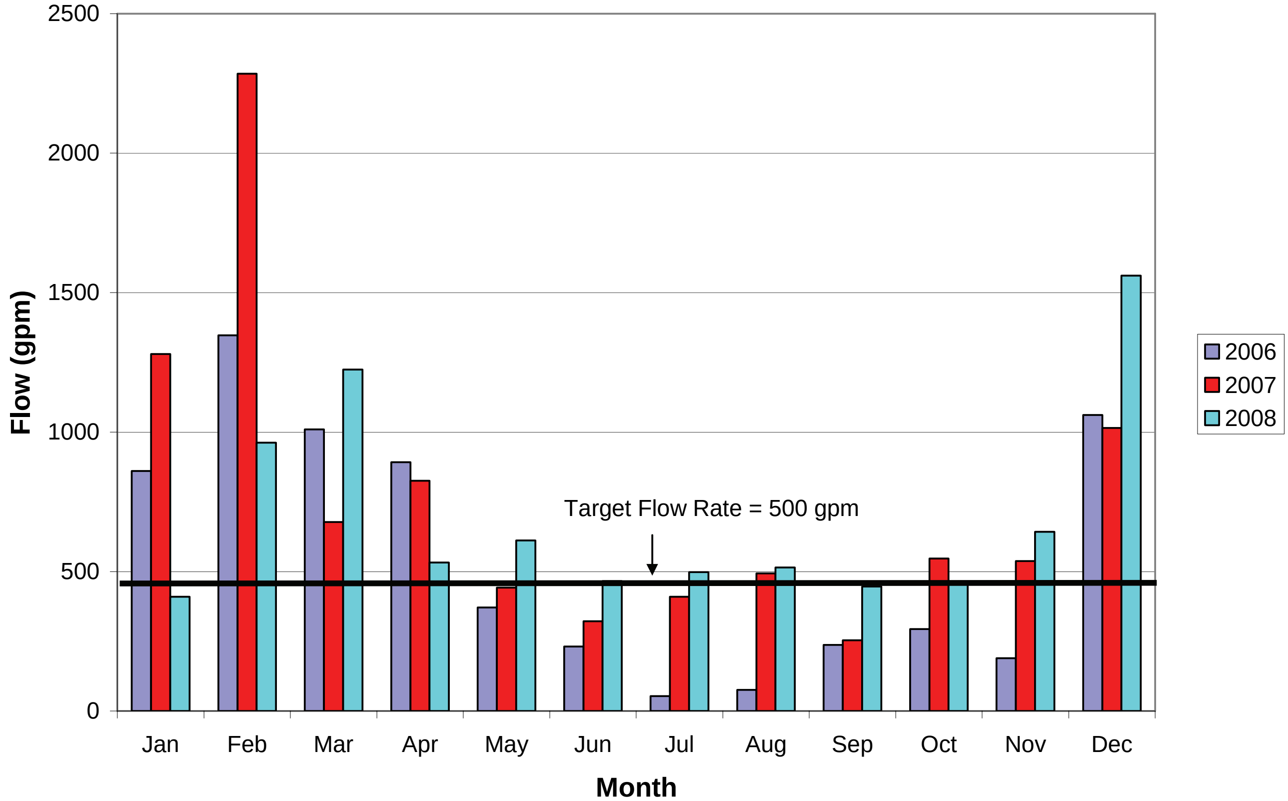


Figure A.2–158 Flow into SSOD: 2006 – 2008

Figure A.2−159. Flume 2

Figure A.2−160. Flume 4

Attachment A.3

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A.3.0 Groundwater Elevations and Capture Assessment

A.3.1 Groundwater Elevations and Capture Assessment

This section discusses groundwater elevation and capture assessment. Quarterly groundwater elevation maps for 2008 are provided in Figures A.3−1 through A.3−4. Each groundwater elevation map contains the following quarter-specific information:

- Groundwater elevation data and resulting water-table contours.
- Interpreted capture zones and flow divides.
- Bedrock highs.
- Waste Storage Area (Phase II) Design particle track remediation footprint.
- Extent of the maximum 30 μg/L total uranium plume.
- Module specific pumping rates during the time period in which the groundwater elevation measurements were collected.

Water levels in 2008 were measured at 178 locations, as specified in the "Integrated Environmental Monitoring Plan" (IEMP) which is Attachment D of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2008). Measurements were collected over a time period of 2 to 3 days, as noted below.

Quarter	Measurement Dates	Number of Days	Average Water Level (ft amsl)
1	1/7/08 to 1/9/08	3	514.07
2	4/8/08 to 4/9/08	2	519.39
3	7/7/08 to 7/9/08	3	519.23
4	10/6/08 to 10/7/08	2	515.55

amsl = above mean sea level

Thirteen monitoring wells were not measured at various times in 2008 because the wells were either dry or not accessible. A summary is provided below.

Well	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
2014	Dry			Dry
2098				Not Accessible
2544	Dry			
2625	Dry			Dry
2636	Dry			Dry
21192	Dry			Dry
83117_C1				Dry
83335_C1		Dry	Dry	Dry
83336_C1		Dry	Dry	Dry
83337_C1				Dry
83338_C1				Dry
83340_C1				Dry
83341_C1				Dry

Unplanned operational disruptions in 2008 were minimal. The entire well field (excluding the South Plume Recovery Wells) was shut down twice in 2008 for a total of 30 days from April 21 to May 6 and May 26 to June 10 as planned to allow water levels to recover to non-pumping elevations.

The number of wells pumping in each restoration module, the average pumping rate for each restoration module, and water levels are indicated on the quarterly water level maps (i.e., Figures A.3−1 through A.3−4). Information on the figures indicates that extraction wells were sometimes turned off and on during the time period that water levels were collected. An example of this is water level measurements collected during the first quarter of 2008 from January 7 through January 9 (refer to Figure A.3−1). The number of extraction wells pumping in the South Field went from 13 to 12 during this time period. This is noted on Figure A.3–1 by "13/12" for the South Field extraction operational status. The pumping rates on the figures are averages of the actual pumping rates during the measurement period. Operational disruptions and pumping rate changes impact water levels and are avoided as much as possible during measurement periods. Routine quarterly water level measurements were not collected in 2008 during the planned shutdowns.

The 2008 quarterly groundwater elevation maps shown in Figures A.3–1 through A.3–4 illustrate capture of the maximum total uranium plume by means of capture zones interpreted from quarterly water level measurements; predicted capture based on Waste Storage Area (Phase II) design particle track modeling; and groundwater elevation contour lines.

The Waste Storage Area (Phase II) design remediation footprint used in this report was constructed using reverse, non-retarded, particle path interpretations from the VAM 3D, Zoom Groundwater Model.

Figure A.3−5 shows the resulting particle tracks that were used to define the Waste Storage Area (Phase II) design remediation footprint. Model particles were seeded at each extraction well. The resulting particle tracks represent the individual path that each particle traveled over the time period modeled for the Waste Storage Area (Phase II) design (2007 to 2023). The limits of most of the particle tracks are truncated because the particles reached the edge of the Zoom Groundwater Model domain.

The groundwater flow divide between Paddys Run Outlet and the New Baltimore Outlet was not readily distinguishable for most of 2008. Flow is obviously dividing around the bedrock high that separates the Paddys Run Outlet from the New Baltimore Outlet but without additional measurement locations in the New Baltimore Outlet the location where flow is dividing is not apparent. The quarterly capture zone interpretations coupled with the Waste Storage Area (Phase II) particle track interpretations and contoured water table gradients indicate that the 30-µg/L total uranium plume was being captured in 2008.

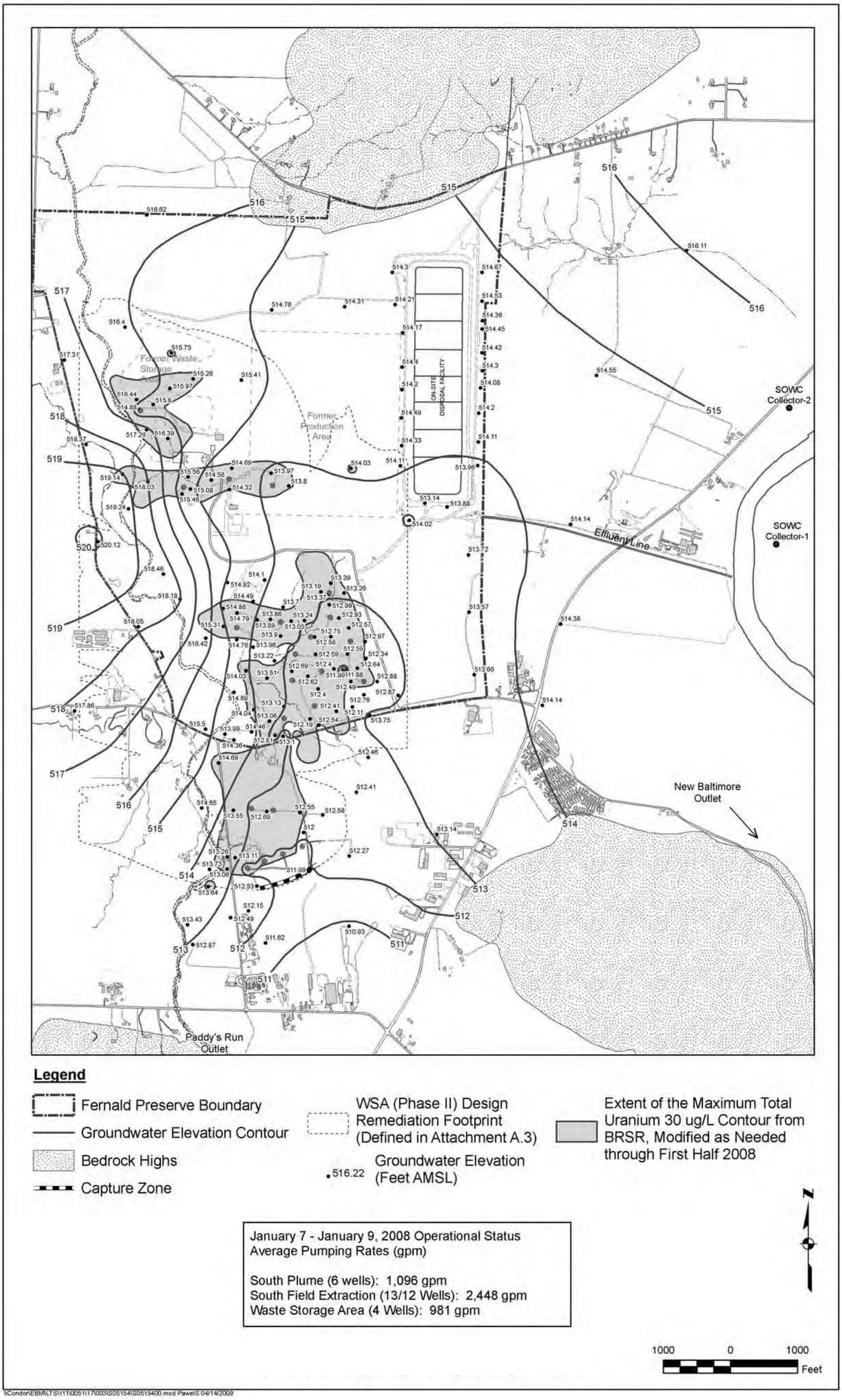

Figure A.3−1. Routine Groundwater Elevation Map, First Quarter 2008 (January 7 through January 9, 2007)

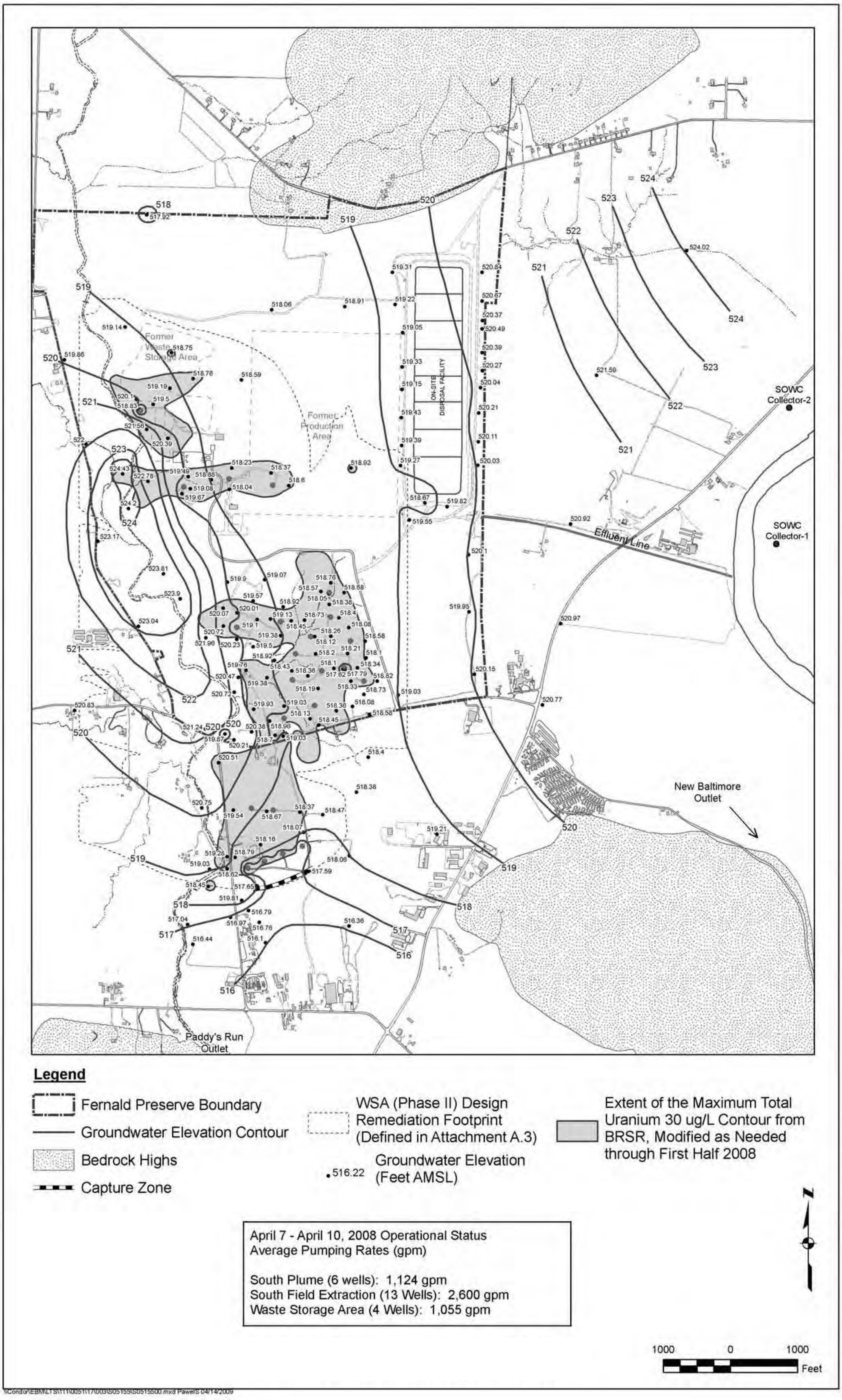

Figure A.3−2. Routine Groundwater Elevation Map, Second Quarter 2008 (April 7 through April 10, 2008)

Figure A.3−3. Routine Groundwater Elevation Map, Third Quarter 2008 (July 7 through July 9, 2008)

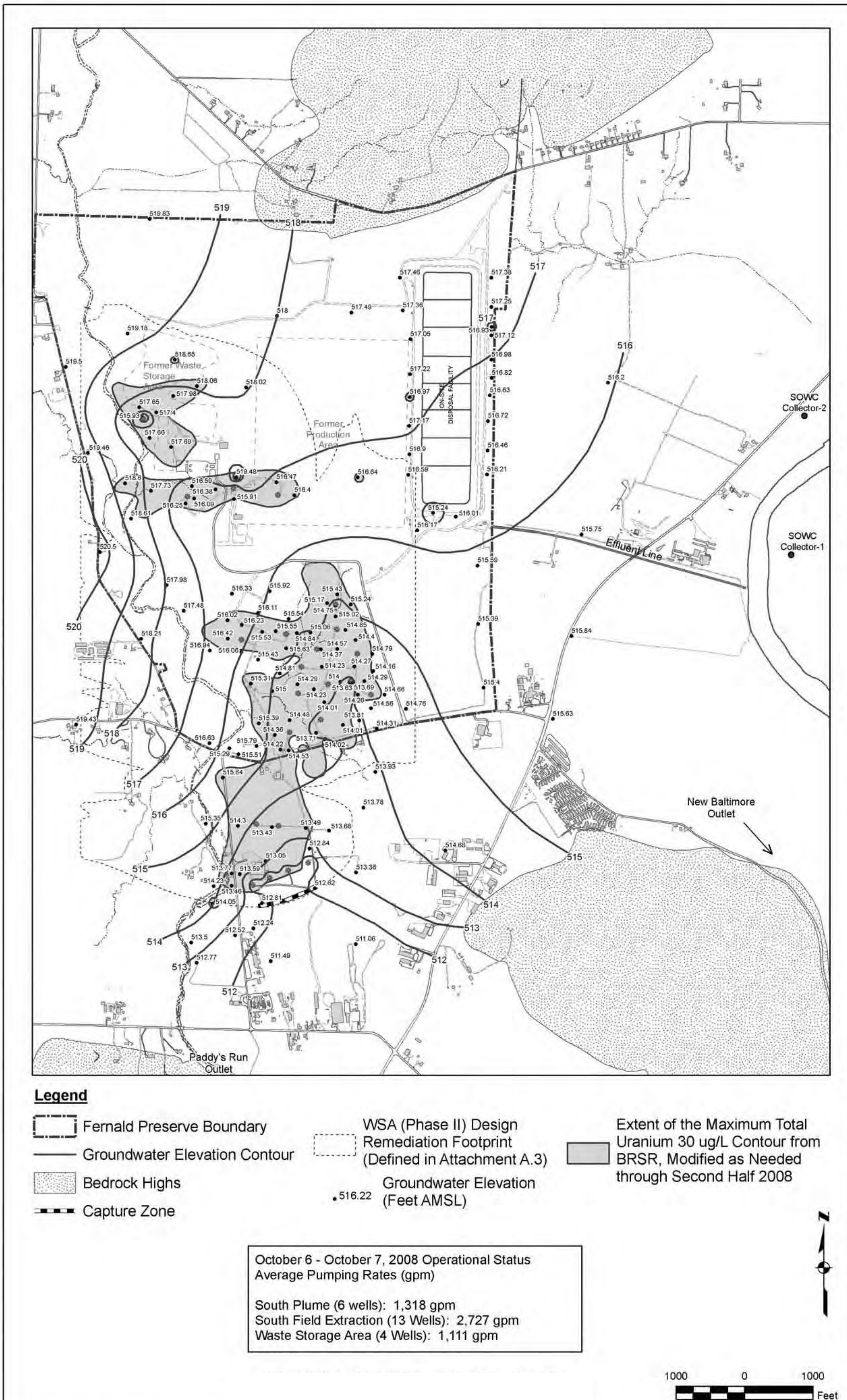

Figure A.3−4. Routine Groundwater Elevation Map, Fourth Quarter 2008 (October 6 through October 7, 2008)

Average annual water table fluctuations and yearly ranges for 2006 through 2008 are as follows:

Year	Average Fluctuation (ft)	Range (ft)
2008	5.7	1.0 to 10.46
2007	4.45	1.7 to 7.7
2006	3.4	2.0 to 7.1

Well cluster hydrographs are also provided in this attachment as a means to assess vertical groundwater gradients. The hydrographs depict groundwater elevations available from 1993 through 2008 from Type 2 and Type 3 wells in the same cluster. Hydrographs for the following monitoring well clusters appear in Figures A.3−6 through A.3−27: 014, 017, 045, 046, 049, 065, 069 (434), 095, 106, 125, 385, 387, 390, 396, 398, 402, 550, 552, 821, 880, 881, and 900. (Note: The last three digits of the monitoring wells identify the well clusters, e.g., cluster 552 consists of monitoring wells 2552 and 3552). Figure A.3−28 identifies the well cluster locations.

Analysis of these hydrographs for 2008 indicates that elevations in the Type 2 and Type 3 monitoring wells within the majority of the clusters are almost always identical for each measurement event. An occasional slight difference can be seen, but these differences do not appear to be indicative of vertical hydraulic gradients. Rather, they are attributed to measurement, and/or transcription errors during data collection and processing.

A.3.2 Annual Planned Well Field Shutdown

Uranium contamination is bound to aquifer sediments in the unsaturated portion of the GMA beneath former contamination source areas. This contamination will remain bound unless water levels in the aquifer rise, saturate the contaminated sediments, and allow the bound contamination to dissolve into the groundwater.

Annual well field shutdowns are conducted to allow water levels in the aquifer to rise as high as possible and saturate some of the aquifer material that is not normally saturated. To achieve the highest water level rise possible, the well field shutdowns are planned to coincide with seasonal high water levels in the aquifer. The first planned shutdown was conducted in 2007.

The planned shutdown in 2008 was conducted in two 15-day phases. The first planned shutdown ran from April 21 to May 6 (approximately 15 days) and the second planned shutdown ran from May 26 to June 10 (approximately 15 days.). The second shutdown was conducted because seasonal water levels were still rising after the first shutdown.

In 2007, the planned shutdown, which took place in June and July, did not coincide with seasonal high water levels as planned because precipitation in 2007 was lower than normal, resulting in seasonal high water levels in the aquifer occurring earlier in the year. Water levels in the aquifer were falling by June 2007. The planned shutdown in 2008 was therefore pushed forward into late April so that it would better coincide with rising seasonal water levels in the aquifer.

Moving the 2008 planned shutdown into late April successfully coordinated the shutdown with seasonal high water levels, which were boosted in 2008 by higher than average precipitation levels in March. Figure A.3-29 shows cumulative precipitation levels from 2004 through 2008, as recorded at the Butler County Regional Airport. Cumulative precipitation in 2008 was approximately 43.68 inches, 6.29 inches more than the cumulative reported for 2007 (37.39 inches).

Water Level Measurements and Sampling

Pressure transducers were installed in six groundwater monitoring wells (2045, 2046, 2649, 23274, 62433, and 32763) for the first shutdown, and 11 groundwater monitoring wells (2045, 2046, 2649, 23274, 62433, 32763, 23118, 22301, 22302, 22303, and 63119) for the second shutdown (Figure A.3-30). Water level measurements were recorded at the top of each hour.

Uranium concentrations were measured in six groundwater monitoring wells (2045, 2046, 23274, 83124, 83294, and 83337) [Figure A.3–31]. The results of the 2008 IEMP first-half uranium sampling is used to represent uranium concentrations in the well prior to the shutdown. Groundwater samples were collected prior to the well field being restarted (May 5 and June 9, accordingly). The results of the 2008 IEMP second-half uranium sampling is used to represent uranium concentrations in the well after the shutdown exercises were completed.

Uranium concentrations were also measured daily for 3 days in the extraction wells after the wells were restarted (Tables A.3-2A, and A.3-2B). The first water sample was collected after the well had been pumping for approximately 5 minutes.

Water Level Results

The zero hour transducer readings (midnight) were used to illustrate water level changes in the transducer wells during the shutdown periods. The maximum water level rise measured during each shutdown in 2008 at each transducer was as follows:

<u>First Shutdown</u>

Location	Just Prior to Shutdown 4/20/2009	Just Prior to Re-start 5/6/2009	Water Level Rise (ft)
32763	519.96	522.28	2.32
62433	518.09	520.10	2.01
2649	520.25	522.17	1.92
23274	518.68	520.14	1.46
2045	519.65	520.15	0.50
2046	520.04	520.27	0.23

Second Shutdown

Location	Just Prior to Shutdown 5/26/08	Just Prior to Re-start 6/10/08	Water Level Rise (ft)
2045	520.74	523.21	2.47
2046	518.15	520.57	2.42
2649	521.69	523.58	1.89
23274	519.06	520.69	1.63
63119	519.90	521.53	1.63
22302	518.44	520.05	1.61
23118	520.22	521.73	1.51
22301	519.11	520.47	1.36
22303	518.56	519.85	1.29
32763	520.02	521.09	1.07
62433	520.39	521.33	0.94

The water level rise calculations indicate that during the shutdown periods the water level rise at the transducer wells ranged from 0.23 ft to 2.47 ft.

Figure A.3-32 shows water levels verses precipitation from May 25, 2007 through February 2, 2009. The figure illustrates that water levels were higher in 2008 during the shutdown periods compared to 2007. The combination of the shutdown and seasonal water level rise in 2008 resulted in a water level that was:

- Approximately 4 ft higher in the former waste storage area compared to 2007 (Monitoring Well 2649);
- Approximately 3 ft higher in the west side of the South Field compared to 2007 (Monitoring Well 2046); and
- Approximately 2.94 ft higher in the east side of the South Field compared to 2007 (Monitoring Well 62433).

Uranium Concentration Results

Uranium concentration measurements collected at six monitoring wells before, during and after the 2008 shutdowns are provided in Table A.3–1. The two shallowest channels (Channels 1 and 2) of Type-8 wells were sampled.

Uranium concentrations measured during the first half of 2008, prior to the first shutdown, are used to represent pre-shutdown concentrations in the monitoring wells. Uranium concentrations measured during the second half of 2008, after the second shutdown, are used to represent post-shutdown concentrations in the monitoring wells.

The uranium concentration data collected in the monitoring wells reveals mixed results. In some wells uranium concentrations during the shutdowns increased (i.e., 2046, 23274, 8337_C1) in other wells the uranium concentrations during the shutdowns decreased (i.e. 2045, 83294_C1).

Uranium concentrations were also measured at extraction wells before, and after the planned shutdowns. Results are provided in Tables A.3–2A and A.3–2B. The last column of each table

Table A.3–1. Uranium Concentrations at Monitoring Wells Before, During, and After the Two System Shutdowns in 2008

Well	Easting	Northing	First Half 2008 Pre-Shutdown		1st Shutdown Pre-Startup 5/5/2008	2nd Shutdown Pre-Startup 6/9/2008	Second Half 2008 Post-Shutdown	
			Date	U Conc (ug/L)	U Conc (ug/L)		Date	U Conc (ug/L)
2045	1348291.0	477158.9	3/24/2008	116.0	109.8	63.1	7/28/2008	73.5
2046	1347949.7	478087.8	3/12/2008	41.0	47.9	53.8	9/16/2008	72.9
23274	1349406.0	478337.0	3/11/2008	210.0	242.4	384.2	9/17/2008	187.0
83124_C1	1346826.3	479977.2	3/24/2008	628.0	632.9	625.6	8/11/2008	691.0
83124_C2	1346826.3	479977.2	3/24/2008	34.9	36.6	27.8		
83294_C1	1349599.5	477189.5	4/2/2008	195.0	178.8	186.7		
83294_C2	1349599.5	477189.5	4/2/2008	415.0	188.1	461.4	8/11/2008	427.0
83337_C1	1346704.3	481051.9	4/15/2008	1220.0	1685.6	1290.5	7/30/2008	2210.0
83337_C2	1346704.3	481051.9	4/15/2008	30.3	68.6	76.1	7/30/2008	420

Table A.3–2A. Uranium Concentrations at Extraction Wells Before and After the First Planned Shutdown

Ext. Well ID	Avg. U Conc. March	U Conc after Re-Start (First Shutdown)[a]						Max after Re-start minus March Avg.
		5/6/2008	5/7/2008	5/8/2008	Min	Max	Range	
	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
RW-01	21.3	20.5	20.5	20.0	20.0	20.5	0.5	-0.8
RW-02	19.3	20.4	21.7	20.2	20.2	21.7	1.5	2.4
RW-03	29.0	30.4	30.4	29.1	29.1	30.4	1.3	1.4
RW-04	4.3	4.0	3.8	3.7	3.7	4.0	0.3	-0.3
RW-06	45.3	47.4	44.4	41.8	41.8	47.4	5.6	2.1
RW-07	41.1	39.5	41.8	39.6	39.5	41.8	2.3	0.7
EW-15a	41.9	50.3	49.0	44.5	44.5	50.3	5.8	8.4
EW-17a	28.9	34.1	31.6	31.0	31.0	34.1	3.1	5.2
EW-18	50.1	46.4	48.3	45.6	45.6	48.3	2.7	-1.8
EW-19	35.9	37.9	39.9	39.6	37.9	39.9	2.0	4.0
EW-20	32.4	27.8	31.7	30.1	27.8	31.7	3.9	-0.7
EW-21a	63.9	74.3	59.7	59.5	59.5	74.3	14.8	10.4
EW-22	47.5	56.3	49.2	47.4	47.4	56.3	8.9	8.8
EW-23	71.5	73.7	73.6	76.1	73.6	76.1	2.5	4.6
EW-24	55.3	53.2	50.3	49.6	49.6	53.2	3.6	-2.1
EW-25	47.4	80.4	54.1	69.5	54.1	80.4	26.3	33.0
EW-26	42.3	49.7	50.4	46.0	46.0	50.4	4.4	8.1
EW-27	49.2	51.3	49.2	54.8	49.2	54.8	5.6	5.6
EW-28a	19.0	15.9	17.0	17.2	15.9	17.2	1.3	-1.8
EW-30	75.9	78.5	72.2	73.1	72.2	78.5	6.3	2.6
EW-31	19.9	21.2	22.1	18.4	18.4	22.1	3.7	2.2
EW-32	10.0	10.2	10.0	9.8	9.8	10.2	0.4	0.2
EW-33a	17.6	16.4	23.0	19.6	16.4	23.0	6.6	5.4

[a]Shading identifies startup concentrations that are higher than or equal to the average concentration in the well prior to the shutdown exercise.

Table A.3–2B. Uranium Concentrations at Extraction Wells Before and After the Second Planned Shutdown

Ext. Well ID	Avg. U Conc. March	U Conc after Re-Start (Second Shutdown)[a]						Max after Re-start minus March Avg.
		6/10/2008	6/11/2008	6/12/2008	Min	Max	Range	
	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
RW-01	21.3	ns	ns	ns	0.0	0.0	0.0	ns
RW-02	19.3	21.0	19.3	19.7	19.3	21.0	1.7	1.7
RW-03	29.0	30.2	29.9	29.1	29.1	30.2	1.1	1.2
RW-04	4.3	3.7	3.4	3.6	3.4	3.7	0.3	-0.6
RW-06	45.3	44.7	42.3	41.5	41.5	44.7	3.2	-0.6
RW-07	41.1	41.5	41.0	40.6	40.6	41.5	0.9	0.4
EW-15a	41.9	45.9	48.0	45.6	45.6	48.0	2.4	6.1
EW-17a	28.9	40.4	31.0	29.2	29.2	40.4	11.2	11.5
EW-18	50.1	47.4	43.4	43.5	43.4	47.4	4.0	-2.7
EW-19	35.9	36.3	39.1	39.8	36.3	39.8	3.5	3.9
EW-20	32.4	26.8	39.1	31.1	26.8	39.1	12.3	6.7
EW-21a	63.9	68.8	62.1	70.7	62.1	70.7	8.6	6.8
EW-22	47.5	57.3	51.5	49.5	49.5	57.3	7.8	9.8
EW-23	71.5	59.7	71.4	66.9	59.7	71.4	11.7	-0.1
EW-24	55.3	51.7	50.9	50.7	50.7	51.7	1.0	-3.6
EW-25	47.4	48.4	76.2	65.1	48.4	76.2	27.8	28.8
EW-26	42.3	55.7	47.3	42.9	42.9	55.7	12.8	13.4
EW-27	49.2	50.8	47.3	49.9	47.3	50.8	3.5	1.6
EW-28a	19.0	17.1	17.2	16.4	16.4	17.2	0.8	-1.8
EW-30	75.9	75.2	77.9	70.2	70.2	77.9	7.7	2.0
EW-31	19.9	19.2	21.5	20.7	19.2	21.5	2.3	1.6
EW-32	10.0	10.3	10.8	9.4	9.4	10.8	1.4	0.8
EW-33a	17.6	ns	ns	ns	0.0	0.0	0.0	na

[a]Shading identifies startup concentrations that are higher than or equal to the average concentration in the well prior to the shutdown exercise.

provides the difference between the maximum uranium concentration measured after the wells were restarted, and the average uranium concentration measured in March at the extraction well. As the data indicates, the uranium concentration increased at most of the wells. The better Extraction Well uranium increases appear to roughly correlate to former source areas.

Extraction Well 25 (33061) exhibited the largest uranium concentration increase during the shutdown (47.4 to 80.4 μg/L) (see Table A.3-2A and Figure A.1-23). This extraction well is located in the south field, just southeast of the former Storm Water Retention Basins (SWRB) [Figure A.1-1]. Monitoring Well 23274 is located in the same area. Monitoring Well 23274 also exhibited a large uranium concentration increase when water levels were higher (210 μg/L to 384.2 μg/L, see Table A.3-1). The uranium increases coincide with the increasing water levels in this area, which indicates that it would be beneficial to keep water levels in this area as high as possible to help flush the uranium from the vadose zone. Surface water infiltration in this area was increased in 2006 when the SWRB liners were removed and drainage from the Former Production Area was allowed to fill the basins and overflow into the western tributary of the Former SSOD.

As noted in Section A.2.4 an infiltration operation is already taking place in this area in the eastern tributary of the SSOD. The eastern tributary of the SSOD cuts through the Glacial Till just south of EW-25 though, limiting the potential infiltration to the aquifer to the area south of Extraction Well 25 (Figure A.2-157). It may be beneficial to conduct a similar infiltration operation into the Former SWRB and western tributary of the SSOD. The western tributary of the SSOD though cuts through the Glacial Till further north than it does in the eastern tributary (Figure A.2-157). Therefore an infiltration operation in the western tributary, coupled with the continued infiltration operation in the eastern tributary of the SSOD could help to deliver more water to the area west and northwest of Extraction Well 25.

A.3.3 Continued Transducer Monitoring

Although not required by the IEMP, pressure transducers installed in 2007 to support the first annual well field shutdown remain in the wells and continue to operate so that daily changes in water levels can be recorded on a continuous routine basis at key points in the aquifer. The transducers are programmed to record a water level measurement at the top of each hour. Data from three of the six locations (former waste storage area [MW 2649], East Side of the South Field [2046], and West Side of the South Field [62433]) are plotted in Figure A.3−32 along with precipitation for data collected through February 2, 2009. The intent is to leave these transducers running until several yearly water level cycles have been recorded. The data will provide a more complete record of seasonal and short-term water table fluctuations and should prove helpful for planning the timing of future well field shutdowns.

Figure A.3−5. WSA (Phase-II) Design Remediation Footprint

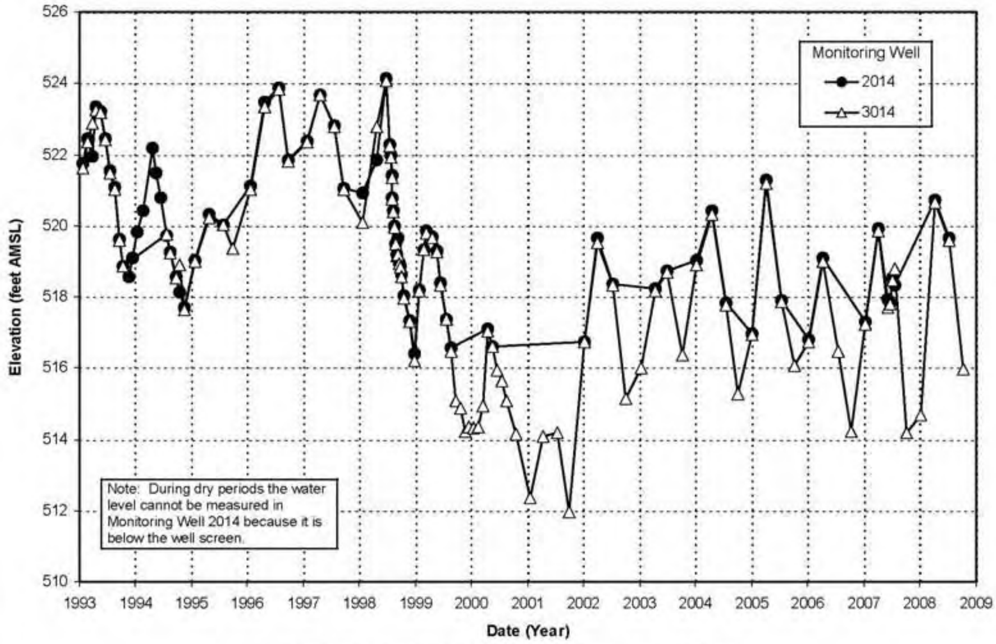

FIGURE A.3-6. HYDROGRAPH FOR WELL CLUSTER 014

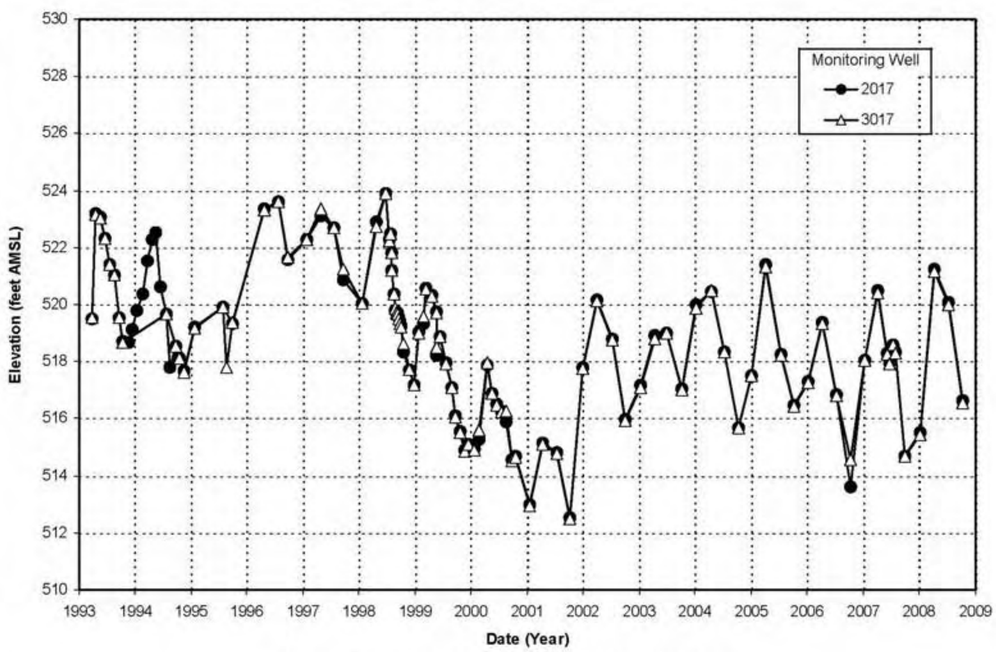

FIGURE A.3-7. HYDROGRAPH FOR WELL CLUSTER 017

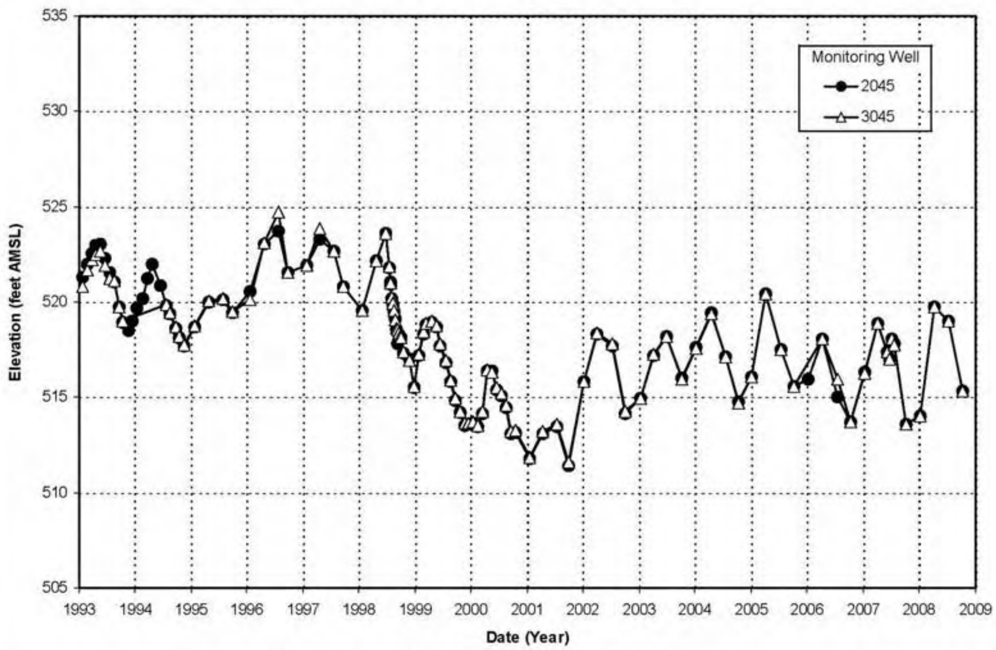

FIGURE A.3-8. HYDROGRAPH FOR WELL CLUSTER 045

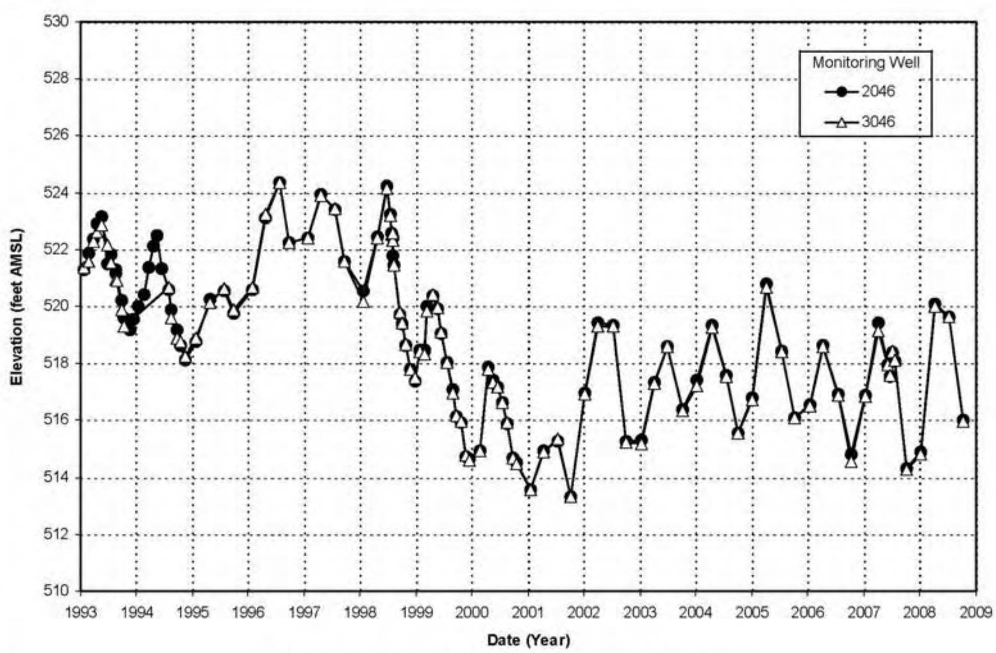

FIGURE A.3-9. HYDROGRAPH FOR WELL CLUSTER 046

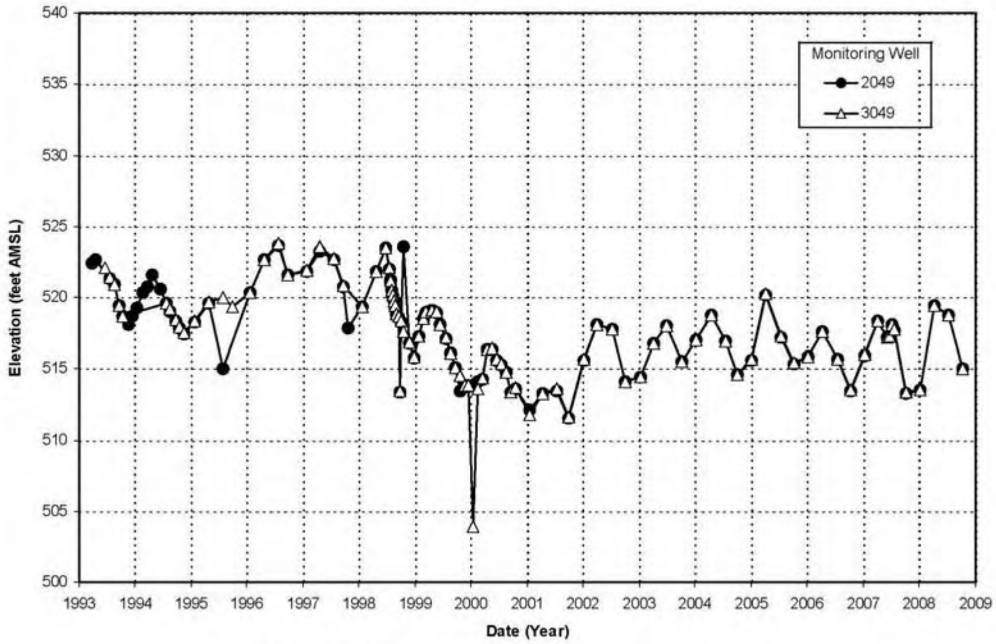

FIGURE A.3-10. HYDROGRAPH FOR WELL CLUSTER 049

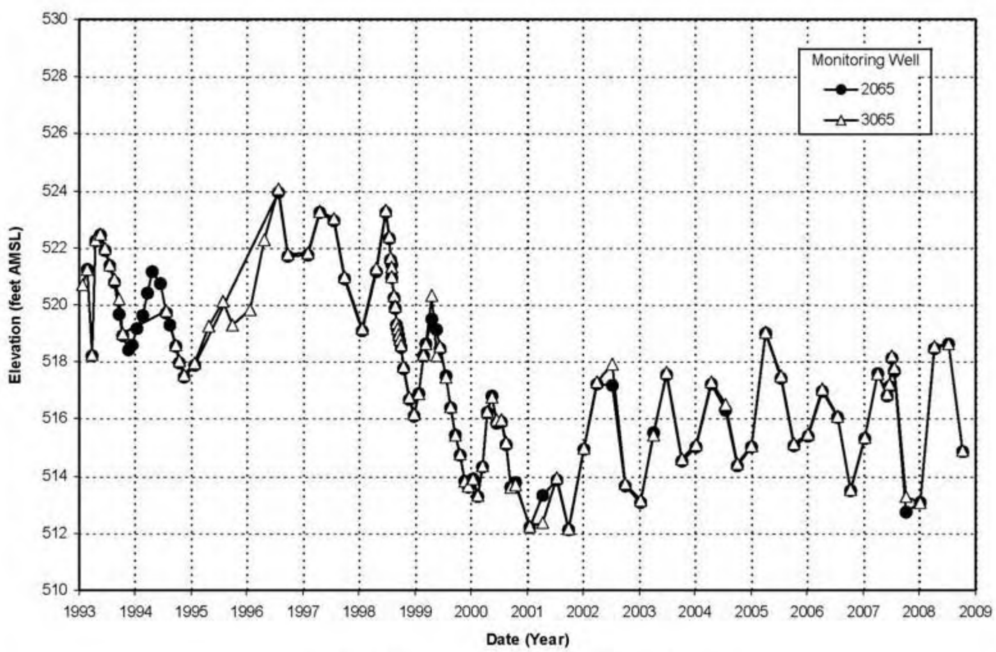

FIGURE A.3-11. HYDROGRAPH FOR WELL CLUSTER 065

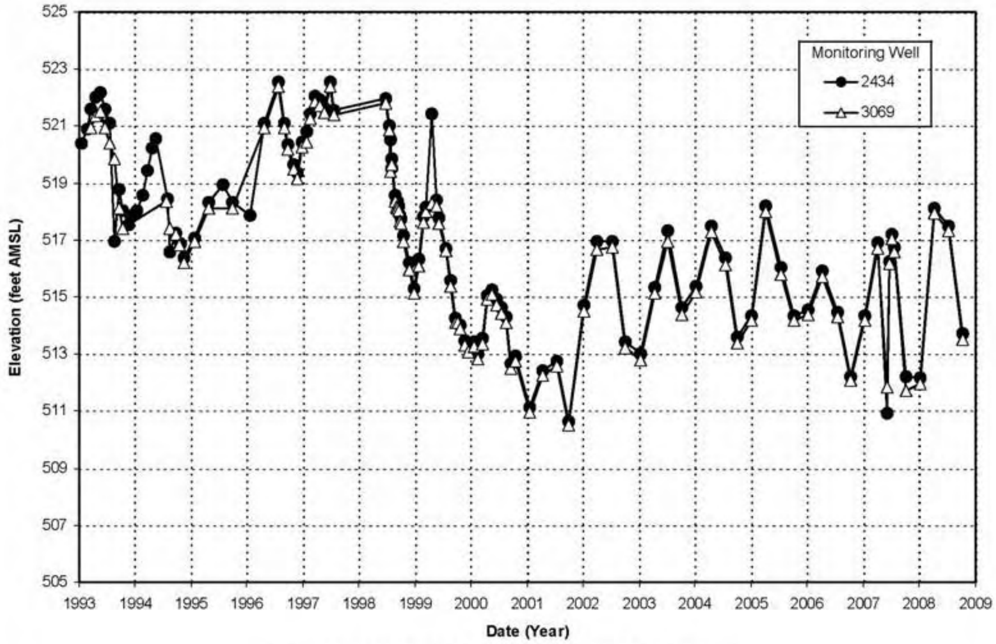

FIGURE A.3-12. HYDROGRAPH FOR WELLS 2434 AND 3069

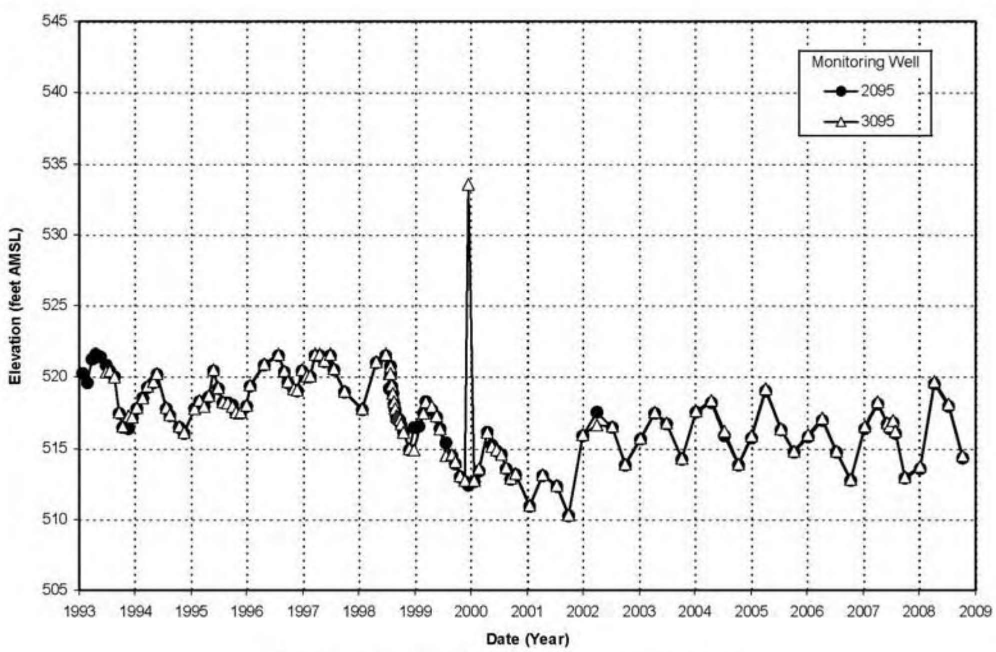

FIGURE A.3-13. HYDROGRAPH FOR WELL CLUSTER 095

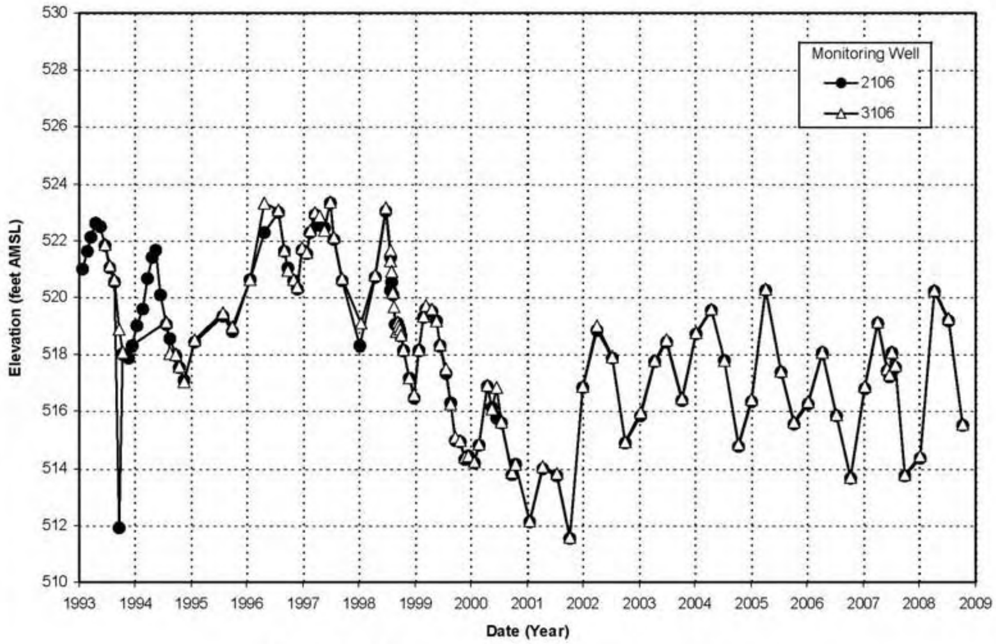

FIGURE A.3-14. HYDROGRAPH FOR WELL CLUSTER 106

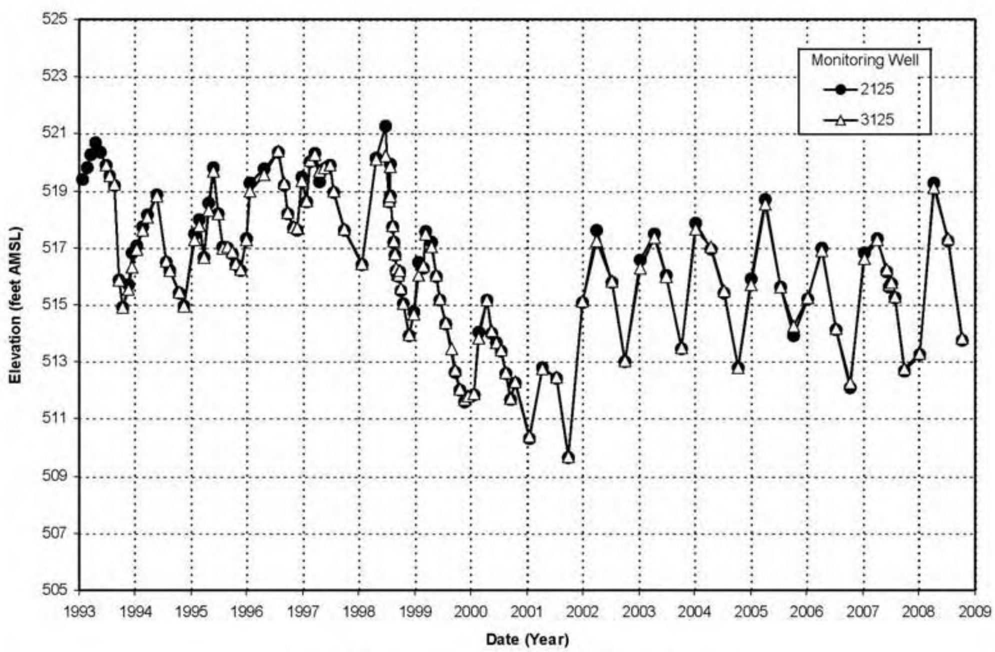

FIGURE A.3-15. HYDROGRAPH FOR WELL CLUSTER 125

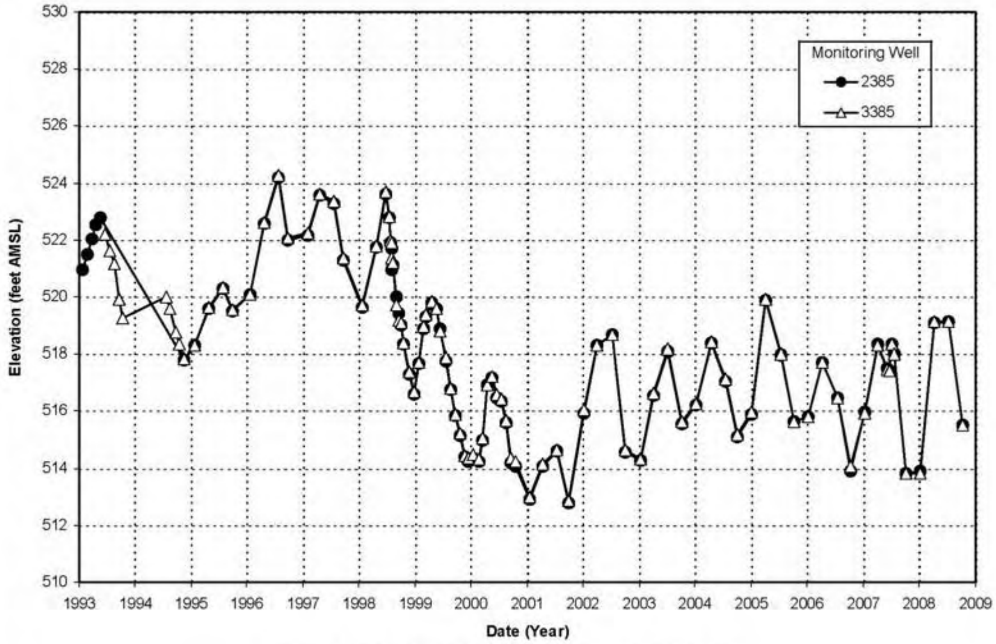

FIGURE A.3-16. HYDROGRAPH FOR WELL CLUSTER 385

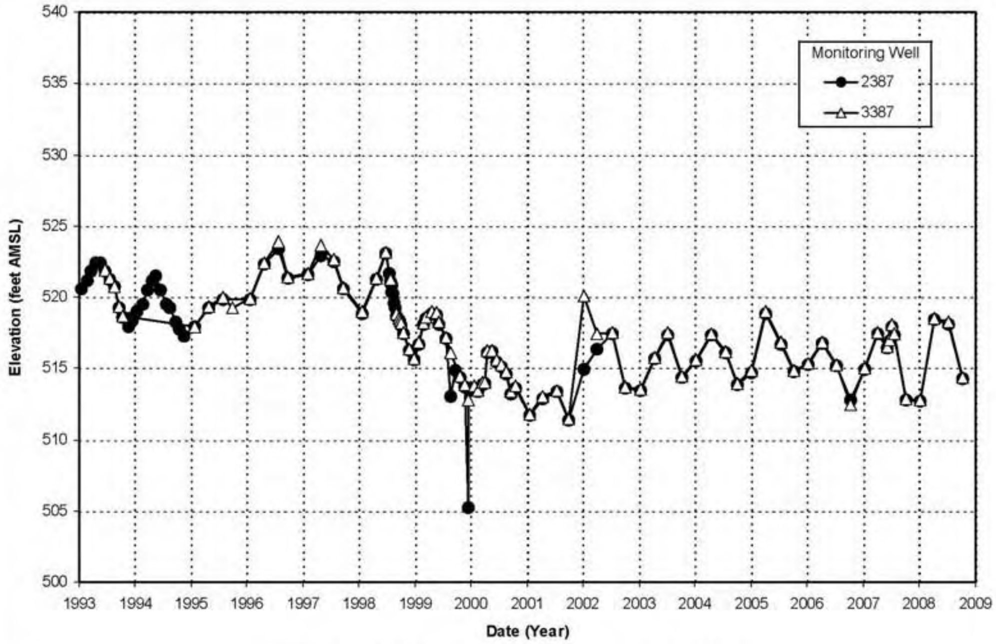

FIGURE A.3-17. HYDROGRAPH FOR WELL CLUSTER 387

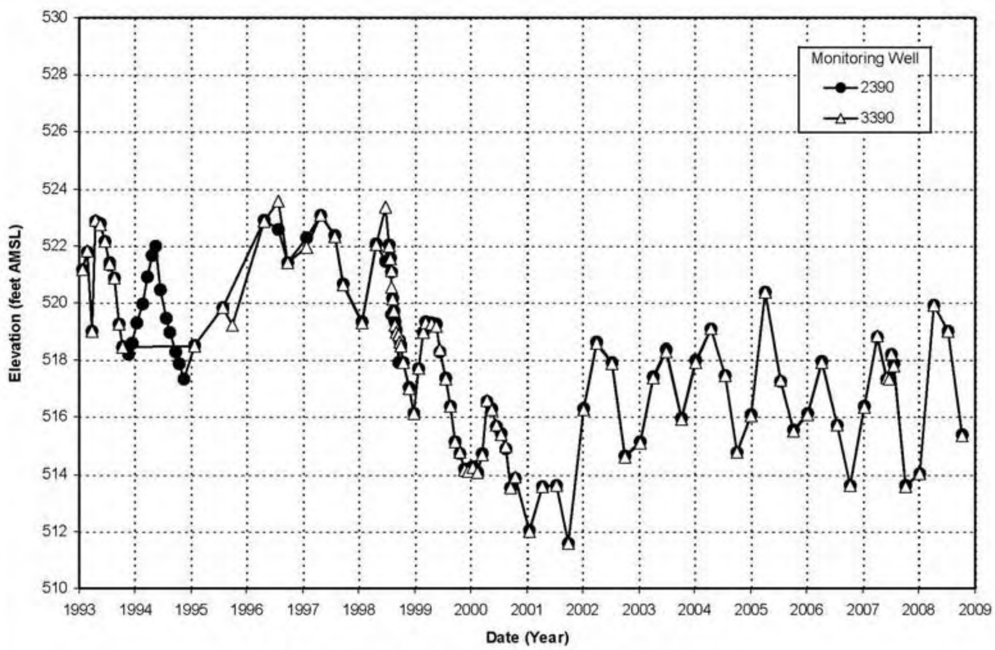

FIGURE A.3-18. HYDROGRAPH FOR WELL CLUSTER 390

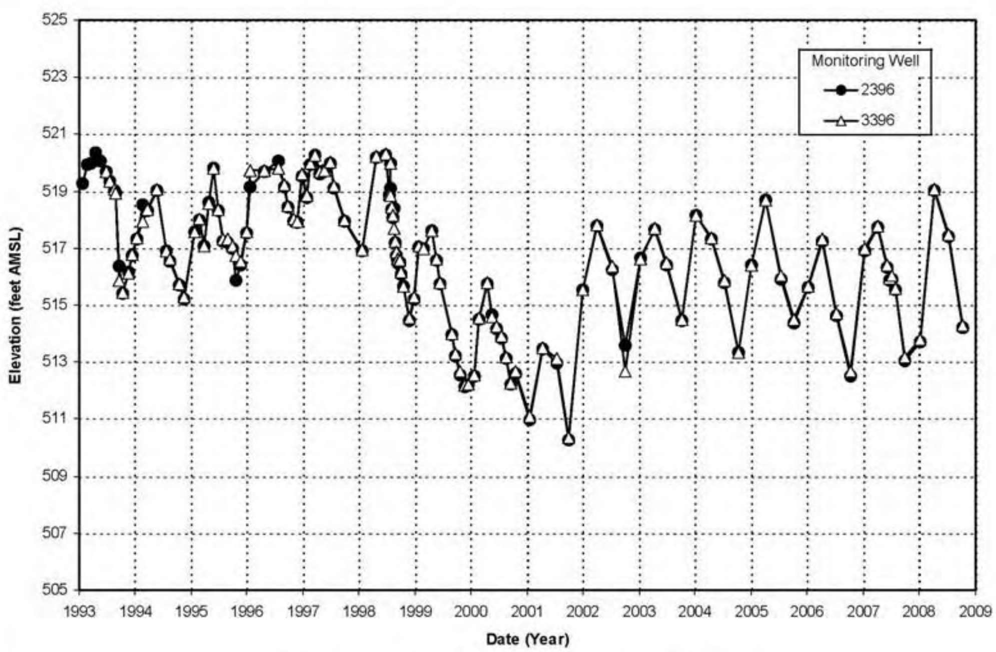

FIGURE A.3-19. HYDROGRAPH FOR WELL CLUSTER 396

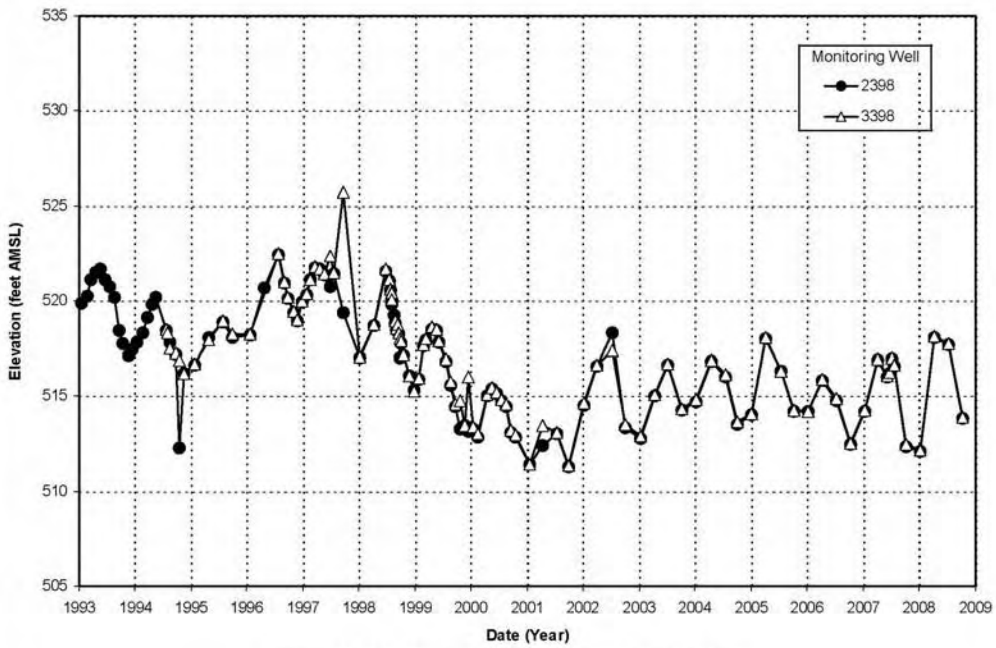

FIGURE A.3-20. HYDROGRAPH FOR WELL CLUSTER 398

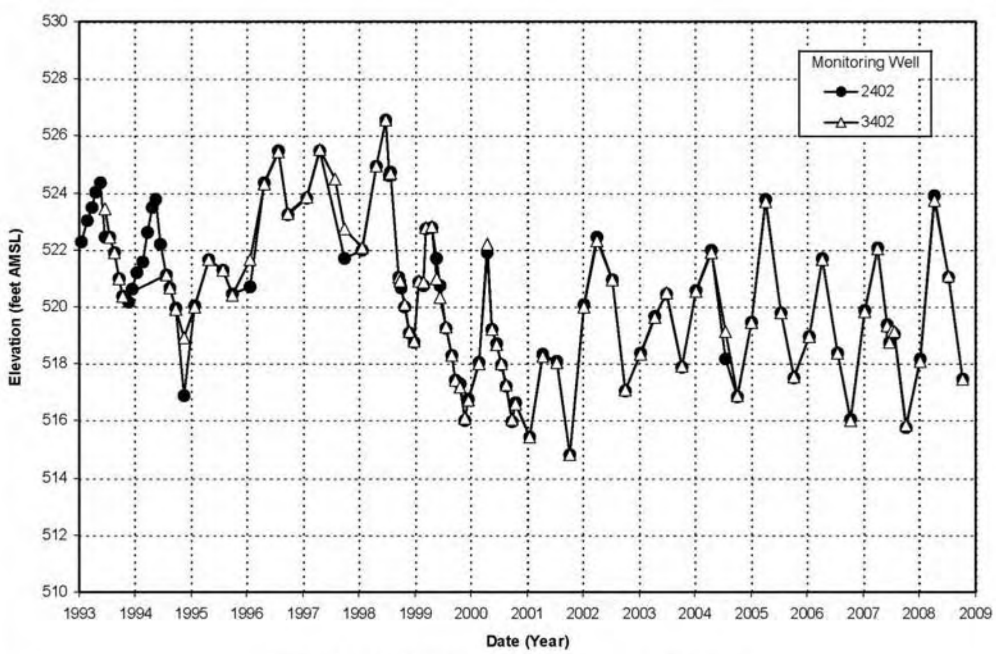

FIGURE A.3-21. HYDROGRAPH FOR WELL CLUSTER 402

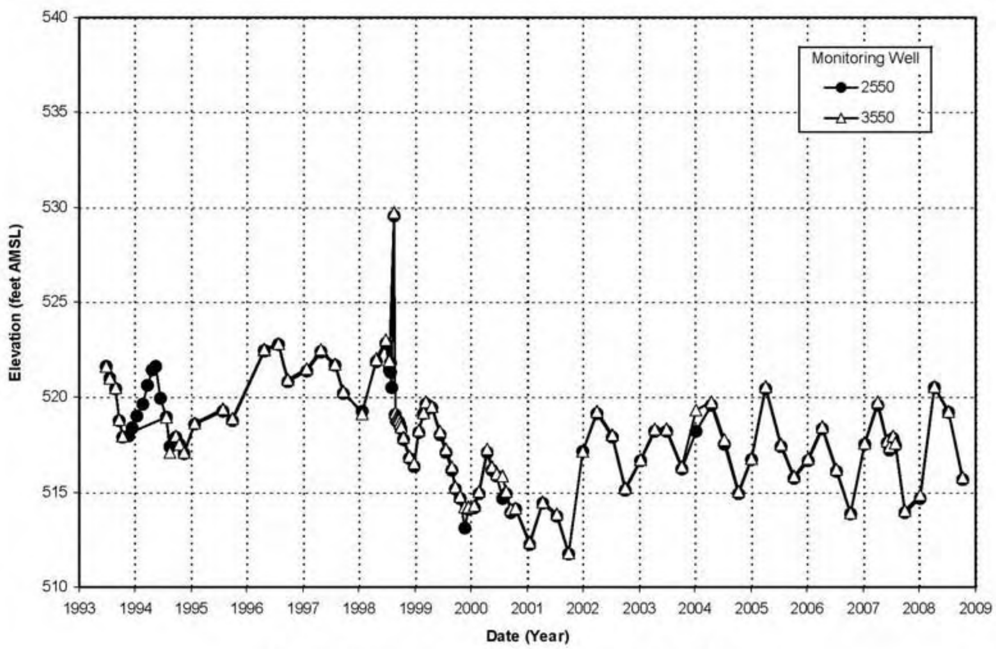

FIGURE A.3-22. HYDROGRAPH FOR WELL CLUSTER 550

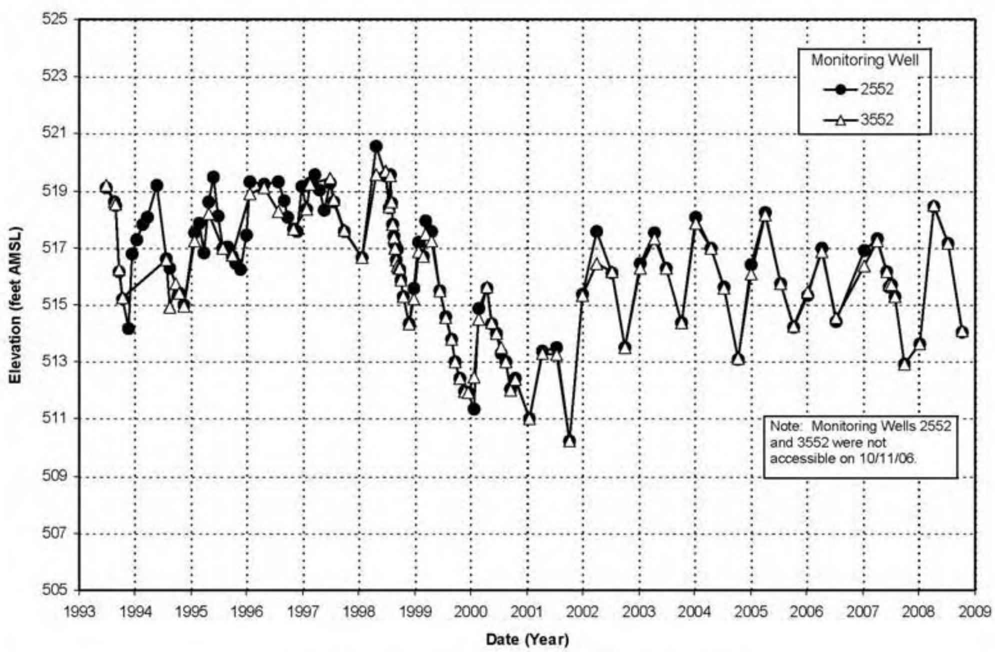

FIGURE A.3-23. HYDROGRAPH FOR WELL CLUSTER 552

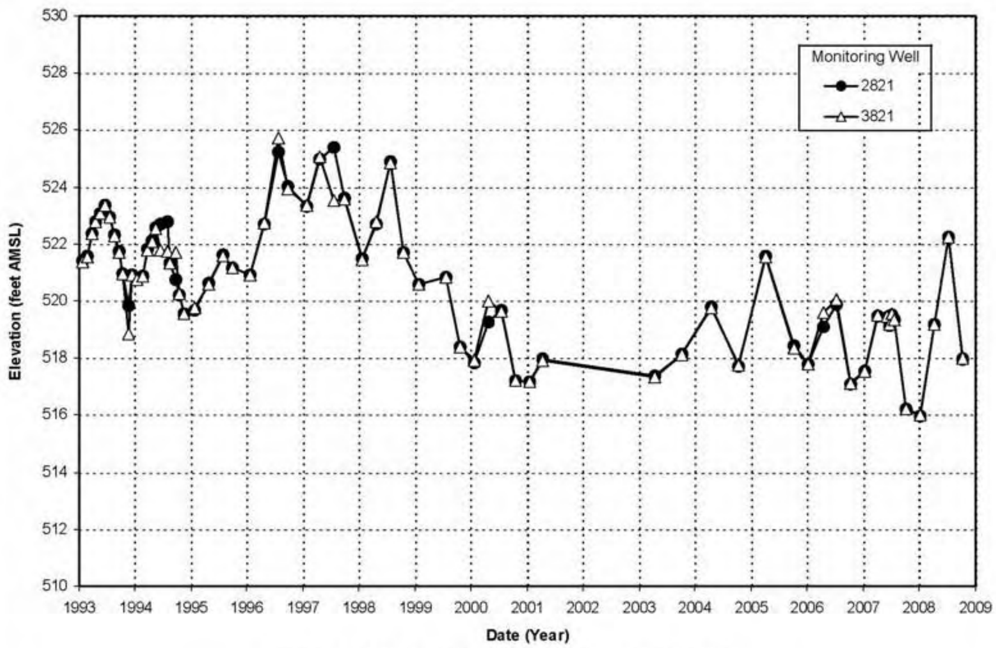

FIGURE A.3-24. HYDROGRAPH FOR WELL CLUSTER 821

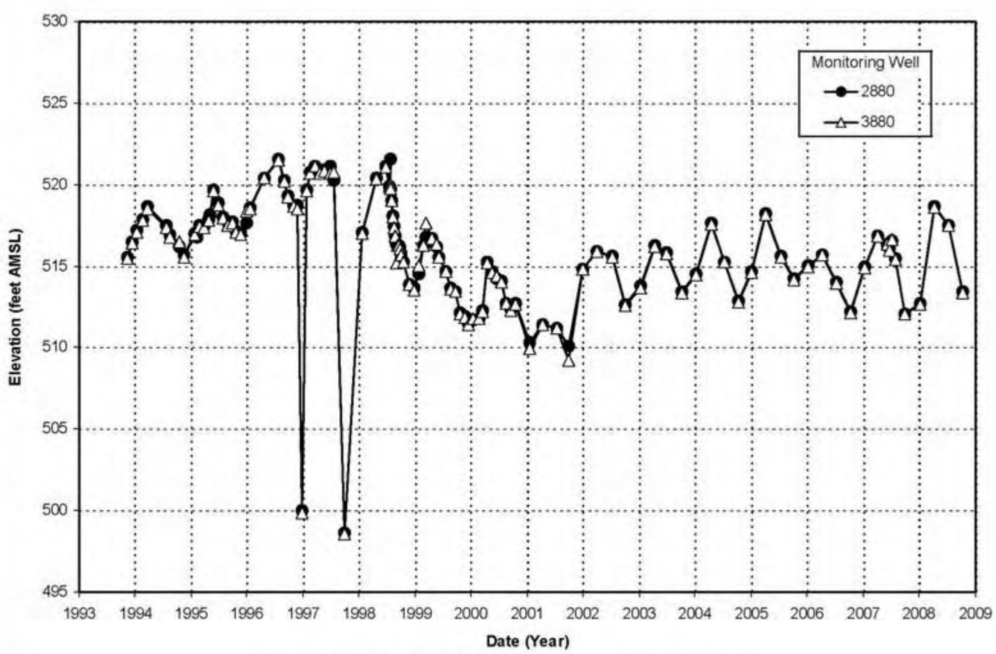

FIGURE A.3-25. HYDROGRAPH FOR WELL CLUSTER 880

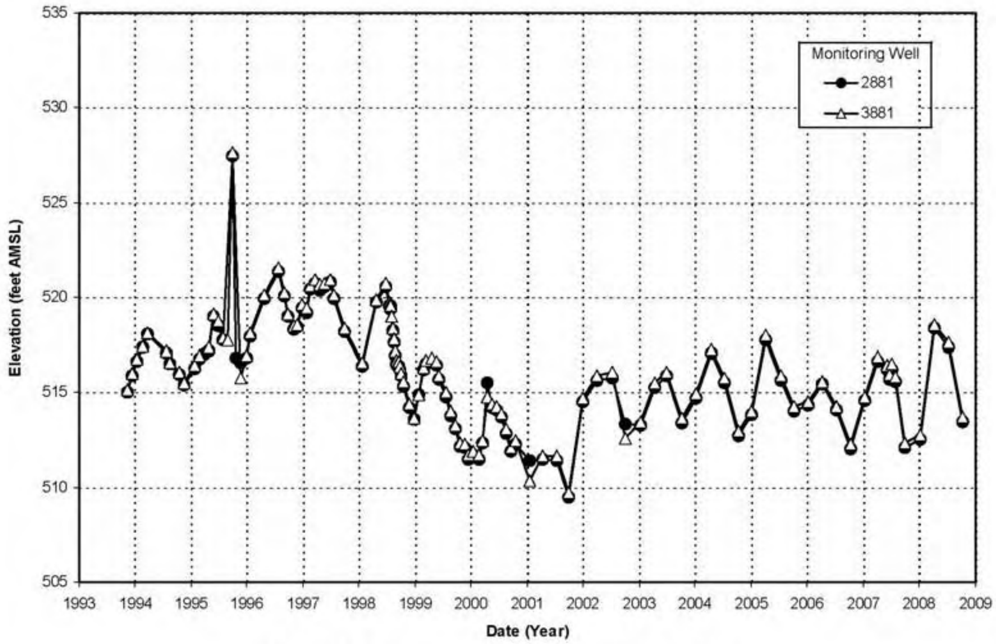

FIGURE A.3-26. HYDROGRAPH FOR WELL CLUSTER 881

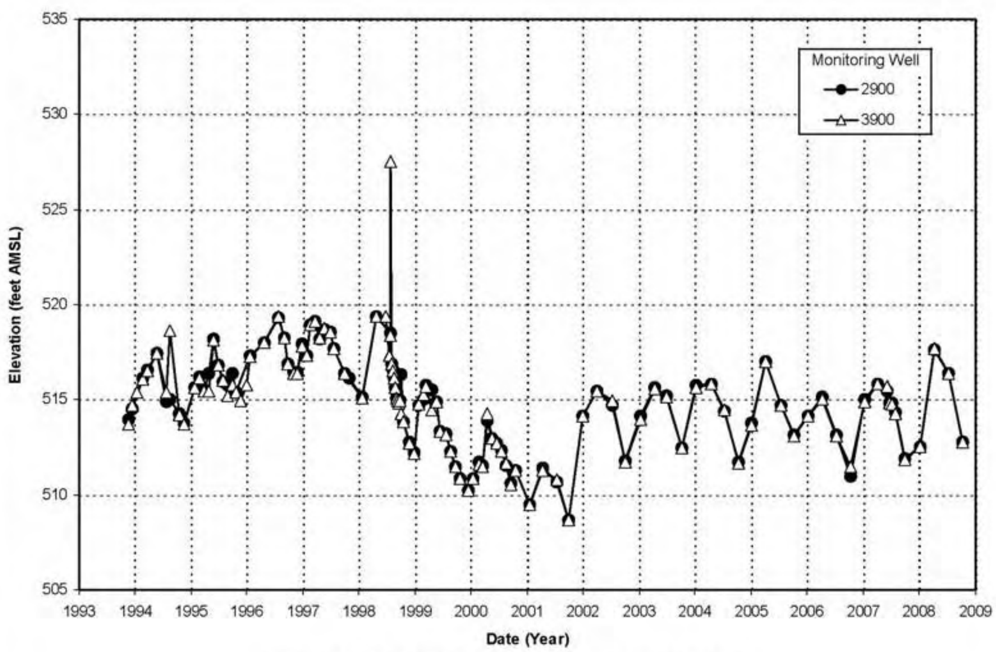

FIGURE A.3-27. HYDROGRAPH FOR WELL CLUSTER 900

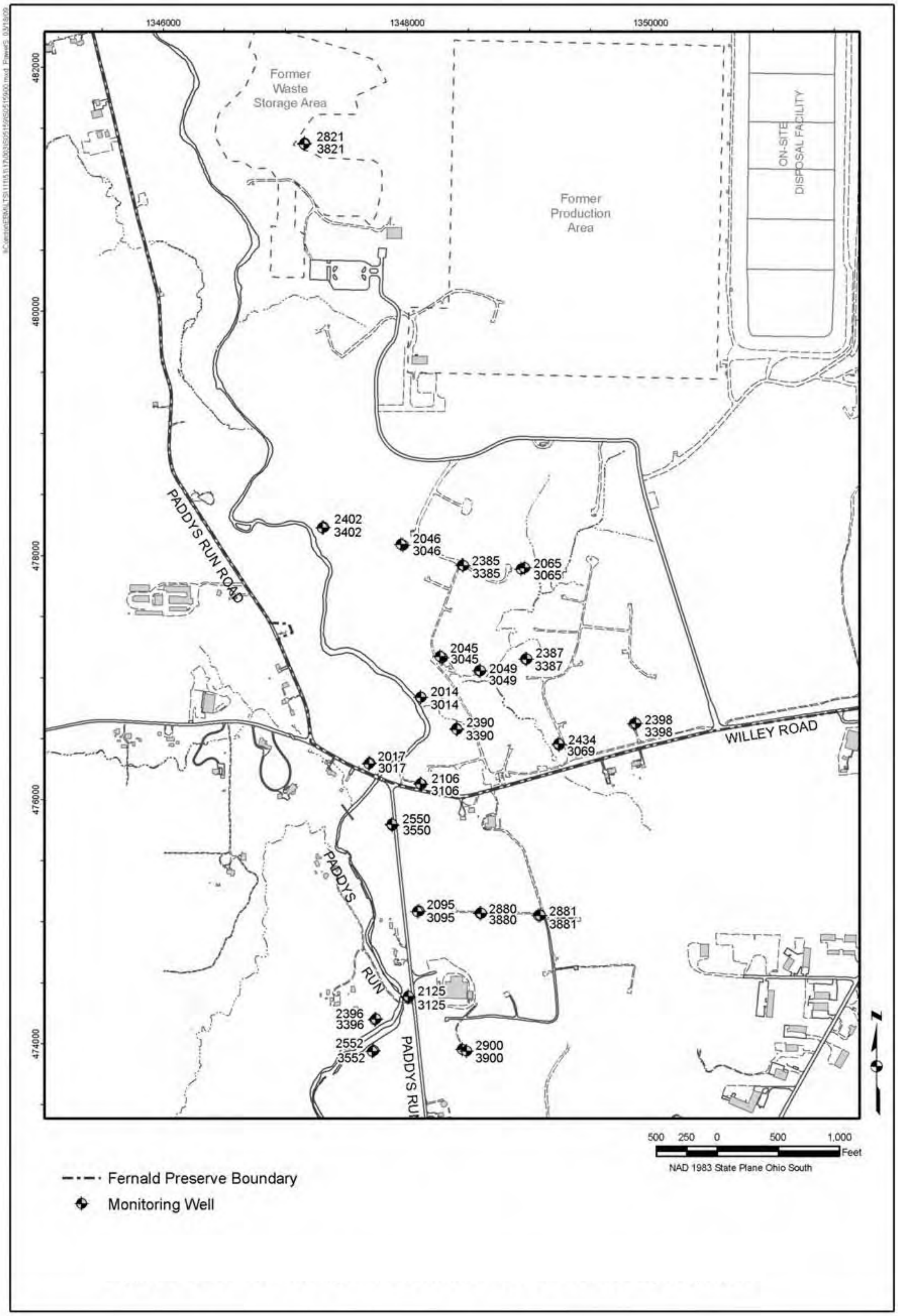

Figure A.3−28. Monitoring Well Locations for Well Cluster Hydrographs

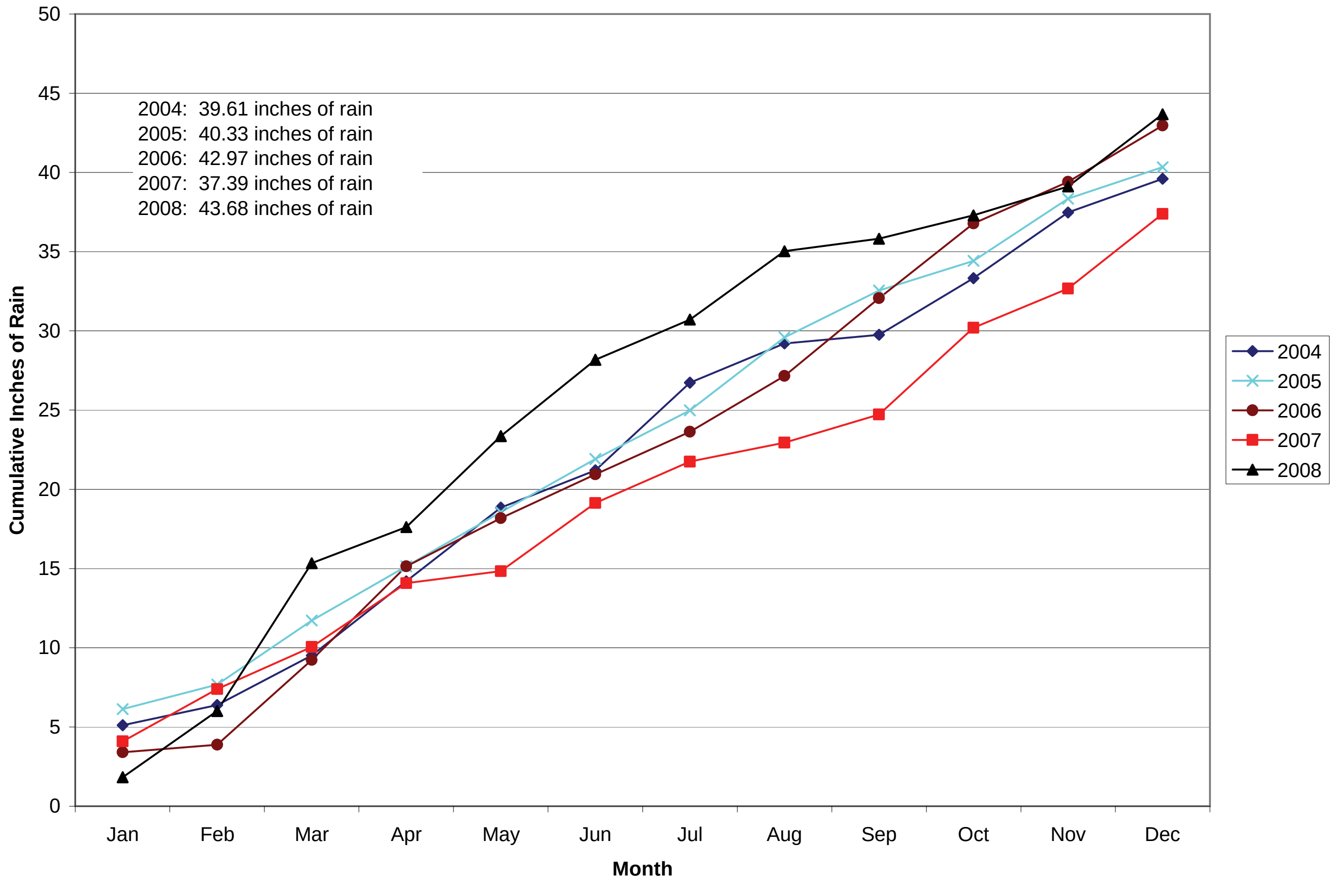

Figure A.3−29. Cumulative Annual Precipitation: 2004 through 2008 As Recorded at the Butler County Regional Airport

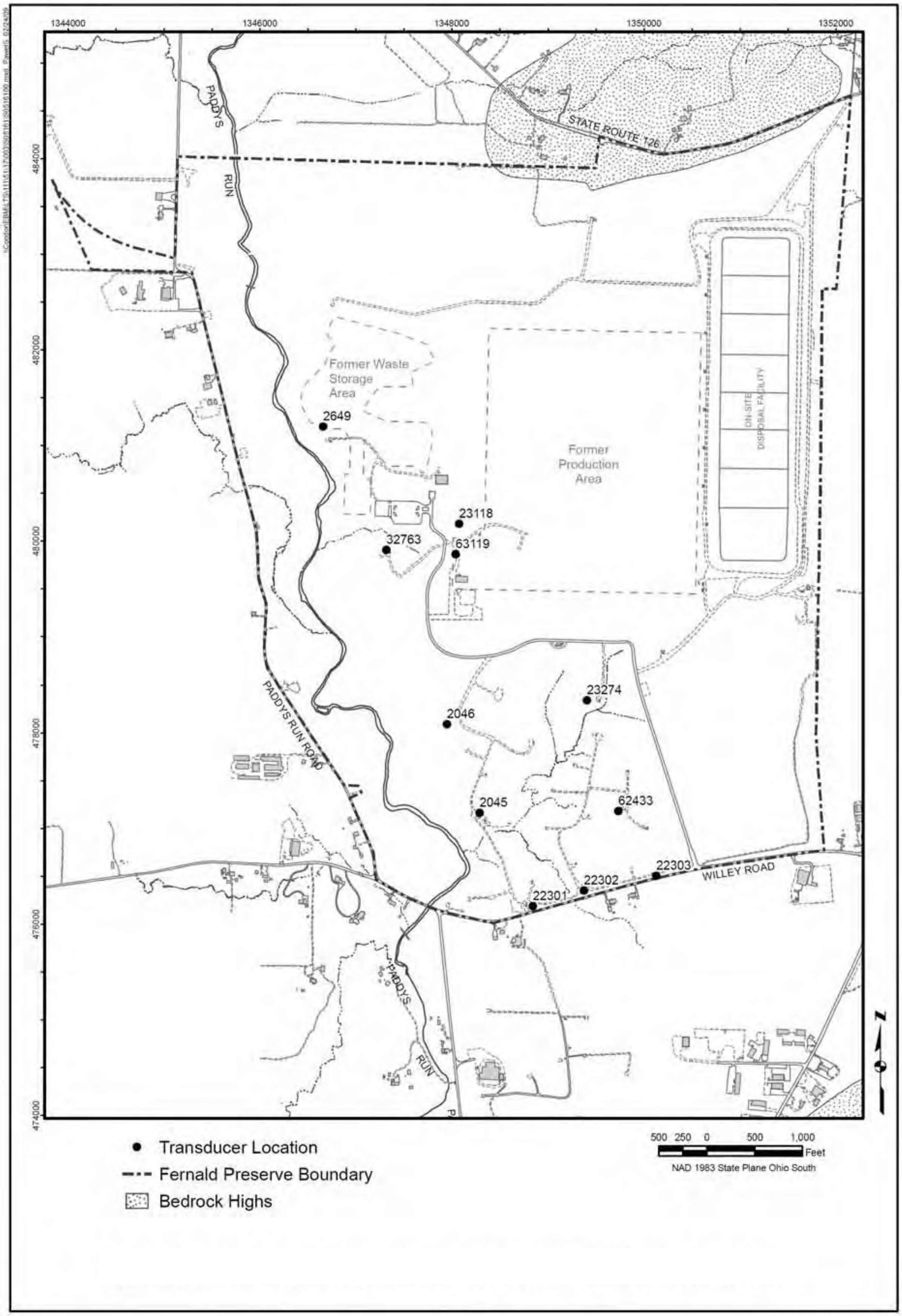

Figure A.3−30. Transducer Locations for the 2008 Operational Shutdown

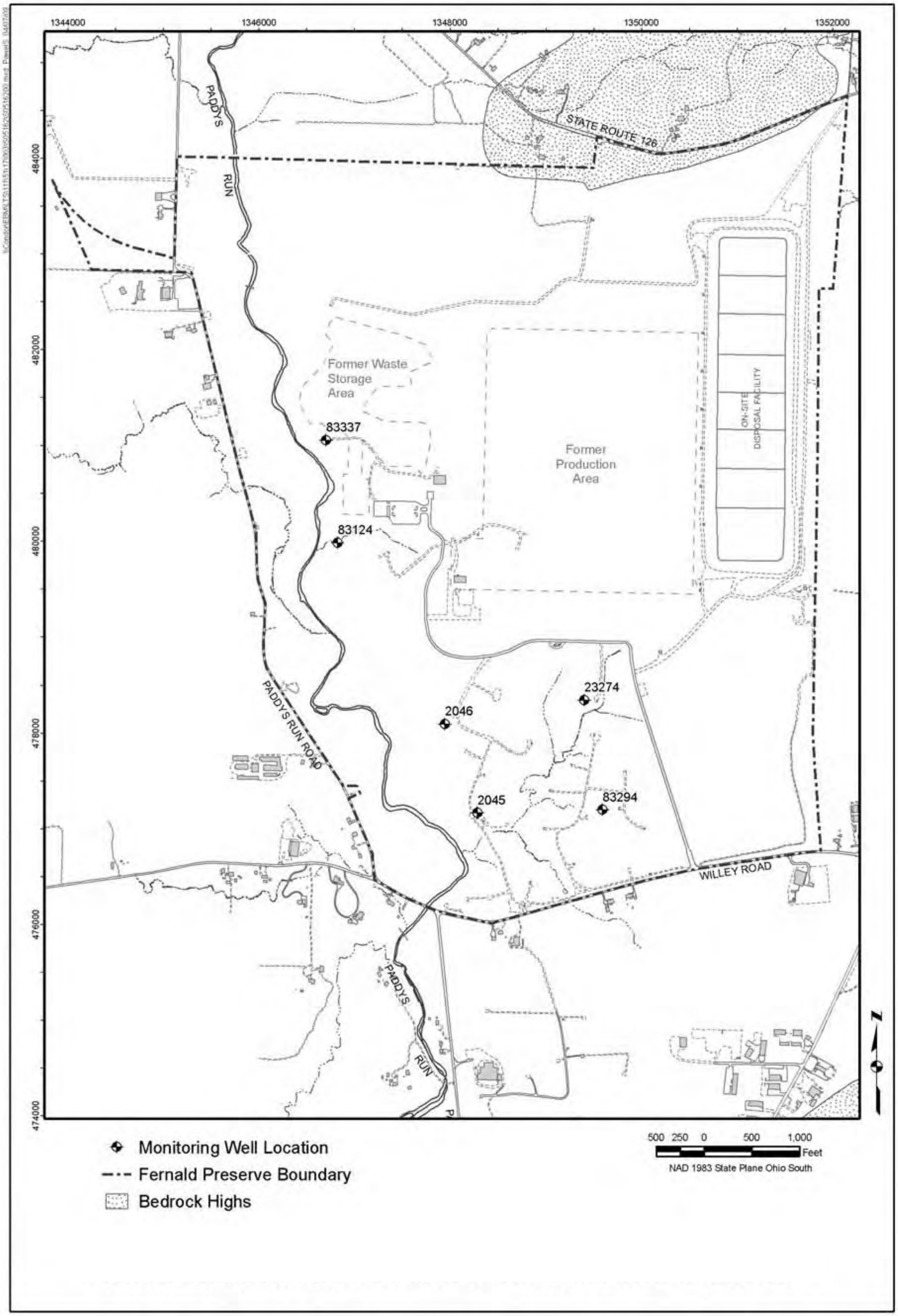

Figure A.3−31. Monitoring Well Locations for the 2008 Operational Shutdowns

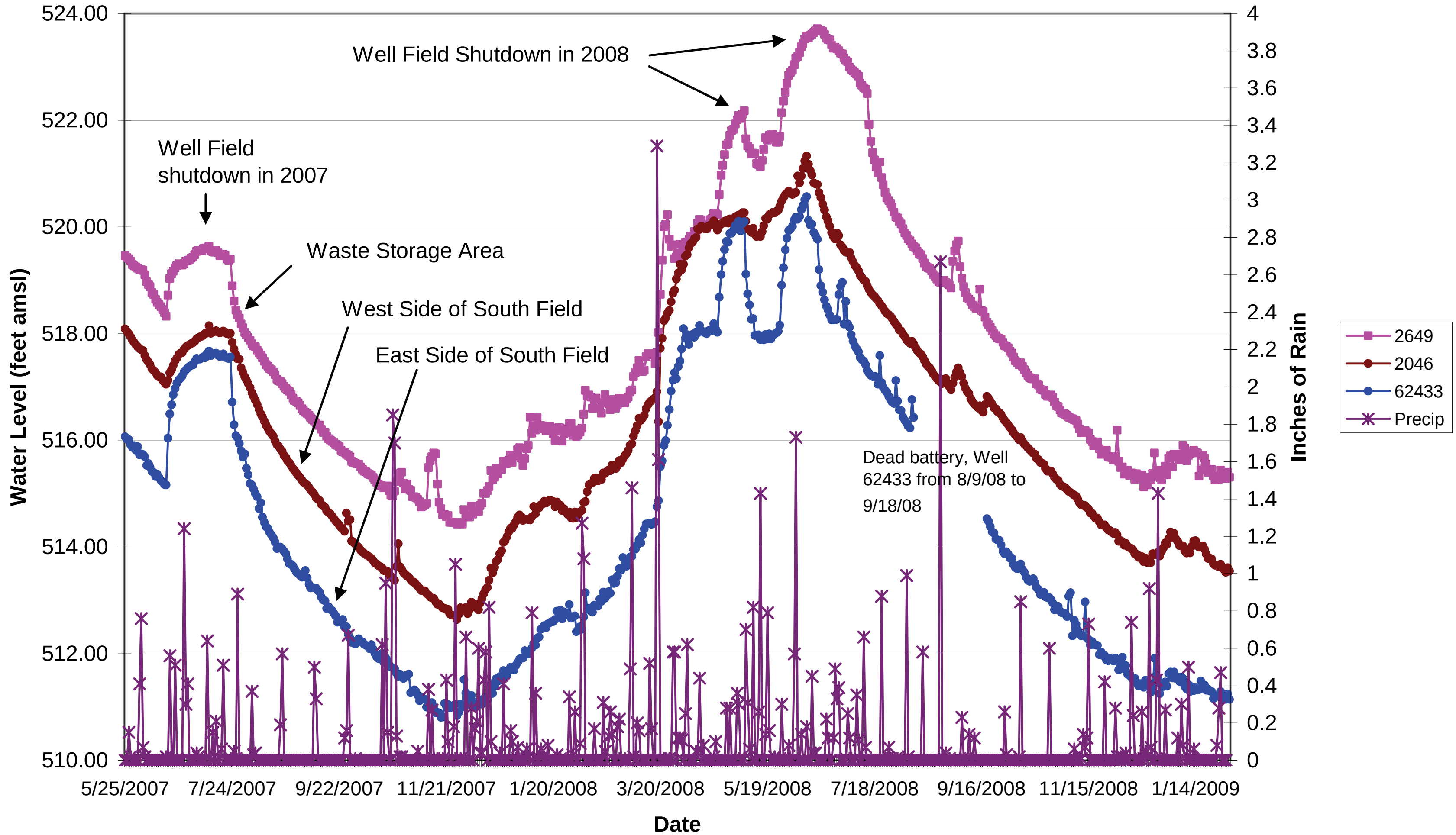

Figure A.3−32. Water Levels versus Precipitation May 25, 2007 through February 2, 2009

Attachment A.4

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A.4.0 Non-Uranium FRL Results

This attachment evaluates non-uranium FRL results for 2008. The purpose of the evaluation is to:

- Identify 2008 non-uranium FRL exceedances (Section A.4.1).
- Determine the persistence of non-uranium FRL exceedances outside the Waste Storage Area (Phase II) design remediation footprint (Section A.4.2).
- Present conclusions (Section A.4.3).

In addition to the routine assessments noted above, additional manganese data was collected near the OSDF and the former waste storage area. Results of this additional sampling effort are presented in Section A.4.4.

A.4.1 Non-Uranium FRL Exceedances for 2008

Table A.4−1 identifies the summary statistics and trend analysis for the 2008 non-uranium FRL exceedances from monitoring wells both inside and outside the Waste Storage Area (Phase II) design footprint. As indicated in Table A.4−1, seven non-uranium FRL constituents had one or more FRL exceedances during 2008. Figure A.4−1 identifies the location of these FRL exceedances.

Figure A.4−1 shows that the non-uranium FRL exceedances in 2008 for monitoring wells were located in the former waste storage area, along the eastern site boundary, and in the PRRS area. Those in the former waste storage area were within the Waste Storage Area (Phase II) design remediation footprint, while those along the eastern property boundary and in the PRRS area were located outside the Waste Storage Area (Phase II) design remediation footprint. Specific discussion regarding exceedances and persistence outside the footprint is provided in Section A.4.2. Further discussion regarding exceedances inside the footprint follows.

Table A.4−2 identifies all of the locations and constituents that had non-uranium FRL exceedances between 1997 and 2008. The first column in Table A.4−2 lists the groundwater FRL constituents monitored in 2008. The second column identifies the wells monitored that have had an exceedance since 1997 for each constituent. The third column identifies the associated aquifer zone monitored. The fourth column identifies the associated monitoring program for each well/constituent. The remaining columns show monitoring years divided into quarters through 2002 and into halves beginning in 2003, to reflect the semiannual sampling frequency. An “X” denotes the time period in which an exceedance occurred. Table A.4−2 also indicates whether exceedances occurred inside or outside of the footprint (shading indicates the well is located outside the footprint).

There were 13 non-uranium constituents monitored in 2008; 7 had exceedances. The following table summarizes the 2008 non-uranium monitoring information:

Constituent	Monitoring Program	2008 Monitoring Summary
Antimony	Property/Plume Boundary for PRRS Constituents	No exceedances
Arsenic	Property/Plume Boundary for PRRS Constituents	No exceedances
Boron	South Field	No exceedances
Carbon Disulfide	Waste Storage Area	No exceedances
Fluoride	Property/Plume Boundary	No exceedances
Lead	Property/Plume Boundary	No exceedances
Manganese	Property/Plume Boundary, Waste Storage Area	Exceedances in former waste storage area wells and one well along the eastern site boundary
Molybdenum	Waste Storage Area	Exceedance in one former waste storage area well
Nickel	Waste Storage Area	Exceedances in former waste storage area wells
Nitrate/Nitrite	Waste Storage Area	Exceedances in former waste storage area wells
Technetium 99	Waste Storage Area	Exceedances in former waste storage area wells
Trichloroethene	Waste Storage Area	Exceedances in former waste storage area wells
Zinc	Property/Plume Boundary	Exceedances one well along the eastern site boundary and PRRS wells

Direct-Push Sampling

In addition to routine monitoring well sampling in the former waste storage area, three locations were sampled for non-uranium constituents using a direct-push sampling tool. The three locations were 13370a, 13379, and 13380. In addition to uranium, these three locations were sampled for Waste Storage Area parameters (technetium-99, nitrate/nitrite, manganese, molybdenum, and nickel). Results for direct push locations 13370a, 13379, and 13380 are provided in Tables A.2−5, A.2−11, and A.2−12, respectively.

No non-uranium FRL exceedances were detected at Location 13380. Non-Uranium FRL exceedances for nitrate/nitrate and manganese were measured at Location 13370A. Non-uranium FRL exceedances for nitrate/nitrite, manganese, and nickel were measured at Location 13379. Locations with exceedances are noted in Figure A.4−1.

In 2008 some additional sampling (direct-push sampling and well monitoring) was conducted in the OSDF area and former waste storage area to further investigate manganese concentrations in the aquifer. Results are presented and discussed in Section A.4.4.

A.4.2 Evaluation of 2008 Non-Uranium FRL Exceedances Outside the Waste Storage Area (Phase II) Design Remediation Footprint

This section presents an evaluation of the persistence of non-uranium FRL exceedances outside the Waste Storage Area (Phase II) design remediation footprint.

A.4.2.1 Background

The *Restoration Area Verification Sampling Program Summary Report* (DOE 1998) states that any FRL exceedance detected at the property boundary during routine monitoring outside the 10-year uranium-based restoration footprint (DOE 1997a) would also be evaluated for persistence. The evaluation would be performed using the same conservative data evaluation method approved in the *Restoration Area Verification Sampling Program Project-Specific Plan* (DOE 1997c) to determine if a change in the aquifer restoration remedy is required. This evaluation was expanded beginning with the 2000 SER (DOE 2001) to include all non-uranium FRL exceedances detected outside of the 10-year uranium-based restoration footprint not just those detected at the property boundary. In the 2003 SER (DOE 2004b), the 10-year uranium-based restoration footprint was replaced with a 10-year time-of-travel remediation footprint based on 2003 target pumping rates and using the VAM 3D Zoom Model. The footprint has since been updated to reflect capture during the time period modeled for the Waste Storage Area (Phase II) remediation design.

Analytical data from samples collected immediately following an FRL exceedance are evaluated to determine if the exceedance is persistent. In accordance with the approved Restoration Area Verification Sampling method, if two or more consecutive sampling events following an FRL exceedance indicate that the concentration in question has decreased below the groundwater FRL, then the exceedance is not considered persistent. If an FRL exceedance outside the Waste Storage Area (Phase II) design remediation footprint is determined to not be persistent, then no additional action is required above and beyond the routine groundwater monitoring specified in the current IEMP. If an FRL exceedance is determined to be persistent, then the cause of the persistent exceedance must be identified and its effect on the aquifer remedy design assessed. Ultimately, the cause needs to be addressed either through a modification of the aquifer remedy or by other means, as applicable.

A.4.2.2 Evaluation and Discussion

Seven possible persistent FRL exceedances were identified in 2007 requiring additional data collection in 2008. The exceedances were: antimony in monitoring wells 2636, 3424, 3426, 3432, 2432, and 2733; and arsenic in monitoring well 2636. The non-uranium FRL exceedances for 2008 along with the possible persistent exceedances identified in 2007 are addressed below.

Figure A.4−1 and Table A.4−1 identify the 2008 non-uranium FRL exceedances outside the Waste Storage Area (Phase II) design remediation footprint. These wells are shaded in Table A.4−1. In 2008, two constituents had one or more FRL exceedance at three wells located outside the Waste Storage Area (Phase II) design remediation footprint:

- Manganese at monitoring well 22204.
- Zinc at monitoring wells 22204, 2625, and 2636.

Table A.4−3 addresses the possible persistent FRL exceedances for those that occur outside the Waste Storage Area (Phase II) design remediation footprint. It includes the exceedances for 2008 listed in the bullets above, as well as those still being evaluated or deemed persistent from the 2007. If two or more sampling events immediately following an FRL exceedance indicate that the concentration decreased below the FRL, then the exceedance is identified as not persistent in Table A.4−3. As shown in Table A.4−3, an FRL exceedance was identified as being persistent in 2008 for manganese at monitoring well 22204. An additional discussion of manganese in the GMA in the OSDF area is provided in Section A.4.4.

The following is a summary of results presented in Table A.4−3:

- Additional data, to be collected in 2009, are necessary to determine the persistence of the zinc FRL exceedances at monitoring wells 22204, 2625, and 2636
- The antimony exceedances detected in 2007 at monitoring wells 2636, 3424, 3426, 3432, 2432, and 2733 are not persistent
- The arsenic exceedance detected at monitoring well 2636 is not persistent
- The FRL exceedance recorded for manganese at monitoring well 22204 in 2008 is persistent.

Figures A.4−2 through A.4−7 present individual concentration versus time graphs for antimony at well 2636, arsenic at well 2636, manganese at well 22204, and zinc at wells 22204, 2625, and 2636.

The evaluation for persistence of non-uranium FRL exceedances in wells located outside the Waste Storage Area (Phase II) design remediation footprint in 2008 marks the twelfth year that an evaluation has been conducted as part of the IEMP. In the past, exceedances identified as persistent became non persistent in later years.

This year, an exceedance for manganese at monitoring well 22204 was identified again as persistent. At this time, no change to the aquifer remedy is planned to address the manganese exceedance at this monitoring well. Additional sampling was conducted for manganese near the OSDF in 2008. Results are presented in Section A.4.4

A.4.3 Conclusions

From the information provided in this attachment, the following conclusions can be made:

- Non-uranium FRL exceedances occurring in the former waste storage area were taken into consideration for the Waste Storage Area (Phase II) Remediation Module Design.
- There was one persistent non-uranium FRL exceedance outside the Waste Storage Area (Phase II) design footprint identified in 2008: manganese at monitoring well 22204. A change in the design of the aquifer remedy to address the exceedance at this monitoring well is not being considered at this time. Additional sampling for manganese near the OSDF was conducted in 2008. Results are presented and discussed in Section A.4.4.
- Additional data are needed to verify whether the zinc exceedances outside the Waste Storage Area (Phase II) design footprint are persistent.

A.4.4 Additional Sampling for Manganese in the Former Waste Storage Area and Near the OSDF

Manganese

In 2008, additional sampling for manganese was conducted near the OSDF and in the former waste storage area for the purpose of verifying the eastern extent of the maximum manganese plume in the former waste storage area, and the nature of the manganese exceedances detected in the GMA near the OSDF. The collection of the additional manganese data addresses concerns expressed by the Ohio EPA in Comment # 10 (Original Comment #30) in the 2006 SER Second Round of Responses to Comments.

Eastern Extent of the Maximum Manganese Plume in the Former Waste Storage Area

Delineation of the maximum manganese plume in the former waste storage area is presented in the *Addendum to the Waste Storage Area (Phase II) Design Report* (DOE 2005). The eastern extent of the plume was defined at that time by wells 2037 and 2008, and by direct push locations 13345, 13323 and 13329. Additional direct push sampling was conducted in 2008 at locations 13379 and 13380. Data for locations 13379 and 13380 are provided in Tables A.2–11 and A.2–12, respectively.

The maximum manganese concentration recorded at 13380 (0.75 mg/L) and 13379 (0.92 mg/L) are posted on the maximum manganese plume map shown in Figure A.4–8. As shown in the figure, the additional data collected in 2008 agrees with the earlier interpretation of the eastern extent of the plume. The eastern extent of the manganese plume appears to be adequately defined.

Manganese Exceedances in the GMA Near the OSDF

Additional manganese data were collected from the GMA near the OSDF in 2008 to investigate whether or not observed manganese exceedances in the GMA indicate the presence of a localized plume. Manganese was a process chemical used in the former production area. The manganese groundwater FRL is 900 µg/L and is based on background values in the aquifer.

The collection of additional data consisted of sampling for manganese in four upgradient OSDF (wells 22201, 22200, 22203, and 22206) and one direct push sampling location (Location 13377). Results for Location 13377 are presented in Table A.2–9. The location is shown in Figure A.2–3A. No FRL manganese exceedance was measured at Location 13377. The highest manganese concentration measured at Location 13377 (down to a depth of 60 ft below the water table) was 275 µg/L.

A slight manganese FRL exceedance was detected at one of the additional upgradient monitoring wells sampled. Monitoring results for the four upgradient wells are as follows:

Well	Manganese Result (µg/L) July 28, 2008	Manganese Result (µg/L) October 30, 2008
22200	472	382
22201	617	**949**
22203	590	471
22203 duplicate	399	NA
22206	573	708
22206 duplicate	707	NA

Other than a slight FRL manganese exceedance in Monitor Well 22201 (949 μg/L), all of the other results were below the groundwater FRL. As discussed below, the slight exceedance at Monitor Well 22201 is believed to be a background issue and hence natural. As discussed below, the data does not indicate that a localized manganese plume is present in the GMA near the OSDF.

Other explanations can explain the manganese FRL exceedances observed in the GMA near the OSDF. As reported in the 1998 SER, it is possible that some of the exceedances are natural. Unconsolidated glacial fluvial aquifers in Ohio have relatively high manganese concentrations. Manganese is an impurity in shale which is a major component of bedrock in the area. The groundwater FRL for manganese is based on GMA background data. Many of the FRL exceedances measured have been only slightly above the background defined FRL, implying that the background value may be incorrectly defined.

Monitoring Wells 2426/22210 and 22204 have shown rather persistent manganese FRL exceedances. Because the exceedances are limited to just a couple of wells it implies that the wells could be the problem, specifically, biofouling in the well could be the possible cause for some of the FRL exceedances. Manganese FRL exceedances are summarized by year below:

Well	97	98	99	00	01	02	03	04	05	06	07	08
2426/22210	X						X	X	X			
2430	X			X								
2431	X											
2432					X							
22204									X	X	X	X
22201												X

Monitoring Well 2426 had several manganese FRL exceedances between 1997 and 2004. It was plugged and abandoned in 2005, and replaced by monitoring well 22210. A manganese FRL exceedance was detected at monitoring well 22210 in the first half of 2005, but no exceedance has been detected since. The data indicates that the manganese exceedances in the area of monitoring well 2426 disappeared with the installation of a replacement well, indicating that monitoring well 2426 was possibly biofouled.

Monitoring well 22204 appears to be the only monitoring well near the OSDF that currently is exhibiting persistent manganese exceedances (see Table A.4–3). It is possible that monitoring well 22204 is also biofouled. Rather than conduct direct-push sampling next to this monitoring well to confirm that biofouling is the cause, DOE would rather just continue monitoring for now.

To conclude, the additional data collected in 2008 reinforces previous observations that a localized manganese plume is not present in the GMA beneath the OSDF. DOE will conduct additional sampling in the area prior to terminating the pump-and-treat stage of the aquifer remedy to document if conditions still support this determination or if additional remedy actions are required.

Table A.4–1. Summary Statistics and Trend Analysis for Non-Uranium Constituents with 2008 Results Above FRLs

Constituent (FRL)[a]	Monitoring Well	No. of Samples[b,c,d]	No. of Samples Above FRL[b,c,d]	No. of Samples Above FRL for 2008[c,d]	Minimum[b,c,d,e,f,]	Maximum[b,c,d,e,f]	Average[b,c,d,e,f]	Standard Deviation[b,c,d,e,f,g]	Trend[b,c,d,e,f,g,h]
Manganese (0.90 mg/L)	2010	14	13	2	0.600	6.14	2.74	1.9	No Significant Trend
	22204	12	10	2	0.418	3.01	1.36	0.64	Up, Marginal
	3821	18	13	2	0.145	11.4	2.84	2.86	No Significant Trend
	83337_C1	3	2	2	0.001	2.08	1.03	NA	NA
	83337_C2	5	1	1	0.0061	1.73	0.37	0.76	No Significant Trend
	83337_C3	5	1	1	0.001	1.03	0.22	0.46	No Significant Trend
	83338_C2	5	2	1	0.001	1.21	0.64	0.55	No Significant Trend
	83339_C1	3	3	2	1.51	3.36	2.41	NA	NA
	83339_C3	4	1	1	0.273	1.26	0.56	0.47	No Significant Trend
	83341_C1	3	3	2	1.65	4.7	3.67	NA	NA
	83346_C1	3	3	2	1.26	3.49	2.08	NA	NA
	83346_C2	4	3	1	0.709	3.56	1.7	1.3	No Significant Trend
Molybdenum (0.10 mg/L)	2649	16	16	2	0.207	0.69	0.48	0.13	Up, Marginal
Nickel (0.10 mg/L)	83346_C1	3	1	1	0.0715	0.167	0.11	NA	NA
	83346_C2	4	1	1	0.01	0.119	0.05	0.05	No Significant Trend
Nitrate/Nitrite-N (11 mg/L)[i]	2649	24	23	2	0.805	102	50.8	25.7	No Significant Trend
	2821	26	9	2	1.38	120	17.6	26.1	**Up, Significant**
	83340_C1	3	3	2	40.1	58.2	49.8	NA	NA
	83340_C2	4	4	2	58.8	86.7	67.8	12.8	No Significant Trend
	83340_C3	4	4	2	67.7	133	105	27.7	No Significant Trend
	83341_C2	4	1	1	0.09	54.5	16.7	25.6	No Significant Trend
	83341_C3	4	2	1	0.005	42	17.2	20.8	No Significant Trend

Table A.4–1 (continued). Summary Statistics and Trend Analysis for Non-Uranium Constituents with 2008 Results Above FRLs

Constituent (FRL)[a]	**Monitoring Well**	**No. of Samples[b,c,d]**	**No. of Samples Above FRL[b,c,d]**	**No. of Samples Above FRL for 2008[c,d]**	**Minimum[b,c,d,e,f,]**	**Maximum[b,c,d,e,f]**	**Average[b,c,d,e,f]**	**Standard Deviation[b,c,d,e,f,g]**	**Trend[b,c,d,e,f,g,h]**
Zinc (0.021 mg/L)	22204	12	2	1	0.001	0.0405	0.011	0.012	No Significant Trend
	2625	5	2	2	0.00325	0.0324	0.015	0.014	**Up, Significant**
	2636	5	2	2	0.00254	0.0238	0.013	0.009	**Up, Significant**
Technetium-99 (94 pCi/L)					(pCi/L)	(pCi/L)	(pCi/L)	(pCi/L)	
	2649	24	24	2	101	1480	692	436	**Up, Significant**
	2821	26	14	2	0.253	651	168	183	**Up, Significant**
	83340_C1	3	3	2	243	817	476	NA	NA
	83340_C2	4	4	2	192	313	242	51	No Significant Trend
	83340_C3	4	4	2	265	428	316	75	No Significant Trend
					(µg/L)	(µg/L)	(µg/L)	(µg/L)	
Trichloroethene (5.0 µg/L)	2649	16	14	1	0.125	120	57.0	30.1	Down, Significant
	2821	18	3	1	0.125	10.4	2.15	3.06	No Significant Trend

Note: Shading indicates well is outside the Waste Storage Area (Phase-II) design remediation footprint.

[a]From *Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996), Table 9-4.
[b]Based on samples from August 1997 through 2008.
[c]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[d]Rejected data qualified with either an R or Z were not included in the count, the summary statistics, or Mann-Kendall test for trend.
[e]If the number of samples is greater than or equal to four, then the Mann-Kendall test for trend and all of the summary statistics are reported. If the total number of samples is equal to three, then the minimum, maximum, and average are reported. If the total number of samples is equal to two, then the minimum and maximum are reported. If the total number of samples is equal to one, then the data point is reported as the minimum.
[f]For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.
[g]NA = not applicable
[h]Mann-Kendall test for trend is performed using data from third quarter 1998 through 2008.
[i]FRL based upon nitrate from *Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996), Table 9–4.

Table A.4−2. Groundwater FRL Exceedances From 1997 Through 2008 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006		2007		2008	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2	1	2	1	2
Antimony																																					
	22208	0	OSDF																								X										
	2398	2	P/PB																															X			
	2431	0	P/PB																								X										
	2432	0	P/PB																															X			
	2636	4	PRRS																									X		X				X			
	2733	0	P/PB																															X			
	3070	2	P/PB																															X			
	3398	2	P/PB																															X			
	3424	0	P/PB																															X			
	3426	0	P/PB																															X			
	3432	0	P/PB																															X			
	4398	2	P/PB																															X			
Arsenic																																					
	2625	4	PRRS												X																						
	2636	4	PRRS		X	X				X	X											X						X									
	2898	4	PRRS											X																							
	2900	4	PRRS											X																							
Boron																																					
	2045	2	SF								X		X		X																						
	2049	2	SF	X	X			X	X	X	X	X	X	X	X		X								X												
Carbon disulfide																																					
	2649	1	WSA						X																												
	3821	1	WSA										X																X								
Fluoride																																					
	2431	0	P/PB						X																												
Lead																																					
	2431	0	PRRS											X																							
	3733	0	P/PB	X													X																				
Manganese																																					
	2010	1	WSA													X				X						X	X	X	X		X	X	X	X	X	X	X
	22198	0	OSDF																					X													
	22204	0	OSDF																							X			X	X	X	X	X	X	X	X	X
	22205	0	OSDF																												X						
	2431	0	P/PB			X	X																														
	2432	0	P/PB														X			X	X		X			X											
	2648	1	WSA		X				X				X		X				X				X						X	X		X					
	2898	4	PRRS																				X					X									
	2899	4	PRRS													X																					
	2900	4	PRRS													X																					

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2008 Quarterly/Semiannually

		Aquifer		1997		1998				1999				2000				2001				2002				2003		2004		2005		2006		2007		2008	
Constituent	Well[a]	Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2	1	2	1	2
Manganese	3821	1	WSA										X		X				X				X			X	X	X			X	X		X	X	X	X
	83337_C1																																			X	X
	83337_C2																																				X
	83337_C3																																				X
	83338_C2	1	WSA																															X		X	
	83339_C1	1	WSA																															X		X	X
	83339_C3																																			X	
	83341_C1	1	WSA																															X		X	X
	83341_C2	1	WSA																															X	X		
	83346_C1	1	WSA																															X		X	X
	83346_C2	1	WSA																															X	X		X
Molybdenum																																					
	2649	1	WSA	X					X				X		X				X				X			X	X	X	X	X	X	X		X		X	X
Nickel																																					
	22198	0	OSDF										X																								
	2398	2	P/PB	X		X	X	X	X			X	X																								
	4398	2	P/PB							X				X																							
	83346_C1	1	WSA																																		X
	83346_C2	1	WSA																																		X
Nitrate/Nitrite																																					
	2648	1	WSA				X						X		X			X									X	X	X			X					
	2649	1	WSA		X		X		X		X		X		X		X	X	X	X	X	X	X		X	X	X	X	X		X	X		X		X	X
	2821	1	WSA										X													X				X		X	X	X	X	X	X
	3821	1	WSA														X				X								X				X		
	83338_C2	1	WSA																																X		
	83338_C3	1	WSA																																X		
	83340_C1	1	WSA																															X		X	X
	83340_C2	1	WSA																															X	X	X	X
	83340_C3	1	WSA																															X	X	X	X
	83341_C1	1	WSA																															X			
	83341_C2	1	WSA																																		X
	83341_C3	1	WSA																															X			X

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2008 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006		2007		2008	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2	1	2	1	2
Technetium-99																																					
	2648	1	WSA										X					X	X							X											
	2649	1	WSA		X		X		X		X		X		X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X		X		X	X
	2821	1	WSA										X												X	X	X	X	X	X	X	X	X	X	X	X	X
	83338_C2	1	WSA																																X		
	83338_C3	1	WSA																																X		
	83340_C1	1	WSA																															X		X	X
	83340_C2	1	WSA																															X	X	X	X
	83340_C3	1	WSA																															X	X	X	X
Trichloroethene																																					
	2649	1	WSA						X				X		X				X				X			X	X	X	X	X	X	X		X			X
	2821	1	WSA																															X	X		X
Zinc																																					
	22199	0	OSDF																							X											
	22204	0	OSDF																							X										X	
	22210	0	OSDF																											X		X					
	2398	2	P/PB				X																														
	2431	0	P/PB					X	X					X																							
	2432	0	P/PB							X				X			X																				
	2625																																			X	X
	2636																																			X	X
	2733	0	P/PB								X																										
	2900	4	PRRS													X												X							X		
	3128	4	PRRS																											X							
	3426	0	P/PB								X		X																								
	3429	0	P/PB							X	X																										
	3431	0	P/PB																			X															
	3733	0	P/PB																							X											
	3899	4	PRRS																X																		

Note: Shading indicates well is outside the Waste Storage Area (Phase-II) design remediation footprint.
[a]As defined in the IEMP, Rev. 3, all monitoring is semiannual (as of 2003).
[b]WSA = Waste Storage Area
SF = South Field
P/PB = Property/Plume Boundary for FRL Exceedances
PRRS = Property/Plume Boundary for Paddys Run Road Site
OSDF = Property/Plume Boundary for on-site disposal facility
[c]Sampling for the IEMP was initiated in August 1997.

Table A.4–3. Summary of Persistence Evaluation of Non-Uranium FRL Exceedances Outside the Waste Storage Area (Phase-II) Design Remediation Footprint

Constituent	Monitoring Well	Pertinent 2007 Results	2008 FRL Exceedance[a]		Evaluation Results for 2008	Figure No.
			1st Semiannual	2nd Semiannual		
Antimony	2636[b]	Additional Data Required	No	No	Not Persistent	A.4–2
	3424	Additional Data Required	No	No	Not Persistent	
	3426	Additional Data Required	No	No	Not Persistent	
	3432	Additional Data Required	No	No	Not Persistent	
	2432	Additional Data Required	No	No	Not Persistent	
	2733	Additional Data Required	No	No	Not Persistent	
Arsenic	2636[b]	Additional Data Required Persistent in 2004	No	No	Not Persistent	A.4–3
Manganese	22204	Persistent	Yes	Yes	Persistent	A.4–4
Zinc	22204		Yes	No	Additional Data Required	A.4–5
	2625		Yes	Yes	Additional Data Required	A.4–6
	2636		Yes	Yes	Additional Data Required	A.4–7

[a]NS = not sampled
[b]This monitoring well is often dry and cannot be sampled. In the first quarter of 2002 it had an FRL exceedance for arsenic. In the second quarter of 2002 it did not have an FRL exceedance for arsenic. The well was dry from the third quarter of 2002 through 2003. In the first half of 2004, the well had another FRL exceedance for arsenic and a first-time-ever FRL exceedance for antimony. The well was dry in the second half of 2004, the second half of 2005, all of 2006, and the second half of 2007.

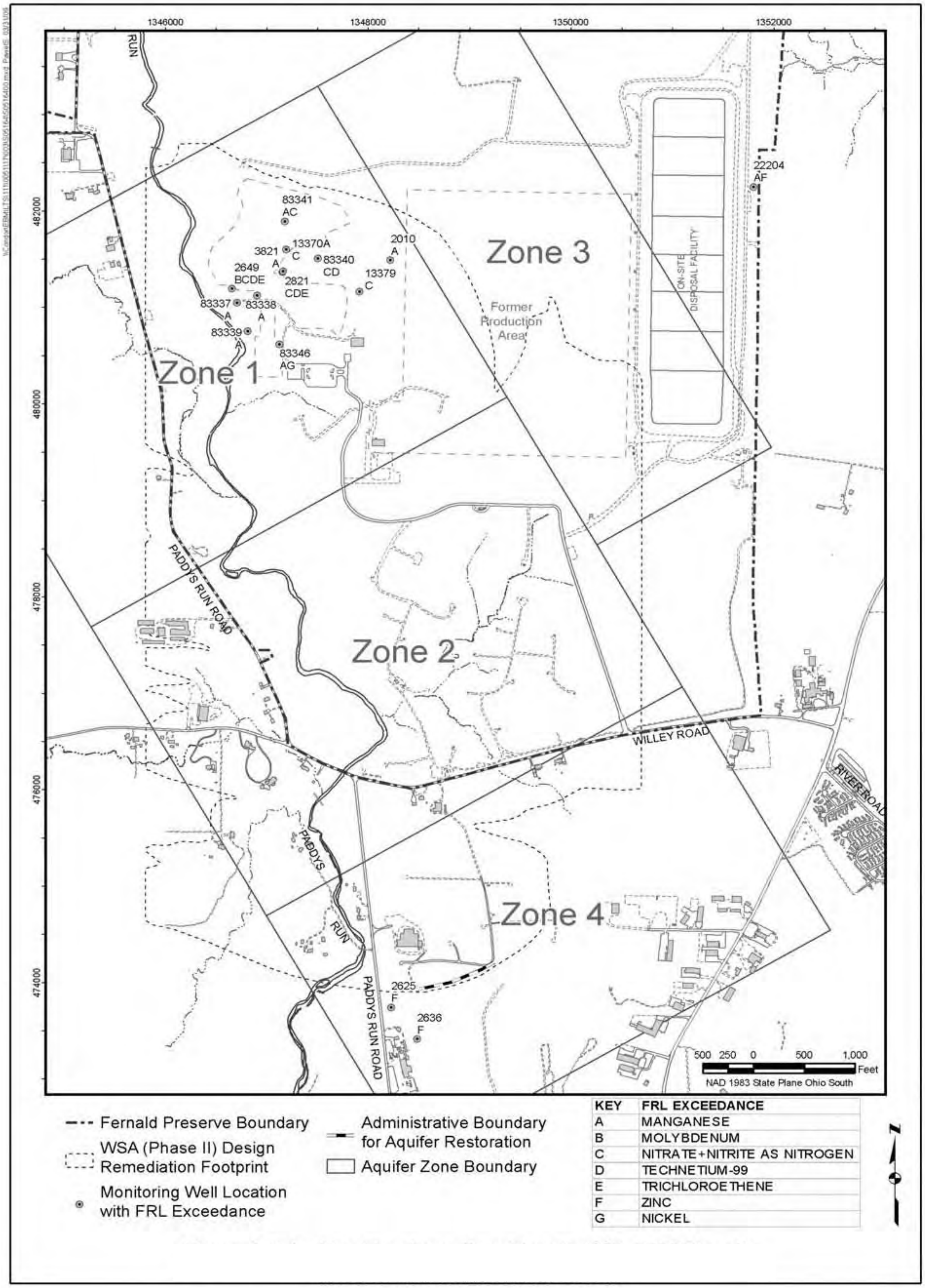

Figure A.4−1. Non-Uranium Constituents With 2008 Results Above FRLs

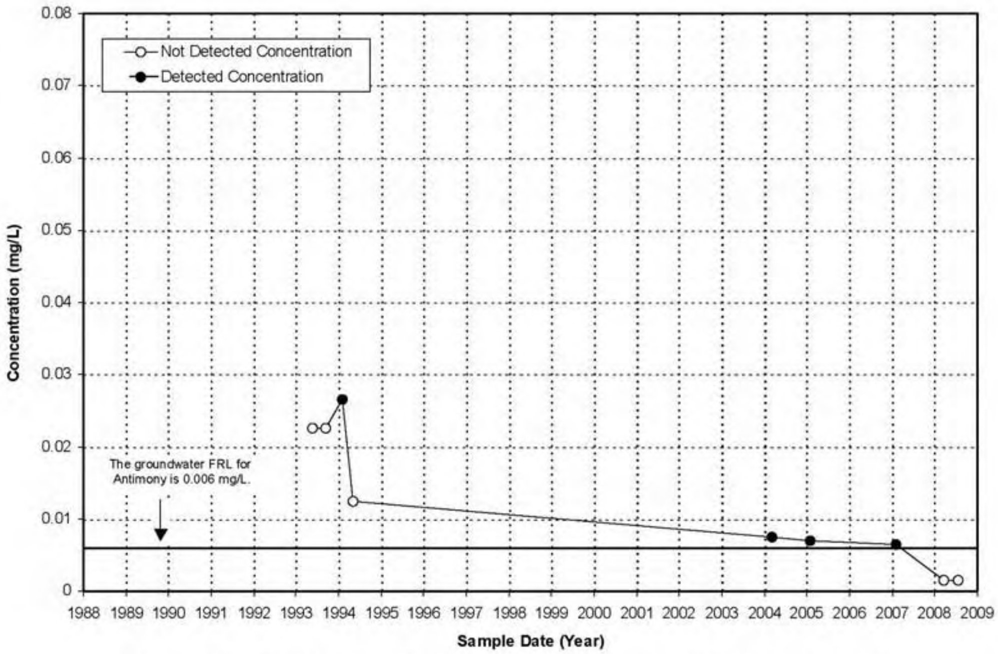

FIGURE A.4-2. ANTIMONY CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

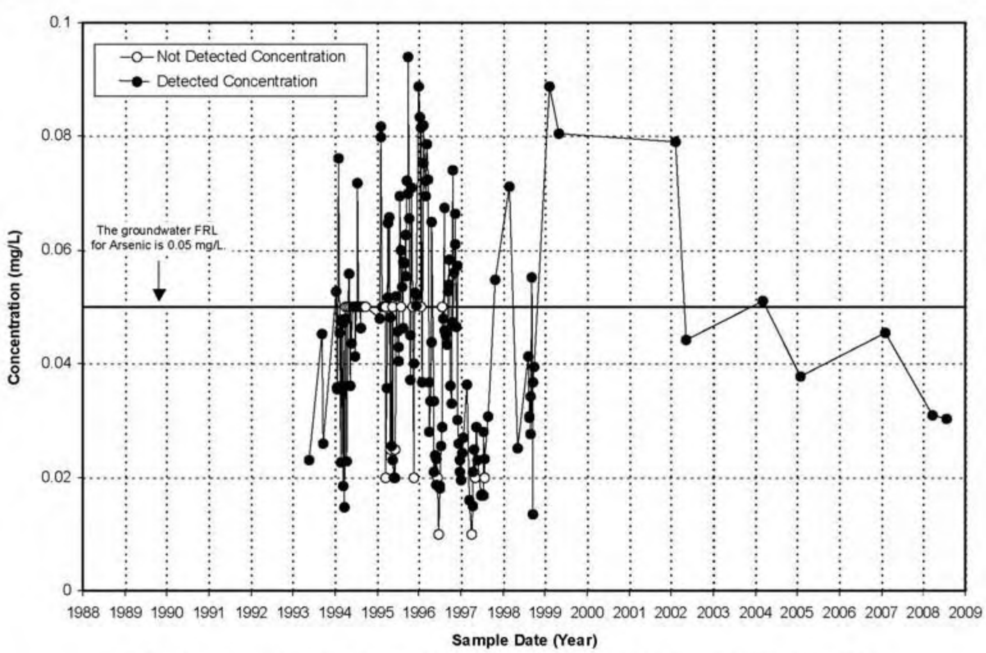

FIGURE A.4-3. ARSENIC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

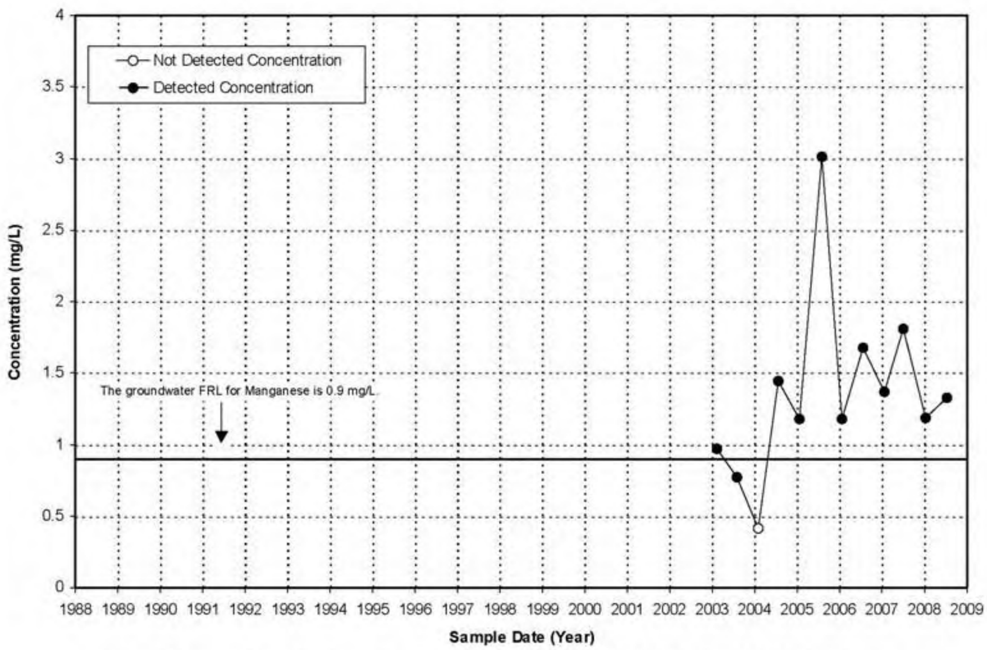

FIGURE A.4-4. MANGANESE CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22204

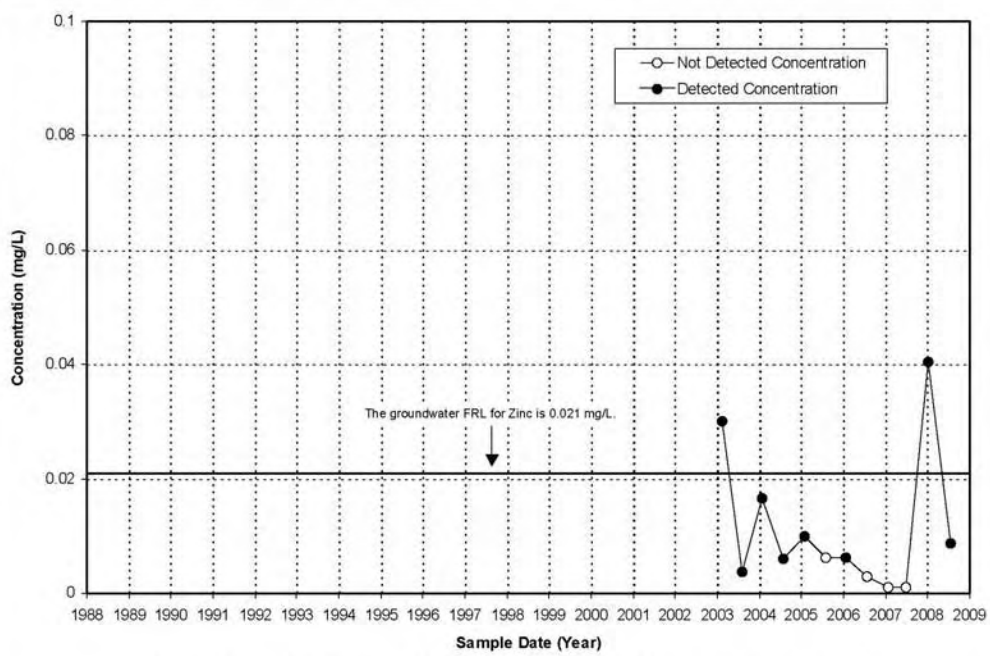

FIGURE A.4-5. ZINC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22204

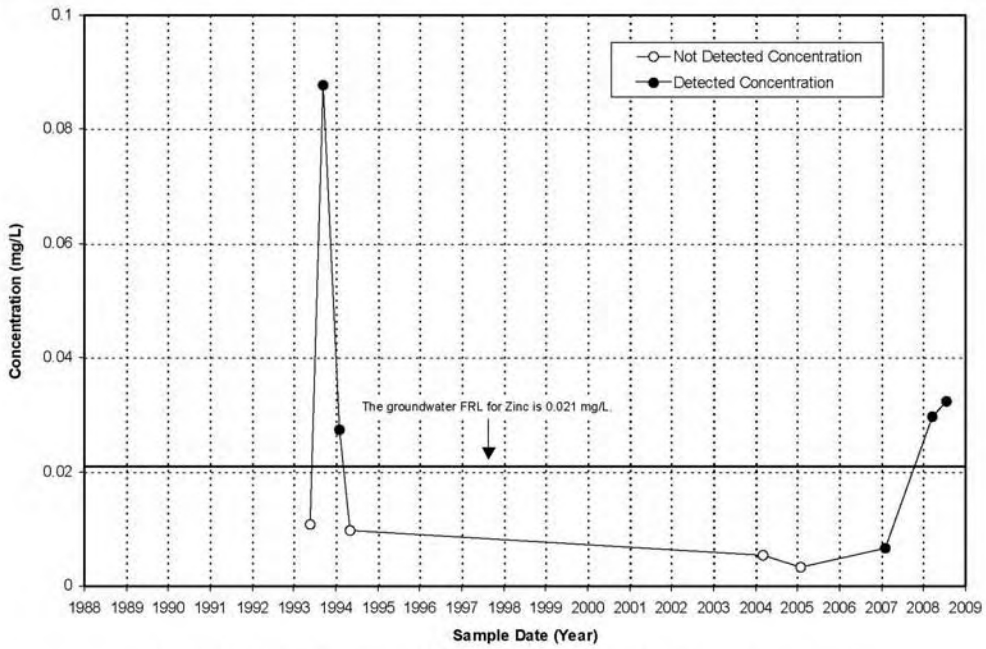

FIGURE A.4-6. ZINC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2625

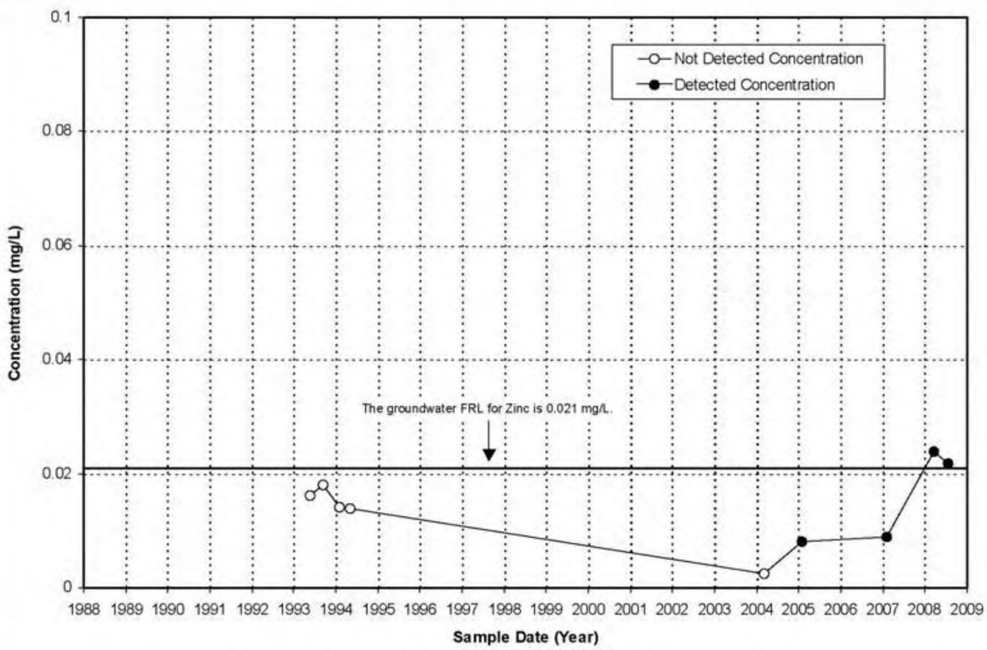

FIGURE A.4-7. ZINC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

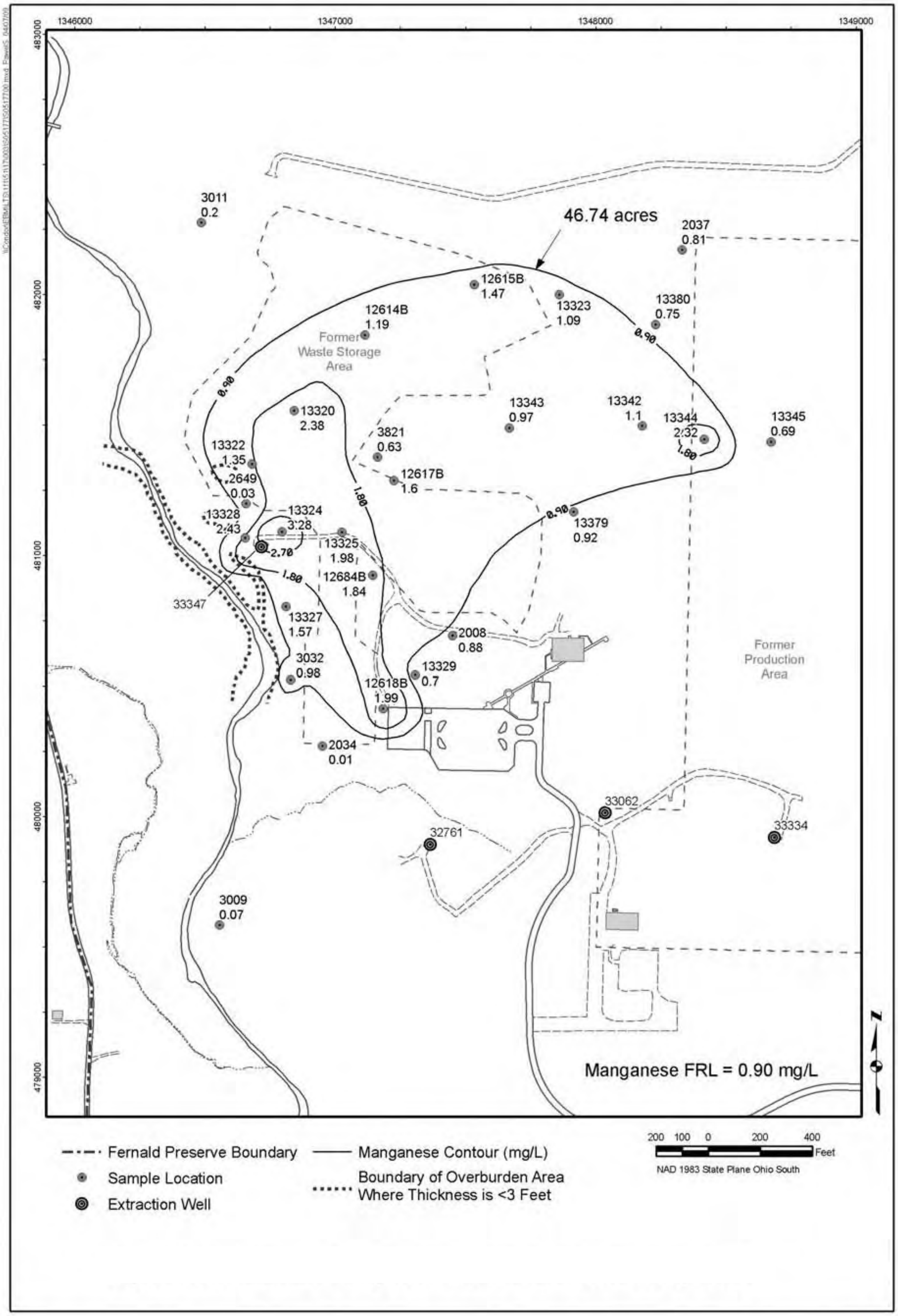

Figure A.4–8. Maximum Manganese Plume in the Waste Storage Area

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Attachment A.5

A.5.0 On-Site Disposal Facility Monitoring Results

This attachment provides results for the on-site disposal facility (OSDF) leak detection and leachate monitoring program for 2008. Monitoring and sampling were conducted in accordance with the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (LMS/FER/S03496), Attachment C "Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP)". The objective of the GWLMP is to meet regulatory requirements for groundwater detection monitoring in the Great Miami Aquifer (GMA) and perched groundwater system and to provide leachate monitoring information.

No indication of a leak from the OSDF was detected in 2008. The maximum accumulation rate in the leak detection system (LDS) (1.36 gallons per acre per day (gpad) in Cell 5) was well below the Initial Response Leakage Rate of 20 gpad. Water quality trends observed in the horizontal till wells (HTWs) and GMA wells are attributed to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

Facility Description

The OSDF is situated in the northeast area of the Fernald Preserve. It has a capacity of 2.96 million cubic yards (yd^3) (2.26 million cubic meters [m^3]); a maximum height of approximately 65 feet (ft) (20 meters [m]); and covers an area of approximately 90 acres (36 hectares). The facility consists of eight individual cells. All eight cells were 100 percent full and capped by October 2006.

Protection of the GMA and the overlying perched groundwater system includes the following measures for each of the eight cells (refer to Figure A.5−1 for a cross section of the liner system):

- Leachate collection system (LCS)
- LDS
- Multi-layer composite liner system
- Multi-layer composite cap system.

The LCS consists of a gravel layer installed beneath the waste to collect rainwater that came in contact with the waste during cell construction and additional moisture that is draining from the waste following capping. The LDS is located beneath both the LCS and the primary geosynthetic liner system, and provides a mechanism for collecting and monitoring leakage through the primary liner layer of the OSDF prior to any releases to the environment. Both systems drain to the west and extend beyond the synthetic liner systems into valve houses, where leachate becomes accessible for monitoring.

The base of each cell liner also slopes toward the center line of the cell, and the center line of the base is sloped toward the west. Leachate moving along the top of a liner would first travel toward the center line and then west along the center line to be drained from the cell via piping at the penetration box, which is the lowest elevation point of the cell.

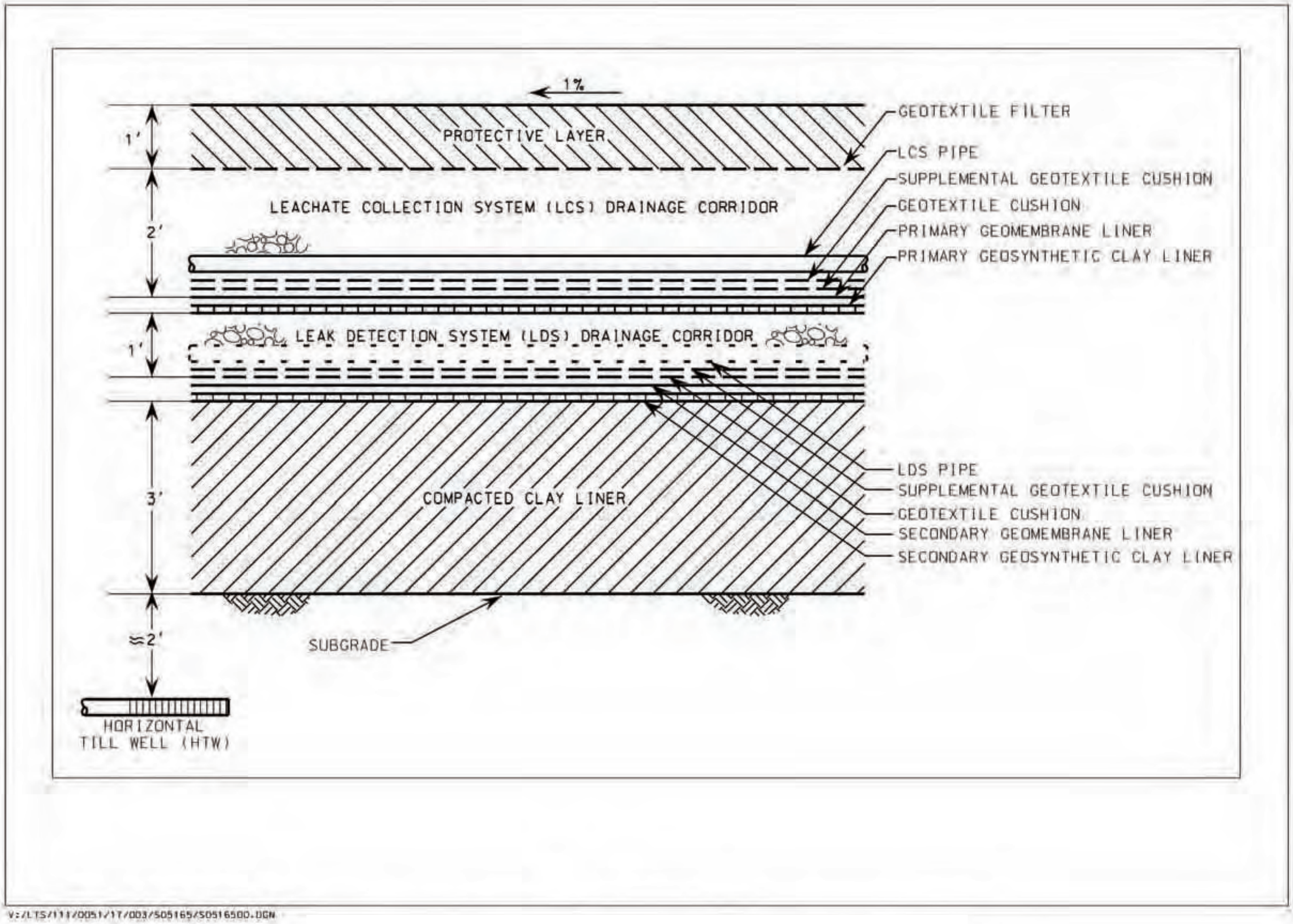

Figure A.5−1. On-Site Disposal Facility Liner System with HTW at the Drainage Corridor

Each cell is monitored below the penetration box with an HTW, which represents the first monitoring point for a release from a cell. HTWs provide monitoring of the perched groundwater quality beneath the point where the LCS and LDS pipes exit the liner system. The GMA is monitored via both an upgradient and a downgradient monitoring well for each cell. Figure A.5−2 identifies the well locations associated with the OSDF. Table A.5−1 identifies specific dates for the following cell activities:

- Sample initiation for each monitoring horizon.
- Waste placement initiation.
- LDS volume measurement initiation.
- Cap geomembrane layer completion.
- Cap completion (through seeding).

A construction quality assurance/quality control program was executed for each cell of the OSDF. The synthetic liners and caps of each cell were inspected and tested for defects at the time of installation. Given the attention to quality assurance/quality control during the installation of the OSDF liner system, it is doubtful that a breach in the liner would have gone unnoticed, but it is possible that a breach could develop. Such a breach would provide a potential pathway for leachate migration, but adequate hydraulic head is needed to drive leachate through the breach and clay liner into the underlying horizon.

The GWLMP provides the facility performance assessment strategy for the OSDF, and covers the following topics:

- Understanding how a cell can leak.
- Monitoring hydraulic head in the LDS and the action leakage rate.
- Water quality monitoring in the LCS, LDS, HTW and GMA wells.
- Residual soil contamination beneath the facility and its possible impact to HTW water quality results.

<u>Information Organization</u>

The 2008 OSDF leak detection and leachate monitoring information is organized in the following sections:

- Flow and Hydraulic Performance (Section A.5.1),
- Water Quality: Data Presentations and Evaluations (Section A.5.2),
- Cell Cap Inspections (Section A.5.3), and
- Summary of Overall Performance and Recommendations (Section A.5.4)

Sub-attachments A.5.1 through A.5.8 provide cell-specific information for disposal cells 1 through 8, respectively. Each sub-attachment includes figures, tables, and analytical information.

A.5.1 Flow and Hydraulic Performance

A.5.1.1 Overall LCS Volumes

In 2008, leachate volumes were measured at a meter within the OSDF leachate conveyance system lift station located immediately south of the valve houses. The volumes measured include water pumped from the LDS tanks from each cell. LDS volumes are subtracted from the total meter reading to obtain a measurement that represents the collective leachate volume from all OSDF cells.

Leachate volumes have been measured since waste placement was initiated. Figure A.5−3 is a graph showing monthly leachate volumes for 2008. According to the data collected in 2008, approximately 249,421 gallons of leachate were collected and pumped to the Backwash Basin for subsequent treatment at the Converted Advanced Wastewater Treatment Facility (CAWWT). The total volume measured in 2008 (249,421 gallons) was down 27 percent from the total volume measured in 2007 (342,253 gallons). The volume of precipitation that fell on the OSDF in 2008 was approximately 64.2 million gallons (43.7 inches of rain over 54.1 acres). The facility cap inhibits rainwater from permeating into the OSDF. Collected leachate in 2008 represents approximately 0.4 percent of the precipitation that fell on the OSDF in 2008, indicating that the cap is performing as designed to reduce infiltration.

The GWLMP identifies that trend analysis of the LCS flow monitoring measurements will be conducted for capped cells in order to provide an indication of changes in system performance. Monthly accumulation volumes for Cells 1 through 8 are plotted and provided in Sub-attachments A.5.1 through A.5.8 respectively. The plots indicate that leachate volumes from the capped cells are diminishing over time, as expected.

A.5.1.2 LDS Accumulation Rates and Volumes

Quantitative measurement of the volumes accumulating in and pumped from the LDS tanks was initiated according to the various dates in Table A.5−1. These measurements were taken from a pressure transducer installed in the primary containment vessel and attached to a data logger that measured and recorded water levels hourly. Beginning in early 2008, the method of measurement was automated by recording readings from capacitance probes installed in each primary containment vessel and attached through a remote control unit to the CAWWT control room where water levels are converted automatically to volumes based on the tank manufacturer's design specifications for the LCS and LDS tanks. These data are used to determine both accumulation rates (in gpad) and accumulation volumes (in gallons) for each cell’s LDS.

The GWLMP states that trend analysis of the LDS flow monitoring measurements will be conducted for capped cells to provide an indication of changes in system performance. Monthly accumulation volumes for Cells 1 through Cell 8 are provided and graphically displayed in Sub-attachments A.5.1 through A.5.8, respectively.

The OSDF Final Design Calculation Package (DOE 1997b) defines an initial response leakage rate for individual cells of 20 gpad. The 2008 maximum LDS accumulation rates and the percent of the initial response leakage rate for each cell are as follows:

Cell	LDS Maximum Accumulation Rate (gpad)	Percent of Initial Response Leakage Rate
1	0.06	0.3
2	0.00	0.0
3	0.00	0.0
4	0.26	1.3
5	1.36	6.8
6	1.34	6.7
7	1.03	5.1
8	0.52	2.6

These LDS accumulation rates indicate that the liner systems for the cells are performing well within the specifications outlined in the approved OSDF design. The initial response leakage rate of 20 gpad is a design criterion for commencing an investigation into the possibility that a leak from the facility has occurred. Because all of the cells are closed and capped, it is expected LDS accumulation rates will continue to diminish over time. Rates will continue to be closely tracked to document if the primary liner systems continue to perform as designed.

A.5.1.3 Liner Efficiencies

Cell-specific apparent liner hydraulic efficiencies are calculated using the following equation:

$$[1-(Vol_{LDS}/Vol_{LCS})] \times 100$$

Apparent liner hydraulic efficiency is a measure of how a cell's liner is performing. The above equation considers *all* the LDS volume to be leakage through the primary liner, which is a conservative measure. In the EPA report of the 1995 Workshop on Geosynthetic Clay Liners, Appendix F (EPA 1996), several sources of flow from leak detection layers are identified. These sources include:

- Top liner leakage
- Construction water and compression water
- Consolidation water
- Water from groundwater infiltration.

Monthly apparent liner efficiencies were consistently greater than 90 percent for Cells 1 through 8 throughout 2008. As shown below, monthly apparent liner efficiencies for all cells generally improved from January 2008 to December 2008. Monthly liner efficiencies (in percentages) are provided for Cells 1 through 8 in Sub-attachments A.5.1 through A.5.8, respectively.

Apparent Liner Efficiency (%), January 2008 compared to December 2008

Month	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8
January 2008	99.54	100	100	100	93.28	92.91	92.38	96.18
December 2008	100	100	100	99.29	96.85	97.77	95.88	97.79

A.5.1.4 HTW Water Yields

HTW water yields are monitored at each cell to document trends in perched-water purge volumes. In 2008 the HTWs were purged four times (January/February, May, August, and November). Average purge water yields from the HTWs ranged from 34 gallons beneath Cell 8 to 1,056 gallons beneath Cell 5. The Cell 3 HTW water yield, which had been trending upward from 2001 through 2005, showed a third-year decline in average yield. The HTW water yields will continue to be tracked and factored into the OSDF leak detection evaluation, where appropriate. The water-yield graphs are provided in each cell's sub-attachment and are updated with purge volume data collected prior to each sampling event.

A.5.2 Water Quality: Data Presentations/Evaluations

The same analysis and data presentations conducted last year for 2007 data were conducted again for 2008 data, with the exception of a statistical analysis of the annual LCS sampling for Appendix I and polychlorinated biphenyl (PCB) constituents as outlined in Figures A.5-4A and A.5-4B of the 2007 SER (DOE 2008a). A data set of at least eight samples is required for the LCS data evaluation process. A statistical analysis of LCS data was conducted for Cells 1, 2, and 3, and reported in the 2007 SER (DOE 2008). Cell 4, the next cell for which the statistics would have been conducted, did not have a complete data set of eight results at the end of 2008.

In this year's SER, water quality data presentations are provided on a cell-specific basis, and consist of the following tables and graphs.

- Summary statistics for refined baseline parameters (uranium, boron, total organic carbon (TOC), total organic halogens (TOX), and sulfate) in the LCS, LDS, HTW, and GMA monitoring wells;
- Summary of annual LCS sampling results; and
- Concentration versus time plots: refined baseline parameters in the LCS, LDS, and HTW, and total uranium in the GMA monitoring wells.

Summary statistics tables for refined baseline parameters in Cells 1 through 8 are provided in each cell-specific sub-attachment. Each table summarizes the number of detected samples, the total number of samples, and the percent of detected samples. The data set is then checked for possible outliers. Once selected outliers are removed the average, distribution type, trend, and presence of serial correlation are determined. Statistics were run using the ChemStat® software program (Version 6.2). Distribution was determined using a Shapiro-Wilks Test of Normality at a 95 percent confidence level. Trend was determined using a Mann-Kendall Test for Trend at both a 90 percent and 95 percent confidence level. Serial correlation was checked using a Rank Von Neumann Ratio Test at a 99 percent confidence level.

The information provided in each summary table is based on a standardized quarterly sampling frequency. Information in each table is also included on the concentration plots provided in the cell-specific sub-attachments. Note that minimum and maximum results provided on concentration plots are based on the non-standardized data (i.e., all results provided on the charts with the exception of pre-purge HTW results). Averages and trends presented on concentration plots are based on the standardized frequency data sets (e.g., quarterly) so that concentrations are weighted appropriately for trend analysis and to account for outlier removal. Outliers have been removed from cell-specific concentration plots.

LCS sampling summary tables, summarizing the results of the annual LCS sampling, are provided in each cell-specific sub-attachment. Each table presents the number of samples, number of detected samples, the percentage of detected samples, the minimum and maximum concentration measured, the average concentration measured, the groundwater FRL, the background concentration in groundwater and the number of samples used to determine the average, the average background concentration in the perched groundwater and the number of samples used to determine the average, the maximum perched water concentration and the number of samples above the maximum, and the detection limit. For 2008, these tables have been re-formatted to present the data by analyte type, then alphabetically by parameter.

LCS sampling results presented in Subsections A.5.1 through A.5.8 show that technetium-99 was detected in the LCS at Cells 4 through 8 in 2008. A statistical analysis will be conducted in 2009 to determine the usefulness of technetium-99 as a monitoring parameter at Cells 4 through 8, similar to the statistical analysis that has been conducted for technetium at Cell 1 (see the 2007 SER). Technetium will be added to the LDS sampling constituent lists in Cells 4 through 8 in 2010, pending the outcome of the statistical analysis. LCS sampling results presented in Subsection A.5.1 through A.5.8 also conclude that copper will be sampled both the LCS and LDS of Cell 7 and Cell 8 beginning in 2009.

Concentration plots for the refined baseline constituents for each cell are provided on two plots in each sub-attachment: one showing the LCS, LDS, and HTW; and one showing the HTW and GMA wells. The HTW is provided on both plots to serve as a reference horizon.

Water quality trends observed beneath the facility in the HTW and GMA wells in 2008 are attributed to background concentration fluctuations.

A.5.3 Cell Cap Inspections

OSDF cell cap inspections are conducted on a quarterly basis. The inspection team typically includes representatives from Tetra Tech, Inc. (supporting the EPA); OEPA; the Ohio Department of Health; the S.M. Stoller Corporation; and the DOE Office of Legacy Management. During OSDF construction, a cell cap was included in the quarterly inspection once it was seeded and vegetation was becoming established. Issues identified during inspections typically include small erosion rills, rocks that surface as top soil settles, animal burrows and digging, small areas that require reseeding, and the presence of woody vegetation and thistle.

The issues are addressed as follows:

- Erosion rills are repaired if they exceed 3 inches wide by 6 inches deep.
- Rocks that surface are removed, especially if they will interfere with mowing activities or may be a source location for erosion.
- Animal burrows and holes are filled in and reseeded, if necessary.
- Areas that require reseeding are seeded and covered with jute matting to help prevent erosion of the seed.
- Woody vegetation is removed and herbicide is applied to the noxious weeds.

Following each inspection, a report is submitted to DOE documenting the inspection and any findings. In 2008, inspections were conducted in March, June, September, and December.

In 2008, there were no visual signs that the integrity of the cap had been compromised in any way.

A.5.4 Summary of Overall Performance/Findings and Recommendations

<u>Performance/Findings</u>

- No indication of a leak from the OSDF was detected in 2008.
- The highest LDS maximum accumulation rate recorded in 2008 was 1.36 gpad in Cell 5; well below the initial response leakage rate of 20 gpad.
- LCS volumes have stabilized and continue to diminish with time. In 2008, 249,421 gallons of leachate were collected and pumped to the CAWWT Backwash Basin.
- LDS accumulation rates indicate that the liner systems are performing well within the specification outlined in the approved cell design.
- Monthly liner efficiencies were consistently greater than 90 percent for Cells 1 through 8 throughout 2008.
- Average per purge water yields from the HTWs in 2008 ranged from 34 gallons (beneath Cell 8) to 1,056 gallons (beneath Cell 5).
- Water quality trends observed in the HTW and GMA wells are attributed to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.
- LCS sampling results presented in Subsections A.5.1 through A.5.8 show that technetium-99 was detected in the LCS at Cells 4 through 8 in 2008. A statistical analysis will be conducted in 2009 to determine the usefulness of technetium-99 as a monitoring parameter at Cells 4 through 8, similar to the statistical analysis that has been conducted for technetium-99 at Cell 1 (see the 2007 SER). Technetium-99 will be added to the LDS sampling constituent lists in Cells 4 through 8 in 2010, if the statistical analysis shows that it will be a useful monitoring parameter.
- LCS sampling results presented in Subsection A.5.1 through A.5.8 also conclude that copper will be sampled in both the LCS and LDS of Cell 7 and Cell 8 beginning in 2009.
- In 2008, there were no visual signs that the integrity of the OSDF cap had been compromised in any way.

Table A.5−1. OSDF Initiation and Completion Dates

Cell	Sample Initiation per Horizon[a]	Waste Placement Initiation	LDS Volume Measurement Initiation[b]	Cap Geomembrane Layer Completion[c]	Cap Completion[d]
1	LCS: February 17, 1998 LDS: February 18, 1998 HTW: October 30, 1997 GMA-U: March 31, 1997 GMA-D: March 31, 1997	December 23, 1997	May 1999	August 17, 2001	December 20, 2001
2	LCS: November 23, 1998 LDS: December 14, 1998 HTW: June 29, 1998 GMA-U: June 30, 1997 GMA-D: June 25, 1997	November 12, 1998	May 1999	July 17, 2003	November 12, 2003
3	LCS: October 13, 1999 LDS: August 26, 2002 HTW: July 28, 1998 GMA-U: August 24, 1998 GMA-D: August 24 1998	October 26, 1999	October 1999	July 16, 2004	September 20, 2004
4	LCS: November 4, 2002 LDS: November 4, 2002 HTW: February 26, 2002 GMA-U: November 6, 2001 GMA-D: November 5, 2001	November 08, 2002	November 2002	December 18, 2004	April 29, 2005
5	LCS: November 4, 2002 LDS: November 4, 2002 HTW: February 26, 2002 GMA-U: November 6, 2001 GMA-D: November 5, 2001	November 19, 2002	November 2002	June 22, 2005	August 29, 2005
6	LCS: October 27, 2003 LDS: October 27, 2003 HTW: March 14, 2003 GMA-U: December 16, 2002 GMA-D: December 16, 2002	November 18, 2003	January 2004	October 28, 2005	January 12, 2006

Table A.5−1 (continued). OSDF Initiation and Completion Dates

Cell	Sample Initiation per Horizon[a]	Waste Placement Initiation	LDS Volume Measurement Initiation[b]	Cap Geomembrane Layer Completion[c]	Cap Completion[d]
7	LCS: September 2, 2004 LDS: September 2, 2004 HTW: February 24, 2004 GMA-U: January 21, 2004 GMA-D: January 21, 2004	September 9, 2004	September 2004	July 2006	October 25, 2006
8	LCS: October 18, 2004 LDS: October 18, 2004 HTW: May 19, 2004 GMA-U: March 31, 2004 GMA-D: March 31, 2004 GMA-SW: August 22, 2005 GMA-SE: August 22, 2005	December 2, 2004	December 2004	September 24, 2006	October 25, 2006

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; GMA-D = downgradient Great Miami Aquifer; GMA-SW = southwest Great Miami Aquifer; and GMA-SE = southeast Great Miami Aquifer
[b]Prior to 1999, overall LDS volumes were measured. From 1999 on, LDS volumes were measured by cell.
[c]The cap geomembrane layer is made of high density polyethylene.
[d]Cap completion includes seeding.

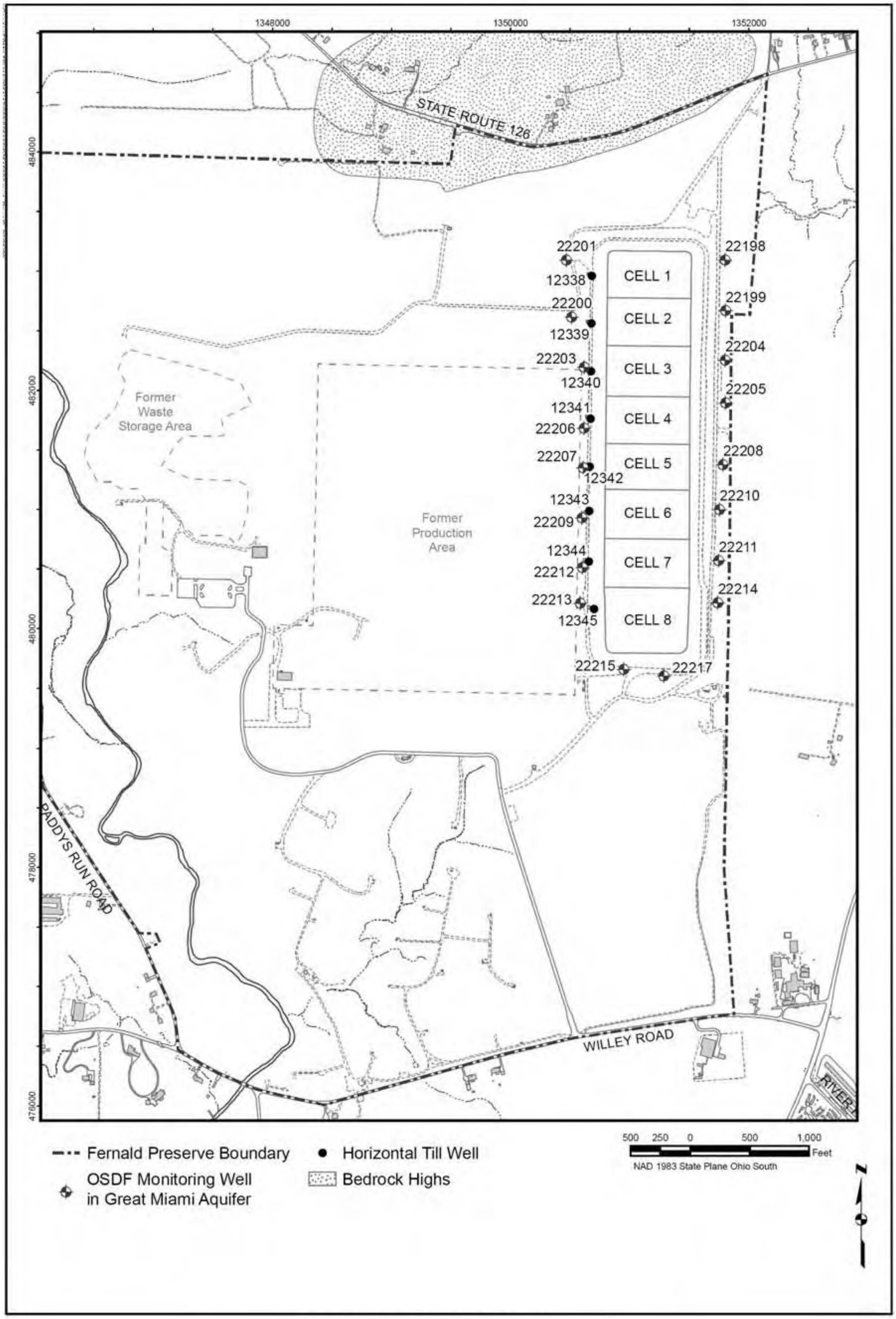

Figure A.5−2. On-Site Disposal Facility Footprint and Monitoring Well Locations

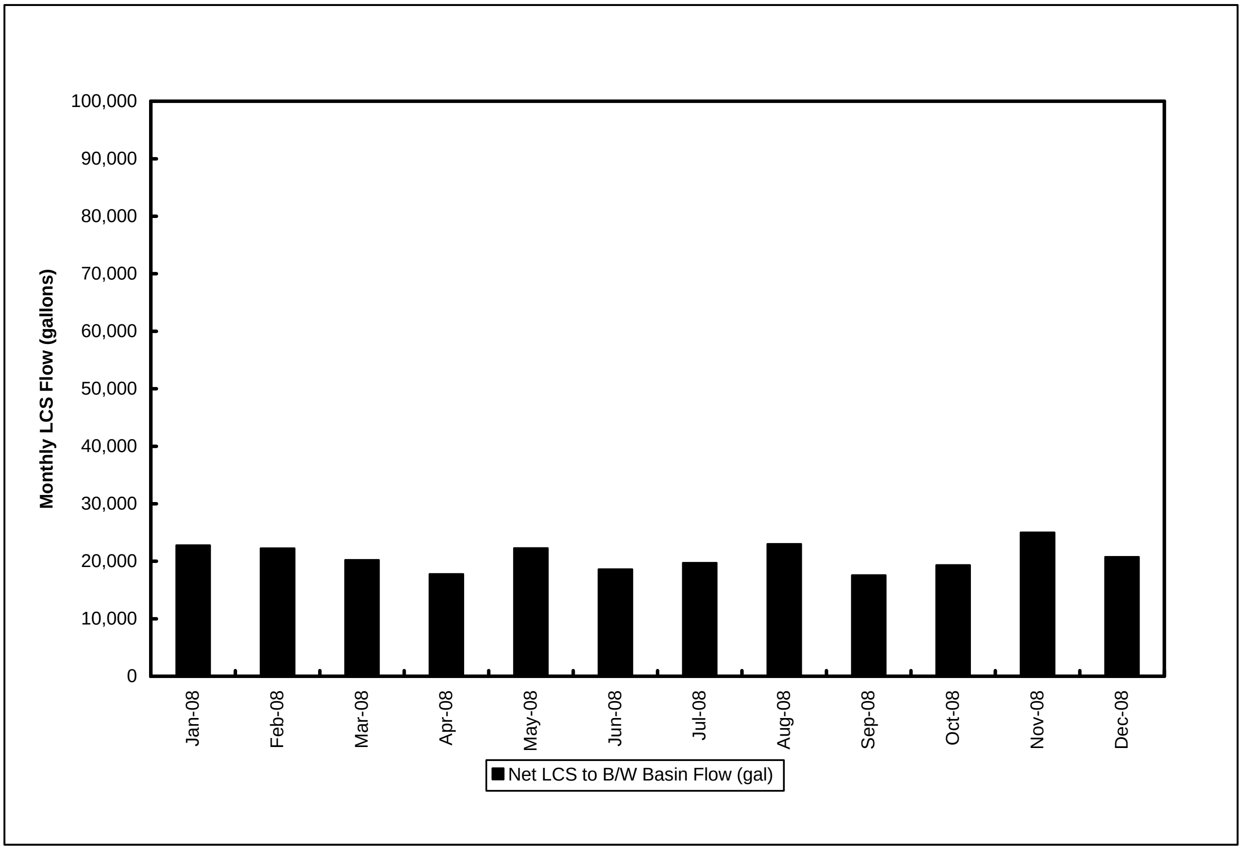

Figure A.5−3. OSDF LCS to Backwash Basin Flow